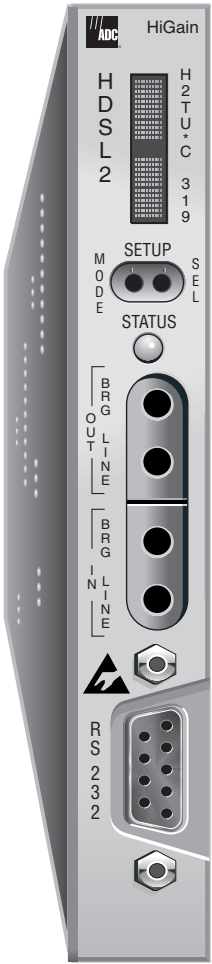


HiGain

USER MANUAL



H2TU-C-319 List 2E Line Unit
Product Catalog: 150-2400-25
CLEI: VACH4XYC



Revision History of This Practice

Revision	Release Date	Revisions Made
01	April 21, 2000	Initial release
02	December 21, 2001	ADC rebranding

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April 21, 2000

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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**.
- Three types of messages, identified by icons, appear in text.



Notes contain information about special circumstances.



Cautions indicate the possibility of personal injury or equipment damage.



The Electrostatic Discharge (ESD) 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 “[List of Abbreviations](#)” on page 63.

INSPECTING 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 D - Product Support](#)” on page 62. 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® product family is the industry's first practical implementation of High bit-rate Digital Subscriber Line 2 (HDSL2). HiGain products are fully compliant with the HDSL2 standard. Providing full-rate T1 access using just a single copper pair, HDSL2 is a cost-effective solution that offers an open architecture. The open architecture inherent in HDSL2 guarantees interoperability, allowing simple, economic accommodation of network growth.

HiGain HDSL2 products provide 1.552 Mbps transmission on one unconditioned copper pair over the full Carrier Service Area (CSA) range. The CSA includes loops up to 12,000 feet of 24 American Wire Gauge (AWG) wire or 9,000 feet of 26 AWG wire, including bridged taps.

FEATURES

The H2TU-C-319 List 2E line unit is the Central Office (CO) side of a DS1 transmission system.

- HDSL2 transmission features
 - Three-span range with two regenerators (36 kft, 24 AWG)
 - Lightning and power-cross protection on HDSL2 interfaces
 - Full duplex HDSL2 transmission on one pair at 1.552 Mbps
 - Ultra-low wander (Stratum 1 compliant)
 - Grounded loop detection on High-bit-rate Digital Subscriber Line 2 (HDSL2)
- Front-panel provisioning features
 - Four character status display
 - DS1 splitting and bridge access
 - Status LED
 - RS-232 craft port for connection to a maintenance terminal
- HiGain HDSL2 maintenance screens for inventory, provisioning, and troubleshooting
 - High-performance, non-volatile performance monitoring
 - Non volatile alarm histories
 - Performance Report Messaging (PRM) support for Supplemental PRM (SPRM) and Network PRM (NPRM) at the H2TU-R
- Configuration options
 - Selectable DS1 pre-equalizer
 - Bipolar Violation Transparency (BPVT) options
 - Bit Error Rate (BER) alarm
 - Loss of Signal/Alarm Indication Signal (LOS/AIS) payload alarm option
 - Remote provisioning
 - Selectable loopback activation codes
- Only compatible with ADC HMS-358, Wideband 3190 shelves
- Flash download of firmware updates
- Digital Data Service (DDS) latching loopback

- Payload (PL) and HiGain (HG) loopback source identification
- Network Management and Administration (NMA) interface
- Metallic Test Access (MTA)
- Dual DSX-1 port option
- Margin threshold alarm



This practice describes the operations and features of a standard HiGain HDSL2 system consisting of an H2TU-C-319 List 2E connected to an H2TU-R-402 List 4E. Some of the features described may not apply if the H2TU-C-319 List 2E is connected to other HiGain H2TU-R remote units.

Contact ADC for information regarding such mixed non-standard system applications.

COMPATIBILITY

The H2TU-C-319 List 2E has two unique features, Metallic Test Access and Dual DS1 port options, which are not provided in standard HiGain line units with 3192 mechanics. These features require additional access pins which are provided by a special card edge connector, shown in [Figure 27 on page 57](#). Only the HMS-358 shelves can accommodate this special connector.

APPLICATIONS

HiGain HDSL2 systems provide a cost-effective, easy-to-deploy method for delivering T1 High Capacity Digital Service (HCDS) over a single copper pair. HiGain HDSL2 systems support a multitude of network connections and system models, as shown in [Figure 1 on page 3](#).

- The service is deployed over one unconditioned, non-loaded copper pair.
- Conventional, inline, T1 repeaters are no longer required.
- Cable pair conditioning, pair separation and bridged tap removal are not required.

Each loop has no more than 35 dB of loss at 196 kHz, with driving and terminating impedances of 135 Ω . In general, HiGain HDSL2 systems:

- Operate effectively in the same cable binder group with other HDSL2 lines, HDSL, T1, ADSL, SDSL, POTS, DDS, and other transmission schemes.
- Can be used with customers requiring DS1 service on a temporary or permanent basis.
- Provide a means of quickly deploying service in advance of fiber-optic transmission systems.



DS1 is used throughout this document to refer to either the remote unit's DS1 interface or the line unit's DSX-1 interface.

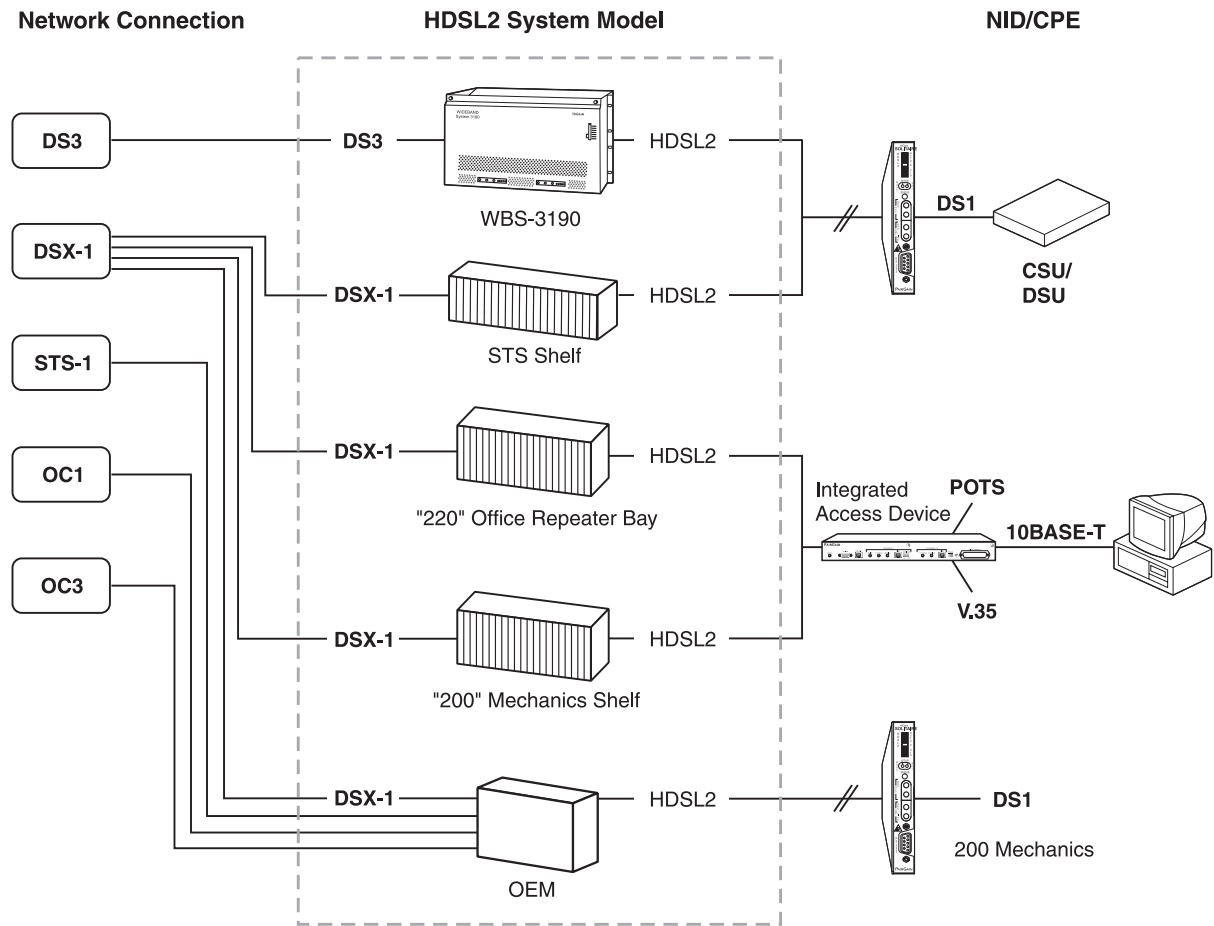


Figure 1. HDSL2 System Model

HIGAIN REGENERATORS

For applications without regenerators or doublers, the H2TU-C-319 is directly connected to an H2TU-R remote unit by one HDSL2 cable pair. The H2TU-C-319 List 2E is compatible with all HiGain H2TU-Rs.

For regenerator applications, one to two regenerators may be used in the HDSL2 loop between the H2TU-C and H2TU-R.

- The H2TU-C-319 List 2E can power one regenerator (H2RU-407 or H2RU-409) and a remote unit (H2TU-R-402) for a total of two spans.
- If the H2TU-R is locally powered, the H2TU-C can power up to two regenerators for a total of three spans.



Future enhancements of the H2TU-C-319 List 2E will support doublers.

FRONT PANEL

Figure 2 shows the H2TU-C-319 front panel. Table 1 on page 4 describes the front-panel components. For a list of front-panel display messages, refer to Table 2 on page 5. For pinout diagrams of the H2TU-C card-edge connector and craft port, refer to “Appendix A - Specifications” on page 55.

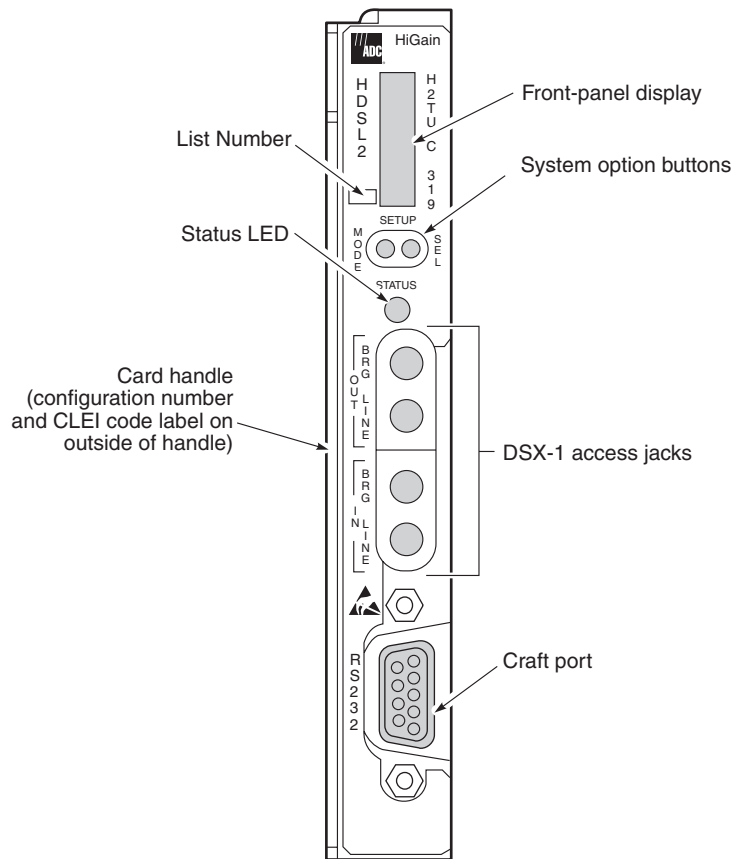


Figure 2. H2TU-C-319 List 2E Front Panel

Table 1. Front-panel Description

Front-panel Feature	Function
Front-panel display	Displays four-character status, provisioning, and alarm system messages. The front-panel display illuminates when power is initially applied. To conserve power the display only remains on for 5 minutes. Using the MODE or SEL buttons reactivates the display and restarts the 5-minute timer. Refer to Table 2 on page 5 for a listing of the four-character messages.
MODE and SEL system option buttons	Permits user options to be monitored and modified without the need of a maintenance terminal. Used to initiate all HiGain loopbacks and test states as well as to display DSX-1 line parameters and line unit identity.
Status LED	The status LED can report the following conditions:
Off	Line power is off.
Green	Normal operation.
Flashing green	HDSL2 acquisition.
Red	Fuse alarm.

Table 1. *Front-panel Description*

Front-panel Feature	Function
Flashing red	System alarm.
Yellow	An H2TU-C-319 Customer Remote Loopback (CREM) or a Network Local Loopback (NLOC) is in effect.
Flashing yellow	H2TU-C-319 is in an Armed state.
DSX-1 access jacks	
BRG	Provides non-intrusive bridging jack access to (IN) and from (OUT) the HDSL2 span at the MUX DSX-1 interface. Allows the two DS1 payloads to be monitored.
LINE	Provides splitting jack access to (IN) and from (OUT) the HDSL2 span at the MUX DSX-1 interface. Breaks the IN and OUT paths to permit test signal insertion and retrieval. The AUX DSX-1 port has no test jack access within the H2TU-C-319 line unit.
Craft port (RS-232)	Provides bidirectional communication between the unit and an external terminal to allow configuration and performance monitoring through the Maintenance Terminal screens.
List number	Identifies the list number of the H2TU-C-319.
CLEI and ECI bar code label	Provides the human-readable Common Language Equipment Identifier (CLEI) code number and the Equipment Catalog Item (ECI) bar code number.
Configuration Number	<p>For some products the configuration number may contain either a standalone two- or three-digit configuration number or a five or six-digit warranty configuration number as follows:</p> <p>Digit 1 - Last digit of shipment year</p> <p>Digits 2 and 3 - Shipment month</p> <p>Digits 4, 5, and 6 - Configuration number</p> <p>The configuration number identifies the version of the product. New configuration numbers usually accompany changes in the last two characters of the CLEI code.</p> <p>The configuration number is found on a small label attached to the unit. It is the last two numbers (following the x) of a 13-character part number. For example: 150-1234-01-x01.</p>

Table 2 lists the front-panel display messages. The four-character display reports the code of an alarm, loopback, or diagnostic message and, in some cases, is followed by a second four-character message that modifies the first message with a value or current configuration setting.

Table 2. *Front-panel Display Messages*

Message	Full Name	Description
ALARM MESSAGES		
ACO	Alarm Cut Off	A system alarm has occurred, and has been retired to an ACO condition by pressing the SEL button on the H2TU-C front panel.
ALRM	Alarm Condition Exists	A system alarm condition is in effect.
DBER	DS1 Bit Error Rate	A system DS1 BER alarm is in effect and remains in effect until cleared.
HBER	HDSL2 Block Error Rate	A system HDSL2 Block Error Rate alarm is in effect.
LA	Loop Attenuation	Indicates that the attenuation on the HDSL2 loop has exceeded the maximum threshold value.
LAIS	Local Alarm Indication Signal	Indicates an AIS (all ones) pattern is being transmitted from the local DS1 output port.
LLOS	Local Loss of Signal	Indicates that no signal is detected at the DSX-1 input to the H2TU-C. Causes a system alarm.
LOSW	Loss of Sync Word	Indicates that the HDSL2 loop has lost synchronization.
LRAI	Line Remote Alarm Indication	Indicates an RAI alarm (yellow) from the CPE with an error-free signal from the line unit or network.

Table 2. Front-panel Display Messages (Cont.)

Message	Full Name	Description
MAL	Margin Alarm	The margin on HDSL2 loop has dropped below the threshold (0 to 15 dB) as set by the operator.
MTA	Metallic Test Access	Indicates the H2TU-C is in a metallic test access state.
PRMF	Performance Report Messaging - Far End	H2TU-R PRM-FE BER threshold has been exceeded.
PRMN	Performance Report Messaging - Near End	H2TU-R PRM-NE BER threshold has been exceeded.
PWR FEED GND	Ground	The HDSL2 loop is grounded.
PWR FEED OPEN	Open	Indicates a line power open condition.
PWR FEED SHRT	Short	Indicates a short between the Tip and Ring of the HDSL2 pair.
RAIS	Remote Alarm Indication Signal	Indicates an AIS (all ones) pattern is being received at the H2TU-R DSI input port.
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the DS1 input to the H2TU-R. Causes a system alarm.
RRAI	Remote Alarm Indication	Indicates an RAI alarm (yellow) from the CPE with errors from the line unit or network.
SPN n	Span Number	Accompanies the LOSW alarm and identifies the span where the LOSW alarm occurred.
TRCI	TX RAI-CI Indication - Customer Installation	Upon reception of an RAI (yellow alarm) from the CPE, the H2TU-R sends RAI-CI toward the network if the network signal received at the H2TU-R is clear. If the network signal is impaired (LOS, AIS or Loss of Frame [LOF]), then the RAI is automatically passed on to the network.
TUC	Transmission Unit Central Office	Accompanies the HBER, MAL, and LA alarm and indicates that the alarm has occurred at the H2TU-R remote unit.
TUR	Transmission Unit Remote End	Accompanies the HBER, MAL, and LA alarm and indicates that the alarm has occurred at the H2TU-R remote unit.
LOOPBACK MESSAGES		
CRG n	Customer Regenerator n Loopback	Signal from customer is looped back to the customer at H2RU n , where n is the number of the regenerator.
CLOC	Customer Local Loopback	Signal from customer is looped back to the customer at the H2TU-R.
CREM	Customer Remote Loopback	Signal from customer is looped back to the customer at the H2TU-C.
NRG n	Network Regenerator n Loopback	DSX-1 signal is looped back to the network at H2RU n , where n is the number of the regenerator.
NLOC	Network Local Loopback	DSX-1 signal is looped back to the network at the H2TU-C.
NREM	Network Remote Loopback	DSX-1 signal is looped back to the network at the H2TU-R.
SMJK	Remote SmartJack Loopback	DSX-1 signal is looped back to the network at the H2TU-R SmartJack module.
DIAGNOSTIC MESSAGES		
A = xx	Maximum Loop Attenuation	The Attenuation (A) message appears followed by xx, where xx is the loop attenuation of the longest (maximum loss) span, measured in dB.
ACQ	Acquisition	The multiplexers of the H2TU-C and H2TU-R (or the H2TU-C and first regenerator) are trying to establish synchronization over the HDSL2 loop of Span 1.
A n L	Acquisition n Loop	The multiplexers of the two devices on Span n are trying to establish synchronization with each other, where n is the number of the span.
ARM	HiGain System Armed	Armed to respond to Intelligent Repeater Loop (ILR) codes.

Table 2. Front-panel Display Messages (Cont.)

Message	Full Name	Description
BAD RT?	No Response from H2TU-R	The H2TU-C receives no response from the H2TU-R and all HDSL2 loop conditions are normal. Therefore, the integrity of the H2TU-R or the HDSL2 loop is questionable.
FERR	Framing Bit Error Occurred	Framing bit error occurred at H2TU-C DSX-1 input.
FLDL	Flash Download	Flash download of firmware updates. Contact Customer Service for update procedures (see “Appendix D - Product Support” on page 62).
HES	HDSL2 CRC Error	H2TU-C HDSL2 Loop Cyclical Redundancy Check (CRC) error.
LBPV	Local Bipolar Violation	A bipolar violation has been received at the DSX-1 input to the H2TU-C-319.
M=xx	HDSL2 Loop Margin	Indicates the power of the received HDSL2 signal relative to noise (S/N with respect to 21.5 dB). Any value of 6 dB or greater is adequate for reliable system operation.
MNGD	Managed	The H2TU-C-319 is under control of the H2TU-319 Network management unit. In this state, the front-panel craft port and push buttons are disabled.
PWR FEED OFF	Power Feed Off	HDSL2 span power has been turned off by setting the PWFD option to off, or HDSL2 span power has been turned off by use of the A2LB Intelligent Office Repeater (IOR) Power Down code.
PWR FEED ON	Power Feed On	Indicates that the HDSL2 loop is not grounded or shorted.
SIG	Signaling	The transceivers of the H2TU-C and H2TU-R (or the H2TU-C and first regenerator) are trying to establish contact with each other over the HDSL2 loop of Span 1.
SnL	Signal <i>n</i> Loop	The transceivers of the two devices on Span <i>n</i> are trying to establish contact with each other, where <i>n</i> is the number of the span.

SYSTEM INFORMATION MESSAGES ^(a)

CODE xxxx	Line Code: AMI or B8ZS	The DS1 line code setting: Alternate Mark Inversion (AMI) or Bipolar with 8-Zero Substitution (B8ZS).
FRM xxxx	Frame: SF, ESF, UNFR	Defines the type of frame pattern being received from the DSX-1: SuperFrame (SF), Extended SuperFrame (ESF), Unframed (UNFR).
LATT xx	Loop Attenuation	The current loop attenuation threshold setting measured in dB.
LIST xx	H2TU-C-319 List Number	The list number of the H2TU-C-319.
MARG xx	Margin	The current margin threshold setting measured in dB.
VER x.xx	H2TU-C-319 Software Version Number	The software version number (x.xx).

(a) System Information Messages are displayed in Scroll Mode. To scroll through system information messages, press the MODE button for 3 or more seconds.

INSTALLATION



Upon receipt of the equipment, 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 Telecommunications.

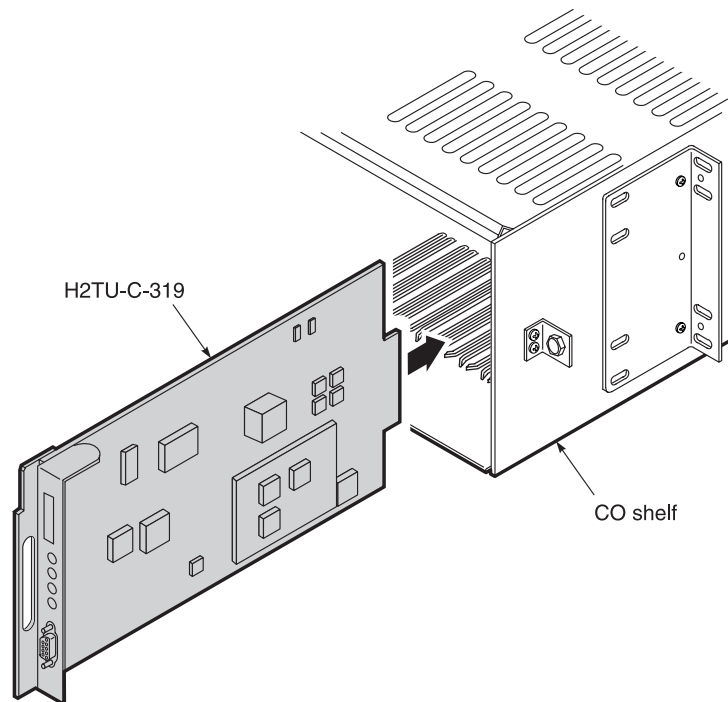


Figure 3. Installing the H2TU-C-319 List 2E into a Shelf



When installing an H2TU-C in a chassis, be sure to wear an antistatic wrist strap. Avoid touching components on the circuit board.



To comply with the intrabuilding wiring requirements of GR-1089 CORE, Section 4.5.9, the shields of the ABAM-type cables that connect the H2TU-C DSX-1 output ports to the cross-connect panel must be grounded at both ends.

- 1 Align the H2TU-C with the enclosure slot guides, then push the unit in until it touches the backplane card-edge connector.
- 2 Place your thumbs on the H2TU-C front panel and push the H2TU-C into the slot guides until properly seated.

VERIFICATION

Once the H2TU-C-319 is installed, verify that it is operating properly. To do this, monitor the following:

- Status LED
- Status messages reported by the front-panel display. [Table 2 on page 5](#) lists the status messages.

Verification without a Downstream Device

If there is no downstream device installed:

- 1 Verify that the H2TU-C powers up. The front-panel display illuminates and reports status messages. [Table 2 on page 5](#) lists the messages.
- 2 Verify that the H2TU-C attempts to communicate with downstream devices (status LED flashes red). Even if a downstream device is not present, the following events should occur:
 - a The front-panel display reports various four-character status messages.
 - b The H2TU-C again attempts communication with downstream devices until a downstream device is detected.

Verification with a Downstream Device

If a downstream device has been installed:

- 1 Verify that the H2TU-C powers up. The front-panel display illuminates and reports various status messages.
- 2 Verify that the H2TU-C attempts to communicate with downstream devices (status LED flashes red). One of the following occurs:
 - If downstream devices are successfully identified and the HDSL2 loop synchronizes, the H2TU-C status LED will be a steady green. The H2TU-C reports normal margin messages on the front-panel display.
 - If downstream devices are not successfully identified, the H2TU-C reports four-character status messages. The H2TU-C attempts communication again and reports four-character status messages. The H2TU-C repeats this cycle until a downstream device is detected.
- 3 If there is more than one span, verify that each subsequent span synchronizes normally by monitoring the front-panel display messages.
- 4 If a remote unit is installed, verify that the last span synchronizes normally. The H2TU-C status LED should be a steady green, and the front-panel display should report normal margin messages.
- 5 Verify that a valid DS1 signal has been applied to the H2TU-C and the H2TU-R.
 - If no DS1 signal is being applied to either the H2TU-C or the H2TU-R inputs, then the appropriate DS1 alarms (LLOS or RLOS) are observed on the front-panel display, and the status LED flashes red.
 - If a valid DS1 signal is being supplied to the H2TU-C and H2TU-R, then DS1 alarm indications should be absent and the status LED should be a steady green.

PROVISIONING REQUIREMENTS

Refer to “[Provisioning](#)” on [page 10](#) for instructions on configuring and monitoring the H2TU-C-319.

The H2TU-C-319 can be provisioned by using the MODE and SEL buttons on the front panel or by accessing the HiGain HDSL2 maintenance screens. While the MODE and SEL buttons can be used to manually accomplish

some provisioning tasks, such as setting system options, the HiGain HDSL2 maintenance screens (available when you connect a PC to the craft port) can handle all provisioning tasks.

After a successful installation, complete the following tasks:

- 1 Set the date and time, as described in “Setting Date and Time” on page 14.
- 2 Set the circuit IDs, as described in “Setting Circuit ID Numbers” on page 14.
- 3 Make changes to configuration, as described in “Making Changes to the System Configuration” on page 15.
- 4 Clear the Performance, Alarm history, and Event Log screens to remove miscellaneous data acquired during startup or use Master Clear in the Master Clear in the Config Menu. This ensures the collection of accurate and meaningful data, as described in “Clearing the History, Alarm, and Event Log Screens” on page 30.

PROVISIONING

There are two provisioning methods:

- Use the MODE and SEL buttons on the front panel of the H2TU-C to:
 - Set system options
 - Reset the H2TU-C to its factory default settings for system options
 - Display system option settings (scroll mode)
 - Select system loopbacks
 - Select MTA test mode
- Use a maintenance terminal, such as an ASCII terminal or a PC running terminal emulation software, connected to the H2TU-C craft port or an HMU craft port to access the HiGain HDSL2 maintenance screens. [Figure 4 on page 13](#) shows the maintenance screen. This provides full access to all H2TU-C status, history, inventory, and provisioning screens.



No dip switches or jumpers are required to provision the H2TU-C-319 as it contains a non-volatile RAM (NVRAM) which stores the system option settings. System option settings are retained if shelf power is lost or if the H2TU-C-319 is unplugged.

USING THE MODE AND SEL BUTTONS

Setting Options through MODE and SEL

To provision the H2TU-C-319 through the MODE and SEL buttons on the front panel:

- 1 Press the MODE button for 1 second and then release it. The front panel display alternately shows the first system parameter and its current setting.
- 2 Press the SEL button to step through all possible settings of the selected parameter.
- 3 After the desired setting has been selected, press the MODE button. This updates the current displayed parameter to the selected setting, then advances to the next configurable parameter. After the last parameter has been selected, a CONF NO message appears on the front-panel display.

- 4 Do one of the following:
 - To cancel the session without saving the requested parameter changes, press the MODE button or do nothing. After 30 seconds, the display returns to its normal mode without saving the new changes.
 - To accept the requested parameter changes, press the SEL button. A CONF YES message displays, and the display returns to its normal mode after saving the new changes.

Resetting to Factory Default Values

All user options for the H2TU-C-319, described in [Table 5 on page 18](#), can be set to the factory default values using the MODE and SEL buttons. To set the user options to their default values:

- 1 Press the SEL button for 6 seconds until the following message appears:

DFLT NO

- 2 Press the SEL button until the DFLT NO message is displayed.

The message changes to DFLT YES indicating the factory default values are now in effect and the display returns to the normal mode.

To terminate the DFLT mode without setting the factory default values, do one of the following:

- Press the MODE button to return to the normal display mode.
- Wait 30 seconds for the unit to return to the normal display mode.

Displaying System Parameter Settings

To scroll through the current settings of all system parameters, press the MODE button for 3 or more seconds. The H2TU-C displays the following parameters:

- H2TU-C-319 software version number
- H2TU-C-319 list number
- Type of frame pattern received from the DSX-1
- Line code of the signal received from the DSX-1
- All user-configured parameter settings
- Loop attenuation threshold setting
- Margin alarm threshold setting

Disabling an Alarm

If the system is in a Minor alarm state, the alarm relay can be disengaged by pressing the SEL button. This turns off the Alarm CutOff (ACO) indication.

Loopback Modes

“[Loopback Operation](#)” on [page 45](#) provides instructions on using the MODE and SEL buttons to activate loopbacks.

USING A MAINTENANCE TERMINAL

Connecting to a Maintenance Terminal

The craft port on the front panel allows you to connect the H2TU-C-319 to a maintenance terminal (ASCII terminal or PC running a terminal emulation program). Once connected to a maintenance terminal, you can access the maintenance, provisioning, and performance screens.

To connect to a maintenance terminal:

- 1 Connect a standard 9-pin terminal cable to the RS-232 craft port, as shown in [Figure 2 on page 4](#), on the H2TU-C-319 front panel.
- 2 Connect the other end of the cable to the serial port on the maintenance terminal.
- 3 Start a terminal emulation program such as ProComm that emulates a VT100 terminal.
- 4 Configure the maintenance terminal to the following communication settings:
 - 9600 baud
 - No parity
 - 8 data bits
 - 1 stop bit
 - Hardware flow control to OFF
- 5 If necessary, press **CTRL** + **R** to refresh the HiGain HDSL2 logon screen.

The Logon Screen

The HiGain maintenance terminal screens allow you to monitor, provision, and troubleshoot an H2TU-C-319 system.

To select a menu from the HiGain HDSL2 logon screen, shown in [Figure 4 on page 13](#), do one of the following:

- Press the first letter of the menu.
- Use the **←** **→** arrow keys to select the menu and press **ENTER**.

[Table 3](#) summarizes the navigational keys. They are also listed in the onscreen Help menu. [Table 4 on page 13](#) describes the Logon screen menus.

Table 3. *Navigational Keys for the HiGain Maintenance Terminal Screens*

Key ^(a)	Function
SPACEBAR	Cycle through selections.
ENTER	Activate the current setting or choice, or display a menu.
ESC or F11 (VT100)	Return to the parent menu.
↑ or CTRL + E	Select the submenu or item above the current one, or return to the previous menu.
↓ or CTRL + X	Select the submenu or item below the current one.
→ or CTRL + D	Select the menu or item to the right of the current one.
← or CTRL + S	Select the menu or item to the left of the current one, or return to the previous menu.
CTRL + R	Refresh the screen.

(a) Legacy management units require use of control keys instead of arrow keys.

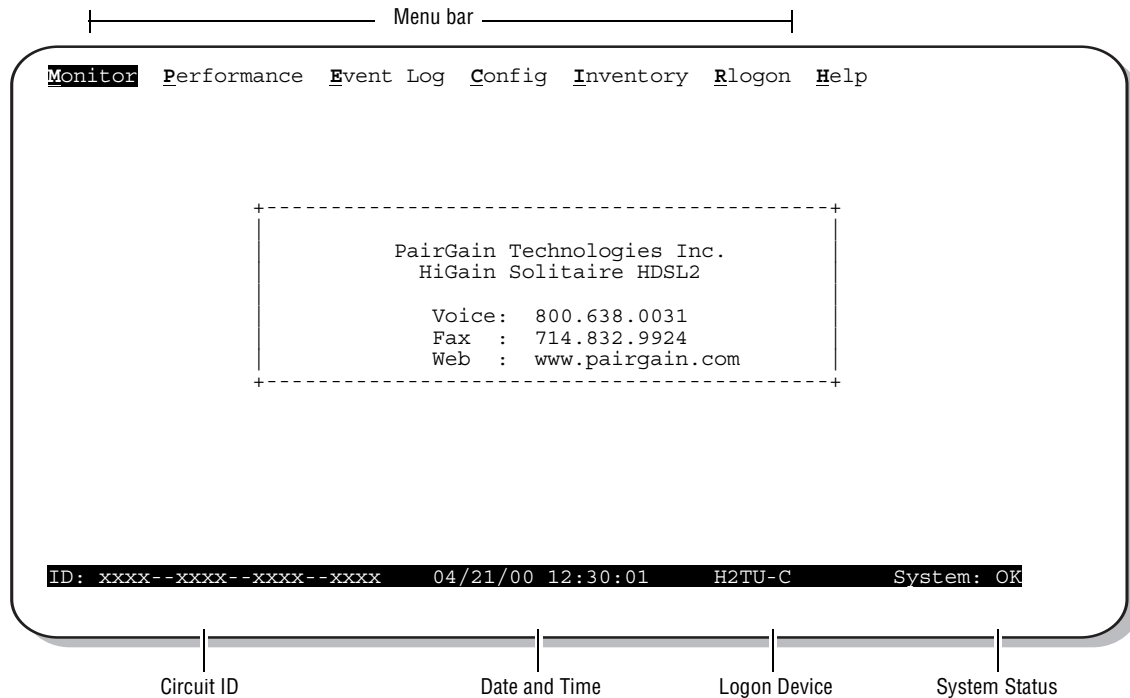


Figure 4. Logon Screen

Table 4. Logon Screen Menus

Press this key:	To access this menu:	Menu Functions
M	Monitor	Monitors loopbacks and alarms, and provides a graphical representation of circuit activity, including ES, UAS, SES, and line code.
P	Performance	Provides performance and alarm histories for current, 24-hour, 48-hour, or 31-day periods for either the DS1 or HDSL2 interface.
E	Event Log	Identifies the 100 most recent system events and reports the date and time of occurrence.
C	Config	Provides standard configuration options, PairGain options, date and time setting, and a reset option (factory settings).
I	Inventory	Provides product information about the various devices that are in the system and lists circuit and device identifications.
R	Rlogon/Rlogout	Performs logon or logout from the H2TU-C or the H2TU-R. The screen that displays R logout when the H2TU-C or H2TU-R is remotely logged on the other unit at the end of the circuit. To logout from the remote unit, press R . R logout changes to R logon. The unit is now locally logged on until R is pressed again to re-initiate the remote logon.
H	Help	Provides a glossary of terms used in the HiGain HDSL2 maintenance screens, a list of navigational keys, and ADC contact information.

PROVISIONING TASKS

After the H2TU-C-319 is successfully installed, perform these basic provisioning tasks:

- Set date and time
- Set circuit ID numbers
- Make any configuration changes
- Clear history, alarm, and event log screens to remove miscellaneous data during startup

Setting Date and Time

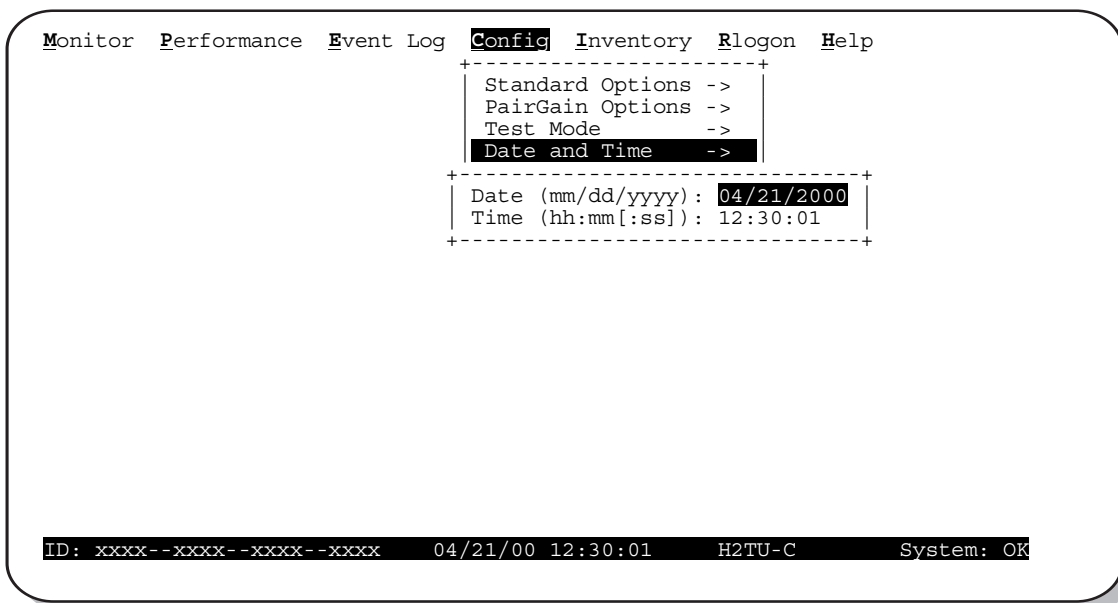


Figure 5. Configuration Menu - Date and Time

- 1 Press **C** to select the Config menu.
- 2 Select **Date and Time**, then press **ENTER**.
- 3 Type the date in the format indicated, then press **ENTER**.
- 4 Type the time in the format indicated, then press **ENTER**. Typing seconds is optional.

Setting Circuit ID Numbers

The Inventory menu provides product information on all units in the system and allows setting of the circuit and unit identification numbers.

```

Monitor Performance Event Log Config Inventory Rlogon Help
-----
Product Information -----
Unit      : H2TU-C          H2TU-R
Product   : H2TU-C-319     H2TU-R-402
List      : 2E             4E
Sw Ver.   : 2.00           2.00
Build #   : 00             00
Checksum  : 0x3FAE         0x3FAE
H2 Xcvr   : L1-RA2 1.31    L1-RA2 1.31
Serial #  : 01232456789    0123456789
CLEI     : VACHDN0CAA      VARHJUUCAA
Mfg. Date: 02/05/00       02/05/00

-----
Circuit and Unit Identifications -----
Circuit ID : xxxx--xxxx--xxxx--xxxx
H2TU-R ID  : YYY--YY--YY--YY

Enter new ID and press <Enter> to set.
ID: xxxx--xxxx--xxxx--xxxx 04/21/00 12:30:01 H2TU-C System: OK

```

Figure 6. Inventory Screen

- 1 Press **I** to select the Inventory menu.
- 2 Type the Circuit ID number, then press **ENTER**.
- 3 Type the ID numbers of all other devices listed in the system, pressing **ENTER** after each entry.

Making Changes to the System Configuration

The Config menu, as shown in [Figure 7](#) below, allows you to make the following types of system configuration changes:

- Standard options, as described in [“Making Changes to Standard and PairGain Options”](#) on page 16
- ADC options, as described in [“Making Changes to Standard and PairGain Options”](#) on page 16
- Date and time, as described in [“Setting Date and Time”](#) on page 14
- Master Clear, as described in [“Clearing the History, Alarm, and Event Log Screens”](#) on page 30
- Reset to factory default configuration, as described in [“Resetting the H2TU-C”](#) on page 30

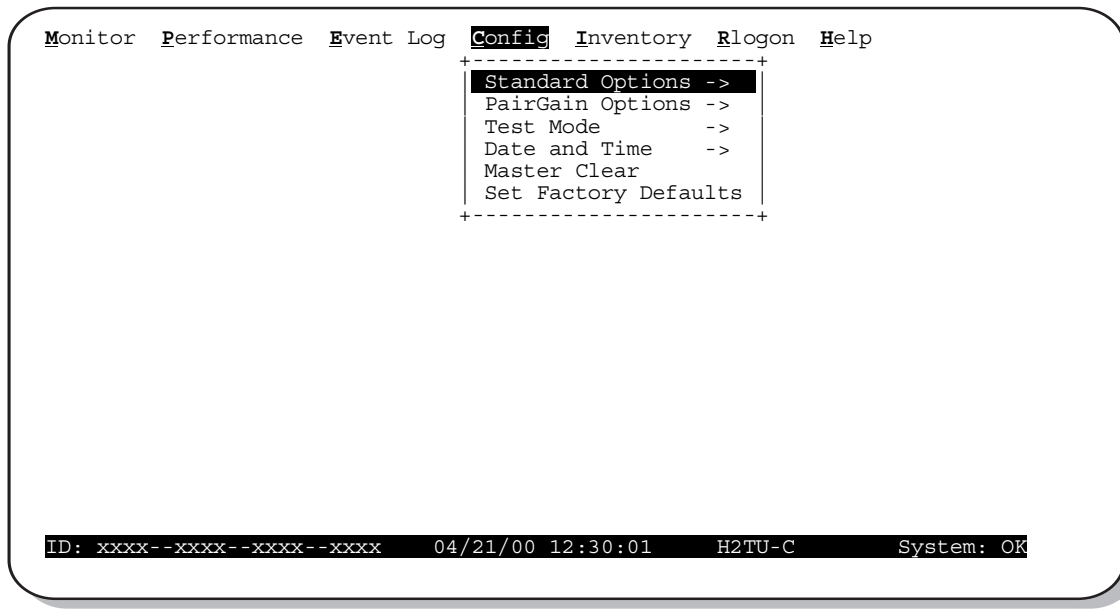


Figure 7. Configuration Menu

Making Changes to Standard and PairGain Options

Figure 8 and Figure 9 on page 17 show the Standard and PairGain configuration options. Standard options are those that are supported by HiGain units when connected to units from other vendors. PairGain options are an extended set of options that are only available when using HiGain units exclusively. For a description of each option and a list of possible option settings, refer to Table 5 on page 18 and Table 6 on page 19. To make changes to these options:

- 1 Press **C** to select the Config menu.
- 2 Use the **↑** and **↓** arrow keys to select **Standard Options** or **PairGain Options**, then press **ENTER**.
- 3 Use the arrow keys to select an option.
- 4 Press the **SPACEBAR** to cycle through the available settings for that option.
- 5 Press **ENTER** to activate your choice.


```

Monitor Performance Event Log Config Inventory Rlogon Help
                               +-----+
                               | Standard Options -> |
                               +-----+
Loopback Timeout (LBTO)                : 120 min
Loop Attenuation Threshold (LATT) [0-40]: 35 dB
Margin Threshold (MARG) [0-15]: 4 dB
DS1 Frame Formatting (FRMG)            : AUTO
DS1 Line coding (DS1)                  : B8ZS
H2TU-C Equalization (EQL)              : 0 ft
H2TU-R Line Buildout (RLBO)           : -7.5 dB
Alarm Pattern (ALMP)                  : AIS
H2TU-R TLOS Loopback (TLOS)          : DIS
Network Loopback Pattern (NLBP)       : AIS
                               +-----+

Press <Space> to cycle through settings and <Enter> to activate.
ID: xxxx--xxxx--xxxx--xxxx 04/21/00 12:30:01 H2TU-C System: OK

```

Figure 8. Configuration Menu - Standard Options (Defaults Shown)

```

Monitor Performance Event Log Config Inventory Rlogon Help
                               +-----+
                               | Standard Options -> |
                               | PairGain Options -> |
                               +-----+
Line Power Feed (PWRP)                 : ON
Remote Provisioning (RTPV)             : ENA
Bipolar Violation Transparency (BPVT)  : DIS
HDSL2 BER Threshold (HBER)             : 1E-6
DS1 BER (DBER)                        : DIS
Special Loopback Mode (SPLB)           : A3LB
SmartJack Loopback (LPBK)              : ENA
Minor Alarm (ALM)                     : DIS
Network AIS Signal (NAIS)              : CI
H2TU-R DS1 Frame Conversion (CONV)     : ACON
Performance Report Messaging (PRM)     : S+N
ESF-RAI to SF-RAI Overwrite (ROVR)    : ENA
SF-RAI to SF-RAI-CI toward NET (RACI) : ENA
Fractional T1 Mode (FT1)               : DIS
Active DS1 Port (ADS1)                 : MUX
                               +-----+

Press <Space> to cycle through settings and <Enter> to activate.
ID: xxxx--xxxx--xxxx--xxxx 04/21/00 12:30:01 H2TU-C System: OK

```

Figure 9. Configuration Menu - PairGain Options (Defaults Shown)

Table 5 on page 18 describes the Standard Config screen options and lists their front-panel display codes. Table 6 on page 19 describes the PairGain Config screen options. Selections in bold typeface are the factory default settings.

Table 5. H2TU-C-319 List 2E Standard Config Screen Options

System Settings Screen Options	Front-panel Display Code	Selection	Description
Loopback Timeout	LBTO	NONE	Disables automatic time-out cancellation of all loopbacks.
		20	Sets automatic cancellation of all loopbacks to 20 minutes after initiation.
		60	Sets automatic cancellation of all loopbacks to 60 minutes after initiation.
		120	Sets automatic cancellation of all loopbacks to 120 minutes after initiation.
Loop Attenuation Threshold	LATT	0 through 40 dB	Determines the maximum loop attenuation before an alarm is declared. The loop attenuation threshold can only be set through the HiGain HDSL2 maintenance screens.
		35 dB	Default value. Zero disables the alarm.
Margin Threshold	MARG	0 to 15 dB	Determines the minimum allowable margin below which a system alarm can occur. Zero disables the alarm. The Margin Alarm Threshold can only be set through the HiGain HDSL2 maintenance screens.
		4dB	Default value.
DS1 Frame Formatting	FRMG	AUTO	Configures the line unit to operate in an auto-framing (AUTO) mode. It detects and locks to both SF or ESF DS1 frame patterns. Line and path performance parameters are maintained and displayed. Unframed payloads will cause the ES-P and SES-P counters to increment.
		UNFR	Same as the AUTO setting except unframed payloads will NOT cause the ES-P and SES-P counters to increment.
DS1 Line Coding	DS1	B8ZS	Places both the H2TU-C and H2TU-R into their B8ZS modes. Applies to both the MUX (port 2) and AUX (port 1) interfaces.
		AMI	Places both the H2TU-C and H2TU-R into their AMI modes. Applies to both the MUX (port 2) and AUX (port 1) interfaces.
H2TU-C Equalization See "Equalization (EQL) Option." on page 20.	EQL	0	Sets the Equalizer to DSX-1 for 0 to 133 feet.
		133	Sets the Equalizer to DSX-1 for 133 to 266 feet.
		266	Sets the Equalizer to DSX-1 for 266 to 399 feet.
		399	Sets the Equalizer to DSX-1 for 399 to 533 feet.
		533	Sets the Equalizer to DSX-1 for 533 to 655 feet.
H2TU-R Line Buildout	RLBO	0 dB	Sets the DS1 RLBO level toward the Customer Interface to 0 dB. H2TU-R Line Buildout can only be set through the HDSL2 maintenance screens.
		-7.5 dB	Sets the DS1 RLBO level toward the CI to -7.5 dB.
		-15 dB	Sets the DS1 RLBO level toward the CI to -15 dB.
Alarm Pattern	ALMP	AIS	Enables the HiGain system to output an AIS payload at its DS1 ports for LOSW and DS1 LOS. See Figure 24 on page 44 for LOS/AIS response priorities.
		LOS	Enables the HiGain system to output an LOS condition at its DS1 ports for LOSW and DS1 LOS.
H2TU-R TLOS Loopback	TLOS	ENA	Enables a logic loopback at the H2TU-R when an LOS occurs at its DS1 input. See Figure 24 on page 44 for LOS/AIS response priorities.
		DIS	Disables TLOS logic loopback.
Network Loopback Pattern	NLBP	AIS	Enables the H2TU-R to transmit AIS toward the CI for any network loopback. See Figure 24 on page 44 for LOS/AIS response priorities.
		LOS	Enables the H2TU-R to transmit LOS toward the CI for any network loopback.

Table 6. H2TU-C-319 List 2E PairGain Config Screen Options

System Settings Screen Options ^(a)	Front-panel Display Code	Selection	Description
Line Power Feed	PWRF	OFF	Disables powering to the HDSL2 pair.
		ON	Keeps the HDSL2 line voltage at nominal -185 Vdc.
Remote Provisioning	RTPV	ENA	Enables remote provisioning.
		DIS	Disables remote provisioning.
Bipolar Violation Transparency	BPVT	ENA	Enables BPVs and HDSL2 CRC errors at the DS1 input to be converted into DS1 BPVs at the DS1 output at the distant end. This makes HiGain transparent to BPVs.
		DIS	Disables BPV Transparency.
See “Bipolar Violation Transparency (BPVT) Option” on page 20.			
HDSL2 BER Threshold	HBER	1E-6	System alarm relay contact closes and the Status LED flashes red when the Block Error Rate (BER) exceeds 10 ⁻⁶ .
		1E-7	System alarm relay contact closes and the Status LED flashes red when BER exceeds 10 ⁻⁷ .
		NONE	Prevents generation of a system alarm due to BER.
DS1 BER	DBER	ENA	Enables the fixed 24-hour DS1 BER threshold.
		DIS	Prevents the generation of a system alarm due to DS1 BER.
Special Loopback Mode	SPLB	GNLB	Configures the HiGain HDSL2 system to respond to the generic inband loopback codes.
		A2LB	Configures the HiGain HDSL2 system to respond to the inband loopback codes of the Teltrend addressable repeater.
		A3LB	Configures the HiGain HDSL2 system to respond to the inband loopback codes of the Wescom addressable repeater.
		A4LB	Configures the HiGain HDSL2 system to respond to the inband loopback codes of the Wescom Mod 1 addressable repeater.
SmartJack Loopback	LPBK	ENA	Enables the HiGain HDSL2 system to recognize all inband SmartJack loopback commands.
		DIS	Configures the HiGain HDSL2 system to ignore all inband SmartJack loopback commands.
Minor Alarm	ALM	ENA	Enables the generation of the output alarm on pin H when a system alarm condition occurs.
		DIS	Disables the generation of the output alarm on pin H when a system alarm condition occurs.
Network AIS Signal	NAIS	CI	If ALMP is set to AIS, this option specifies which pattern is sent to the network when a remote LOS or AIS occurs. When configured for CI, an AIS-CI pattern is sent to the network.
		AIS	When configured for AIS, an AIS pattern is sent to the network.
H2TU-R DS1 Frame Conversion See “H2TU-R DS1 Frame Conversion (CONV) Option” on page 21.	CONV	OFF	No frame conversion takes place at the H2TU-R. Framing is determined by the FRMG option settings of AUTO and UNFR.
		ACON	Auto Conversion of DS1 frame (ACON) and potential frame conversion at the H2TU-R.
		FCON	Auto detection of framing and Forced Conversion of DS1 Frame (FCON) at the H2TU-R.

Table 6. H2TU-C-319 List 2E PairGain Config Screen Options (Cont.)

System Settings Screen Options ^(a)	Front-panel Display Code	Selection	Description
Performance Report Messaging	PRM	SPRM	The H2TU-R generates Supplemental PRM (SPRM) every second if no PRM is received from the CPE within 5 seconds of a reset or if an LOS/AIS/Out-of-Frame (OOF) condition occurs. TL1 commands and responses are enabled.
		NPRM	The H2TU-R generates Network PRM (NPRM) if no PRM is present from the CPE. If the CPE is sending PRMs, NPRM is generated every second in addition to the existing PRM. TL1 commands and response are enabled.
		S + N	The H2TU-R generates an NPRM which is tagged onto an SPRM every second. The H2TU-R generates SPRM if no PRM is present from the CPE. If the CPE is sending PRM, the PRM is converted to an SPRM. TL1 commands and responses are enabled.
		OFF	ESF Datalink (DL) is completely transparent. No PRMs are generated. There are no TL1 responses unless the system is first armed by a TL1 command, which enables performance monitoring.
ESF RAI to SF RAI Overwrite	ROVR	ENA	If the CONV option is set to FCON or ACON, an ESF DS1 payload from the network with an embedded RAI pattern is converted to an SF-RAI pattern toward the CI at the H2TU-R.
		DIS	Prevents conversion to an SF-RAI pattern.
SF RAI to SF RAI-CI Toward Network	RACI	ENA	Allows a DS1 SF-RAI (yellow alarm) signal received by the H2TU-R to be converted to an SF-RAI-CI signal toward the network.
		DIS	Prevents conversion of the DS1 SF-RAI.
Fractional T1 Mode	FT1	ENA	Enables system response to DDS latching loopback commands for fractional T1 applications and enables CPE disconnect or trouble indication. See Figure 24 on page 44 for LOS/AIS response priorities.
		DIS	Disables system response to DDS latching loopback commands for fractional T1 applications and CPE disconnect or trouble indications.
Active DS1 Port	ADS1	MUX	The MUX mode selects the DSX-1 (MUX) port as the active source for the DS1 Signal to transmit to the HSDL Line Port #1. An AIS signal is sent to the auxiliary Port #2. Equalizer settings apply to the MUX DSX-1 port. The AUX equalizer is set to 0.
		AUX	The AUX mode selects the auxiliary DSX-1 Port #2 as the active source for DS1 signal to transmit to the HSDL Line Port. In this case, the MUX port is used as a monitor or splitting device for electrical test access. Equalizer settings apply to the AUX DSX-1 port. The MUX equalizer is set to 0.
		CTHR	Activates the Cut-through mode. This mode electrically connects the MUX port to the AUX port and the H2TU-C operates as a cut-through card. This is used when one tributary from the WBS 3190 MUX card is required to appear at the DSX-1 interface to the local central office. Equalizer settings apply to the MUX DSX-1 port. The AUX Equalizer is set to 0.

Equalization (EQL) Option. Equalization is the configuration of system transmission characteristics within specified limits. An adaptive equalizer inserts a frequency-shaped loss that corresponds to an equivalent addition of an appropriate cable length. By simulating the additional cable loss necessary for correct operation, the equalizer compensates for a range of variation in transmission path characteristics.

Bipolar Violation Transparency (BPVT) Option. The H2TU-C-319 improves compatibility with Digital Loop Carrier (DLC) feeder applications because of its ability to transmit DS1 BPV occurrences between its DS1 interfaces. This feature is required to support protection switching in DLC applications. Each DLC terminal must

be able to monitor the integrity of its Receive DS1 payload and then switch to the protect line when the integrity of the path drops below specific user selected limits. An essential requirement of this feature is the need for each DLC terminal to detect BPVs in its DS1 input. Standard HDSL systems correct DS1 BPVs at the input and therefore prevent them from being detected by the DLC terminals to which they are connected. The H2TU-C-319 and its associated remote units remove this limitation and become BPV transparent by detecting and counting input BPVs at each end and then by replicating them at the DS1 output port of the distant end.

The BPV count is converted into BPVs at the distant end during the following second at a rate of 1 BPV every 128 DS1 bits up to a maximum of 12000 ($BER=7.7 \times 10^{-3}$). This maximum rate is more than adequate since it exceeds the maximum 10^{-3} BER required by most DLC systems.



The MDS1 configuration settings in Table 6 on page 19 can only be initiated from the HMU when the ADS1 option is set to AUX.

HDSL2 BER (HBER) Option. The HBER option permits monitoring of loop integrity and reporting of alarms when excessive errors are detected. The PM primitive used for this purpose is the CRC checksum performed on the HDSL2 frame for both directions of transmission. It is, therefore, called a block error rate rather than the bit error rate associated with the DS1 interface. The CRC errors and counts are displayed on the Monitor screen for both the H2TU-C and H2TU-R. The HBER option allows an alarm to be generated if the total number of CRCs at either the H2TU-C or H2TU-R exceeds the selected BER threshold during the last 1-minute interval.

- HBER option = 1E-6. Alarm is generated if CRC > 92
- HBER option = 1E-7. Alarm is generated if CRC > 9

Once initiated, the HBER count clears when the CRC count drops below the selected threshold. Selecting NONE inhibits this alarm.

DS1 BER (DBER) Option. The DS1 BER alarm occurs when any of the DS1 or DSX-1 performance monitoring parameters listed in Table 7 exceed the counts shown for the 24-hour period between 12:00:00 AM through 11:59:59 PM. These thresholds correspond to a 10^{-6} BER. All PM counters clear to zero at 12:00:00 AM or when Master Clear is selected. See “Clearing the History, Alarm, and Event Log Screens” on page 30.

Table 7. DS1/DSX-1 24-hour PM Threshold

Parameter	Threshold Count
CV-L (BPV)	133,400
ES-L, ES-P, PRM, PDVS-L	648
SES-L, SES-P	100
UAS-P, UAS-L	10

H2TU-R DS1 Frame Conversion (CONV) Option. Frame format conversion is only applicable to the remote H2TU-R, but selectable by the H2TU-C or H2TU-R. This option enables the network to be ESF, which is used to embed SPRM or NPRM into the datalink toward the network. During conversion, frame bit errors are regenerated to ensure transparency.

The HDSL2 system attempts to find ESF or SF framing or determines that no framing exists. The DS1 framing is then synchronized with the HDSL2 frame. If the framing is lost, the system generates an OOF defect which results in UAS-P. As a result, the system reverts to frame search mode.

This option has the following settings:

- OFF: No frame conversion takes place. All framing issues are determined by the FRMG option settings of AUTO and UNFR.

- **ACON:** This is the automatic conversion setting. If the system detects ESF from the network and SF from the CPE, it automatically converts the CPE SF to ESF toward the network as well as the network ESF to SF toward the CPE.

Upon power-on-reset, after loopdown, or after changing the frame conversion option, the framing needs to be re-established before a complete conversion takes place. If there is a failure condition (LOS, AIS, or LOF) during steady state, the previous conversion state is maintained to ensure continuity when the system returns from the failure condition.

If SF is received from the network, the H2TU-R forces an ESF toward the network for about 1.5 seconds. This signals to the far-end PM-NIU at the network boundary that frame conversion is requested. If the far-end PM-NIU is capable of conversion, it changes the framing to ESF. If not, then the H2TU-R reverts to SF and does not apply any conversion.

If an ESF is received from the CPE, it is passed on to the network, and the network’s inbound framing is passed on to the CPE.

- **FCON:** This is the forced conversion setting. [Table 8](#) below lists the HiGain responses to both the ACON and FCON settings for the CONV option. The responses are identical, except in cases 3 and 4. In these cases, the FCON reply is attempting to force the network (or the far-end PM-NIU) to send ESF. It also alerts the CPE with an AIS alarm pattern while forcing the ESF to the network. Continuity is maintained as for ACON. [Table 9 on page 22](#) and [Table 10 on page 23](#) list the ESF and SF frame formats, respectively.

Table 8. Response to H2TU-R DS1 Frame Conversion Options

Case Number	NET Transmit	CPE Transmit	ACON Option	FCON Option
			NET > CPE NET < CPE	NET > CPE NET < CPE
1	ESF	SF	ESF → SF ESF ← SF	ESF → SF ESF ← SF
2	ESF	ESF	ESF → ESF ESF ← ESF	ESF → ESF ESF ← ESF
3	SF	ESF	SF → SF ESF ← ESF	SF → AIS ESF ← ESF
4	SF	SF	SF → SF SF ← SF	SF → AIS ESF ← SF

Table 9. Extended SuperFrame Format

ESF Number	Frame Bits		
	Framing Pattern Sequence (FPS) - 2 kb/s	Frame Bit for Datalink (FDL) - 4 kb/s	Cyclical Redundancy Check (CRC) Bits - 2 kb/s
1		m	
2			C1
3		m	
4	0		
5		m	
6			C2
7		m	
8	0		
9		m	
10			C3
11		m	
12	1		

Table 9. *Extended SuperFrame Format (Cont.)*

ESF Number	Frame Bits		
	Framing Pattern Sequence (FPS) - 2 kb/s	Frame Bit for Datalink (FDL) - 4 kb/s	Cyclical Redundancy Check (CRC) Bits - 2 kb/s
13		m	
14			C4
15		m	
16	0		
17		m	
18			C5
19		m	
20	1		
21		m	
22			C6
23		m	
24	1		

Table 10. *SuperFrame Format*

SF Number	Frame Bits	
	Terminal Framing Bit	SuperFrame Signaling Bit
1	1	
2		0
3	0	
4		0
5	1	
6		1
7	0	
8		1
9	1	
10		1
11	0	
12		0

ESF RAI to SF RAI Overwrite (ROVR) Option. If the ESF RAI to SF RAI Overwrite (ROVR) option is enabled, it allows a network ESF RAI or ESF RAI-CI pattern to be converted into a CPE SF RAI or SF RAI-CI pattern, and overwrites the payload bits with the specific alarm patterns.

If the ROVR option is disabled, it prevents conversion of a network ESF payload with an embedded RAI pattern and preserves the integrity of the CPE payload as it was originally transmitted.

SF RAI to SF RAI-CI Toward Network (RACI) Option. In general, the Remote Alarm Indication - Customer Installation (RAI-CI) signal is a RAI signal which contains a signature indicating that an LOF or AIS failure has occurred within the customer's network.

RAI-CI is transmitted toward the network when these two conditions are simultaneously true at the point from which RAI-CI is originated (at the H2TU-R, toward the network):

- RAI is received from the CI
- No LOF, LOS, or AIS failure is detected in the signal received from the network.

Since RAI-CI meets the definition of RAI, it may be detected and used exactly as an RAI.

For ESF, the RAI-CI signal is a repetitive pattern with a period of 1.08 seconds. RAI-CI is formed by sequentially interleaving 0.99 seconds of the unscheduled message 00000000 11111111 (right-to-left), which represents RAI in the DL, with 90 milliseconds of the message 00111110 11111111 (right-to-left) to flag the signal as RAI-CI.

For SF, the SF-RAI-CI signal is transmitted inband by setting each of the 24 channel time slots to 1000 1011 (left-to-right). In addition to the criteria specified above, the generation of SF-RAI-CI has to be held for 1 second to examine the DS0 channels for the presence of a frame with an all-zeroes pattern. If present, the generation of SF-RAI-CI is suspended for the duration of the all-zeroes pattern.

In all SF environments, the H2TU-R automatically converts a CPE DS1 payload with an embedded RAI signal into an RAI-CI pattern toward the network if the RACI option is enabled (default). Such a conversion affects the payload as described above. Disable RACI to avoid this payload-affecting conversion.



The SF RAI to SF RAI-CI option is only applicable in an all SF framing environment. If SF to ESF conversion is active (the CONV option is set to either ACON or FCON), the SF RAI is converted into ESF RAI in the FDL, regardless of the RACI setting.

Fractional T1 (FT1) Option. Fractional T1 circuits can be used in feeder networks to provide frame relay service. If such circuits are maintained by a DDS test group, then these circuits must respond to DDS/DS0 latching loopback commands, the only tool test groups have at their disposal. A latching loopback, once it has been initiated by the correct sequence, remains locked or “latched” until the correct loopdown sequence has been detected.

The FT1 option, when enabled, allows the H2TU-C to respond to DS0 latching loopback commands and thus support fractional T1 frame-relay applications. This is in addition to the standard full bandwidth T1 2-in-5 loopup and 3-in-5 loopdown SmartJack commands. FT1 supports both the full T1 enable commands and the new DDS latching loopback commands, which must also be enabled. (For more information about latching loopback commands, refer to BellCore TA-TSY-000077, Issue 3, April 1986.)

The FT1 option supports both the DDS NI and DDS DS0 Data Port (DP) latching loopback sequences listed in [Table 11](#).

Table 11. DDS NI and DS0 DP Latching Loopback Sequence

Enable Sequence	Minimum Number of Bytes	Byte Name	Network Code
1	35	Transition in Progress (TIP)	S0111010
2A	35	NI Loop Select Code (LSC)	S1000001
2B	35	DS0 DP Loop Select Code (LSC)	S0000101
3	100	Loopback Enable Code (LBE)	S1010110
4	35	All Ones	S1111111
5	100	LBE	S1010110
6	32	Far End Voice (FEV)	S0111010
Disable/Loopdown	35	TIP	S0111010

The sequences in [Table 11](#) are sent in timeslot 1. The S in the Network Code column is a “don’t care” bit. The loopback is activated after the detection of Sequence 6. Upon completion of the enable sequence, the Test Center

continues to transmit FEV bytes in multiples of 20 until FEV confirmation bytes are returned or until about 2 seconds have elapsed. If the confirmation bytes are not received, a failed attempt is reported. Anticipate the minimum number of bytes when the loopback code is transmitted by a preprogrammed machine test pattern generator. These minimum number of bytes will most likely be exceeded when the codes are sent manually. Also, manual testing may inject random data signals between valid control sequences. The detection algorithm ignores these occurrences and only responds to valid control codes.

Table 12 lists the relationship between the latching loopback sequences and the specific HiGain HDSL2 loopback they initiate.

Table 12. *HiGain HDSL2 Loopback vs. Latching Sequence*

HiGain HDSL2 Loopback	Latching Sequence
NREM	1, 2A, 3, 6
NLOC	1, 2B, 3, 6
NRG1	1, 2B, 3, 4, 5, 6
NRG2	1, 2B, 3, 4, 5, 4, 5, 6

The NLOC and NRG1 through NRG2 loopbacks are called tandem DS0 DP loopbacks. They are used to select one of many loopback points when there are several identical data ports in tandem. The NI loopback is assigned to the H2TU-R (NREM) since it is usually located at the Network Interface (NI). The DS0 DP tandem loopback is assigned to the rest of the HiGain HDSL2 loopbacks because most DDS test sets support this tandem command set.

The Test Center transmits a group of 40 TIP bytes to loop down the loopback. It continues to transmit TIP bytes in multiples of 20 until the TIP bytes are not returned or until about 2 seconds have elapsed. If the bytes are absent, a successful loopdown is reported; otherwise, a failed loopdown is reported. The loop-down can also be initiated by depressing the H2TU-R loopback control button or by any of the standard 3-in-5 loop-down commands. The implemented detection/release loopback algorithm functions properly in the presence of a 10^{-3} bit error rate.

Since the FT1 mode is a combination of both the full T1 and the latching loopback modes, all codes are always active. Therefore, if a loopback is initiated by a latching sequence, it can be looped down by either a latching or generic loopback and vice versa. All loopback commands are completely symmetric in the FT1 mode.

If the latching sequence shown in Table 12 on page 25 is interrupted for more than 20 minutes, the detection is cleared, and the H2TU-C reverts back to its initial state where it searches for the initial sequence 1.

After a successful latching sequence terminates in a latched loopback state, this state remains until the Disable command is detected or until the LBTO option of NONE, 20, 60, or 120 minutes has expired, whichever occurs first.

The unframed AIS pattern that is normally sent toward the network for a CI LOS fault condition must be replaced by the new patterns listed in Table 13 when the FT1 loopback option is selected. In addition, the FT1 mode also requires an input AIS pattern to be converted into an unframed 7E output pattern at both ends as shown in Table 13.

Table 13. Response of H2TU-C 319 List 2E and H2TU-R to LOS and AIS

Case	FT1 Option	H2TU-C Input	H2TU-C Output Pattern			H2TU-R Input	H2TU-R Output	Status Screen	Front-panel Display
			Framing	Payload	FDL				
1	ENA	SF	SF	01111110	N/A	LOS/AIS	01111110 UNFR	RCV RLOS/RAIS XMT IDLE	ALRM RLOS/RAIS
2	ENA	ESF	ESF	01111110	X ^(a)	LOS/AIS	01111110 UNFR	RCV RLOS/RAIS XMT IDLE	ALRM RLOS/RAIS
3	ENA	LOS/AIS	SF	01111110	N/A	LOS/AIS	01111110 UNFR	RCV RLOS/RAIS XMT IDLE	ALRM RLOS/RAIS
4	ENA	LOS/AIS	SF	PL	X ^(a)	SF/PL	AIS	RCV LLOS/LAIS	ALRM LLOS/LAIS
5	ENA	LOS/AIS	SF	PL	X ^(a)	ESF/PL	AIS	RCV LLOS/LAIS	ALRM LLOS/LAIS

(a) Don't care bit

Test Access

The H2TU-C-319 List 2E's PC board's card-edge connector, shown in Figure 27 on page 57, has three separate segments labeled S1 (segment 1), S2 (segment 2), and S3 (segment 3). S3 contains the standard 3192 pin connections. The two extra segments, S1 and S2, have pin connections that support additional features called Dual DSX-1 port option and Metallic Test Access (MTA), respectively, as shown in Figure 10 below through Figure 13 on page 28.

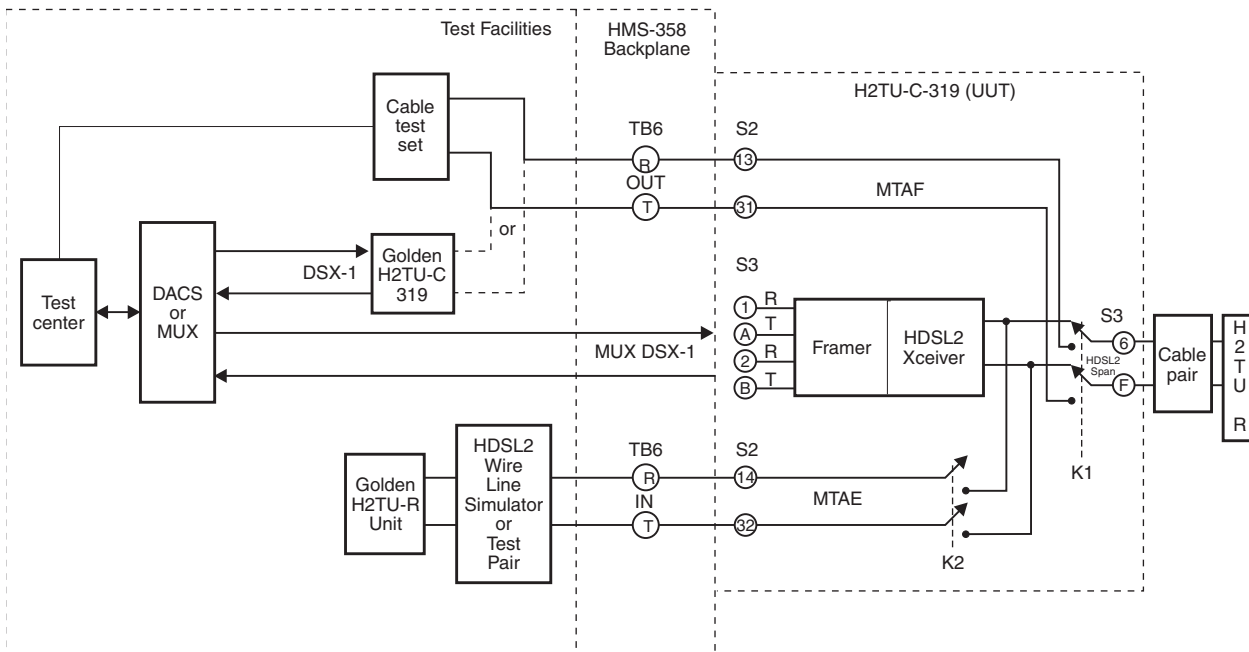


Figure 10. Metallic Test Access Block Diagram

Metallic Test Access. Figure 10 above shows the block diagram of the metallic test access features which are under control of the two relays, K1 and K2. The S2 metallic test access ports (IN or OUT) are bused to terminal block TB6 located on the HMS-358 backplane, as shown in Figure 11 below. Figure 12 displays the location of TB6 on the HMS-358 backplane.

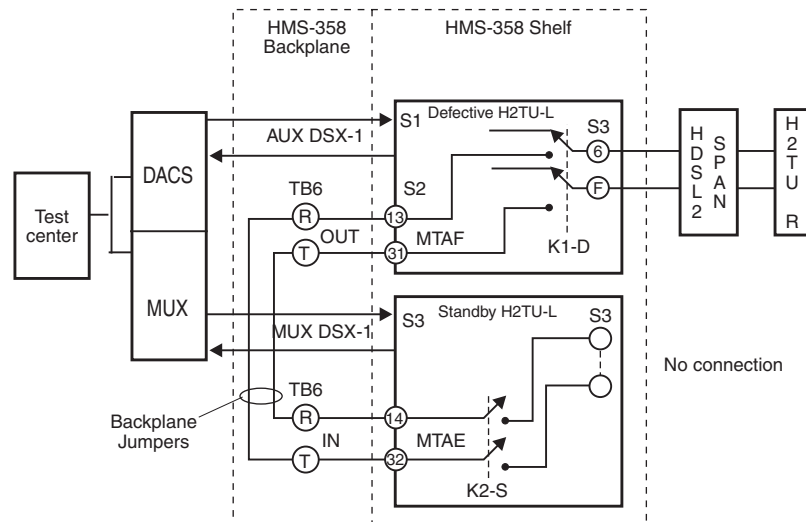


Figure 11. MTA Relays

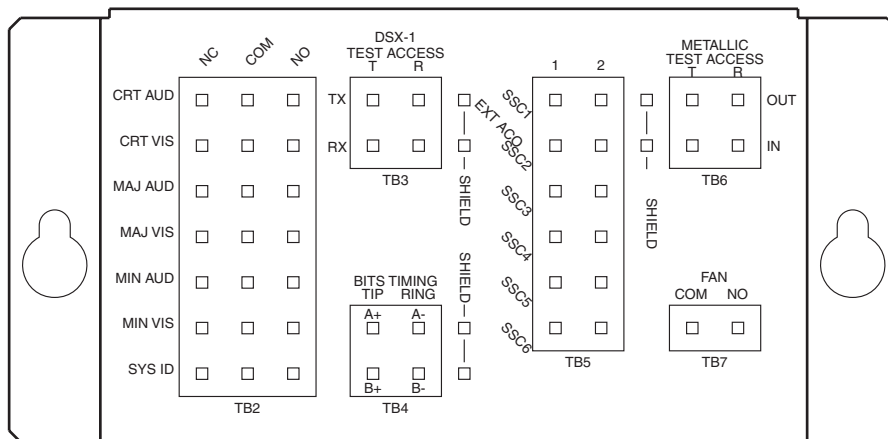


Figure 12. Metallic Test Access TB6 on HMS-358 Backplane

Both relays are energized or pulled down when the user either activates the MTA option from the front panel (or the test menu) or upon command from the HMU. K1 opens the HDSL2 cable pair between the H2TU-Cs transceiver and the incoming span and connects the latter to the Metallic Test Access Facilities (MTAF) OUT T and R pins on TB6. K2 connects the HDSL2 transceiver to the Metallic Test Access Equipment (MTAE) IN T and R pins on TB6. Typical MTAF and MTAE test interfaces are shown in Figure 10 on page 26. A cable test set connected to the out port of TB6 can be used to perform cable tests on the 2 wire HDSL2 cable pairs out to the remote H2TU-R. Alternately, the OUT port of TB6 can connect to a golden H2TU-C-319 which, in conjunction with a T1 test set, can be used to perform system tests on the original circuit minus its H2TU-C-319 and thus isolate any trouble to the equipment or the facilities.

The MTAF IN port of TB6 can connect to an external test facility circuit consisting of an HDSL2 wire line simulator or test pair and a golden H2TU-R remote HDSL2 unit. This connection allows the H2TU-C-319 Unit Under Test (UUT) to be tested from its DSX-1 interface on the simulated test circuit. This allows any problem to be isolated to either the equipment or the facilities. Since this MTA test event disrupts service, it is always accompanied by an MTA/LOSW alarm that is displayed on both the front panel and status screen.

Simultaneous access of the MTAF and MTAE backplane buses by more than one H2TU-C-319 would connect two loops and two transceivers together and must be prevented. Such a conflict is inhibited when the shelf is under command of the HMU-319 management unit. However, when the H2TU-C-319s are under manual control, the conflict can occur if the MTA command is issued to two line units in the same shelf or in different shelves if the TB3 and TB6 ports are bussed together to create a single test access to an entire bay. Therefore, the user must be aware of this potential conflict and take care to avoid it.

Figure 11 on page 27 shows a future enhancement of the H2TU-C-319 List 2E that uses separate commands to control the two test relays K1 and K2. This allows the IN and OUT ports of TB6 to be connected to each other which creates a circuit that allows a suspected H2TU-C-319 to be replaced by a standby H2TU-C-319. The MTAF relay K1-D is activated in the defective H2TU-C unit and the MTAE relay K2-S activated in the standby H2TU-C unit. This allows the original facility circuit of the defective H2TU-C to be connected, by way of the TB6 jumpers to the standby H2TU-C unit. The test center can then switch the DSX-1 interface from the defective H2TU-C unit to the standby unit within a DACS or M13 MUX circuit to complete the test circuit.

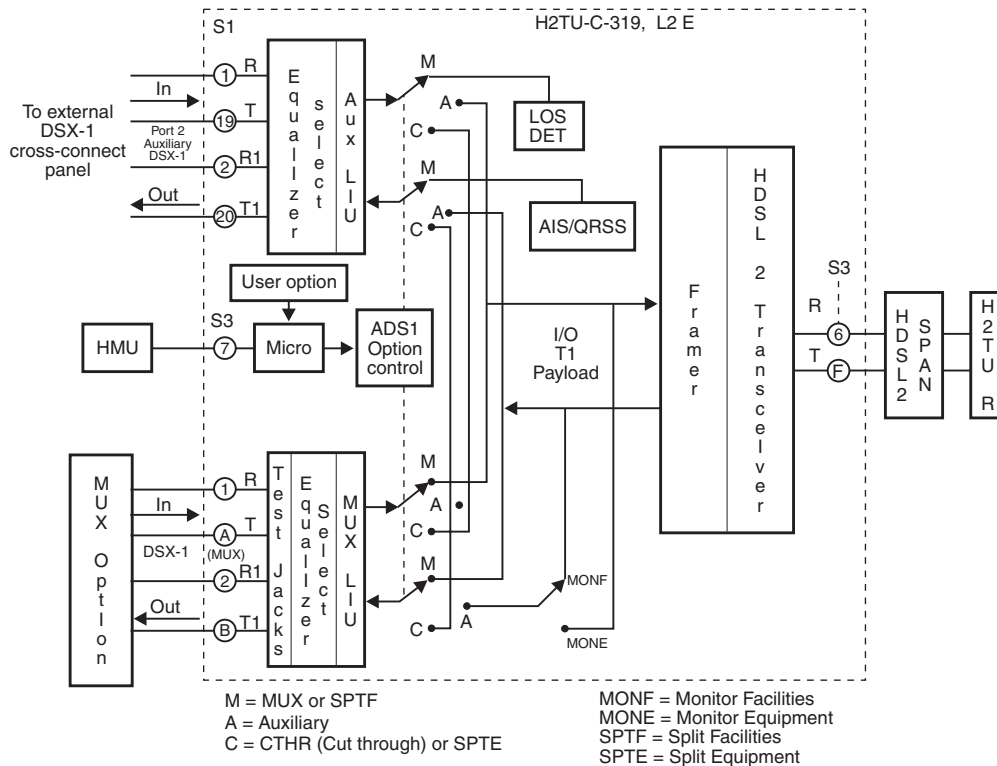


Figure 13. H2TU-C-319 Block Diagram

The separate control of K1 and K2 permits another test scenario. Two external HDSL2 spans can be looped together at TB6 if the two H2TU-C line units that connect to the two spans both enable their MTAF states and close K1 in each unit. This will loop the two pairs together and allow metallic cable tests to be performed from any point in the loop where both pairs can be accessed.

Future enhancements to the H2TU-C-319 List 2E will also allow the following seven bit inband commands to control K1 and K2:

MTAF (Enable K2)1010011
 MTAE (Enable K1)1011110
 DISABLE K1 or K21011011

Dual DSX-1 Port Option

Figure 13 on page 28 is the block diagram of the H2TU-C-319 List 2E Dual DSX-1 Port option. The Input/Output (I/O) DS1 payload from the HDSL2 span is routed to either of the two Line Interface Units (LIU) Auxiliary (AUX) LIU and Multiplexer (MUX) LIU as controlled by the following three settings of the Active DSX-1 (ADS1) user options:

- MUX (M)

In the MUX setting, the I/O DS1 payload from the field is connected to the MUX LIU which connects it to the MUX IN and OUT DSX-1 signal levels at the S3 card-edge connector interface. This interface connects to one of the HiGain M13 multiplexers that plugs into the HMS-358 shelf. An AIS out-of-service indicating pattern is sent toward the Auxiliary LIU for the MUX setting. Additionally, the input port of the AUX LIU is monitored for a valid DS1 signal and an AUX LOS alarm is displayed, if no signal is present.

- AUX (A)

The AUX setting of the ADS1 option routes the I/O DS1 payload to the AUX LIU. This LIU converts the payload to the IN and OUT signal levels at the AUX DSX-1 output pins at S1 of the card-edge connector which provides access to an external DSX-1 cross-connect panel.

The AUX setting of ADS1 also supports a subset of four more user options if the MUX DSX-1 interface is connected to a HiGain MUX. These four options, which can only be initiated from the shelf's HMU-319 management card, are called Monitor Facilities (MONF), Monitor Equipment (MONE), Split Facilities (SPTF), and Split Equipment (SPTE) and are described as follows:

- The MONF setting routes the signal received from the facilities at the I/O DS1 payload interface to the MUX, through the MUX LIU, where it can be examined by the MUX test circuits.
- The MONE setting operates like the MONF setting but operates on the signal received from the equipment.
- The SPTF setting forces ADS1 to its MUX setting and presents the full I/O DS1 facilities payload to the MUX for testing.
- The SPTE forces ADS1 to its CTHR setting and presents the full DSX-1 equipment signal from the AUX port to the MUX for testing. Since both the SPTF and SPTE settings disrupt the original AUX circuit, both modes create minor alarm conditions identified as either ALPM SPTF or ALRM SPTE
- Cut-through (CTHR) (C)

The CTHR setting of ADS1 disconnects both LIUs from the I/O DS1 payload and connects the two LIUs in tandem. This allows a DSX-1 circuit from the normal DSX-1 interface (typically a HiGain MUX) to be cross-connected to the external DSX-1 cross-connect panel by way of the AUX DSX-1 interface.



The Equalizer Select option settings apply to either the AUX or MUX port as determined by the setting (AUX or MUX) of the ADS1 option. The equalizer of the unselected port is set to 0. The equalizer settings apply to the AUX port when the Cut-through setting is selected.

Resetting the H2TU-C



Resetting the H2TU-C to its original factory settings may cause interruption of service.

To reset the H2TU-C-319 to its original factory defaults:

- 1 Press **C** to select the Config menu.
- 2 Use the **↑** and **↓** arrow keys to select **Set Factory Defaults**, then press **ENTER**.
- 3 Press **Y** if you want to reset the H2TU-C, or press **N** to cancel this action.

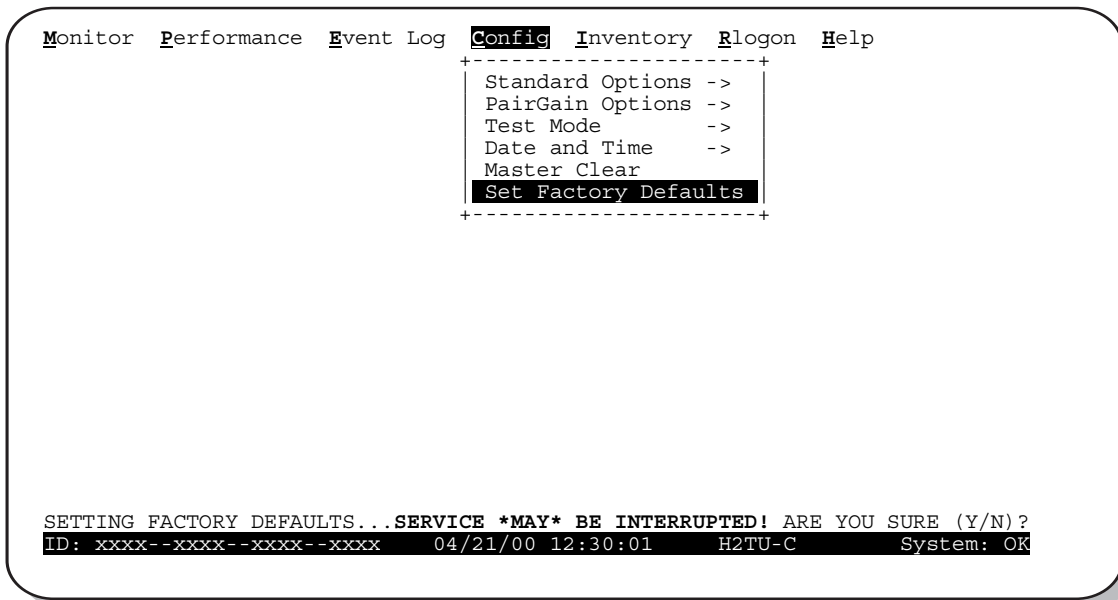


Figure 14. Configuration Menu - Reset to Factory Defaults

Clearing the History, Alarm, and Event Log Screens

Select Master Clear to clear the History, Alarm and Event Log screens after the system has been installed and is functioning properly. This removes miscellaneous data acquired during the startup session and ensures that you have meaningful data thereafter.

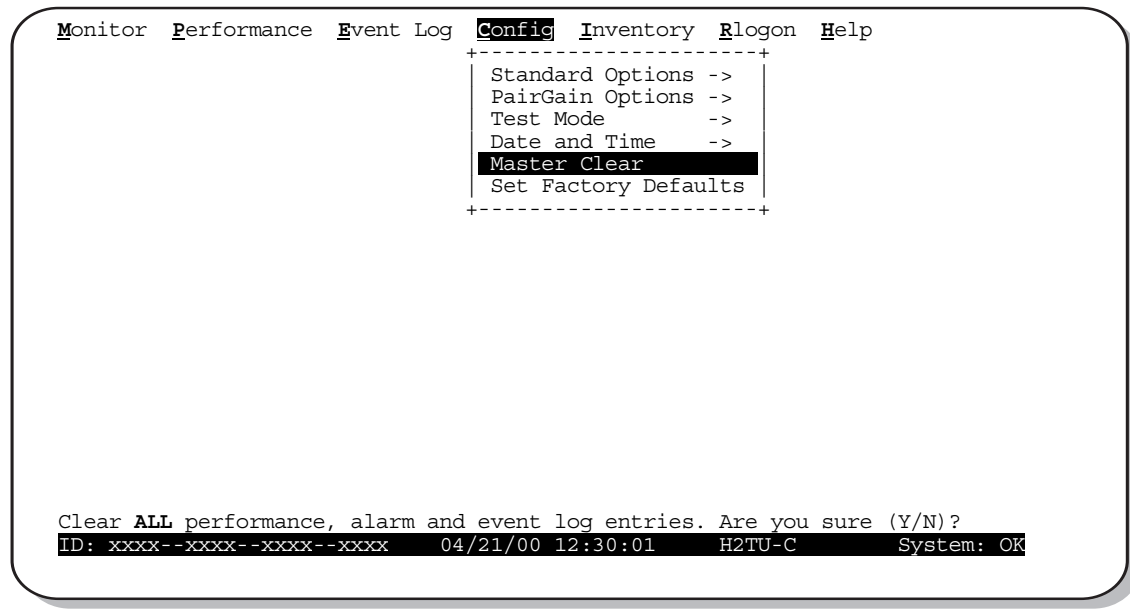


Figure 15. Master Clear

To clear the Event Log, press **E** to select the Event Log screen, then press **L** to clear the screen.

To clear an individual history or alarm screen, do the following:

- 1 Press **P** to select the Performance screen.
- 2 Press the **SPACEBAR** to select either interface (**H2TU-C DS1**, **H2TU-R DS1**, **H2TU-C HDSL2** or **H2TU-R HDSL2**), then press **ENTER**.
- 3 Press the **SPACEBAR** to select the type of statistics (**Current**, **Alarm History**, **25 Hour History**, **48 Hour History**, or **31 Day History**), press **ENTER** after your selection.
 - Selecting **31 Day History** allows you to clear the Current, 25 Hour, 48 Hour, and 31 Day performance history screens for the selected interface.
 - Selecting **Alarm History** allows you to clear the alarm history screen for the selected interface. For information about the DS1 and HDSL2 Alarm screens, see [Table 17 on page 38](#).
- 4 Press **L** to clear the screen.

To clear all history, alarm, and event log screens:

- 1 Press **C** to select the Config screen.
- 2 Select **Master Clear**.
- 3 Press **Y** to clear all screens.

MONITORING SYSTEM ACTIVITY AND PERFORMANCE

The H2TU-C-319 provides two sets of maintenance screens for monitoring system activity and assessing performance.

- The Monitor screens provide a graphical representation of circuit activity and allow initiation of loopbacks.
- The Performance screens provide current, 24-hour, 48-hour, and 31-day performance histories and a continuous alarm history.
- The Event Log provides a description of the 100 most recent events.

SYSTEM OVERVIEW

As shown in [Figure 16](#), the H2TU-C can support up to two regenerators with three HDSL2 spans. Regenerators are supported in firmware version 3.0 and greater.

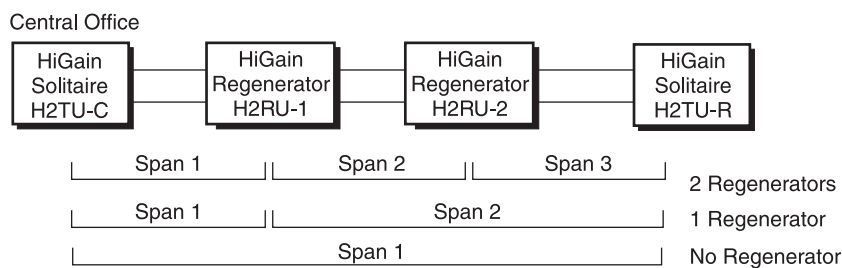


Figure 16. System Spans

The Monitor and Performance screens provide important activity and performance information about the HDSL2 spans and span devices.

USING THE MONITOR SCREEN TO VIEW SYSTEM ACTIVITY

- 1 Press **M** to view the system diagram.

[Figure 17](#) shows an armed circuit with an active loopback and alarms. Terms used on the system diagram are defined in the onscreen Help menu glossary. Abnormal situations are highlighted on the diagram. [Table 14 on page 33](#) describes the screen field.

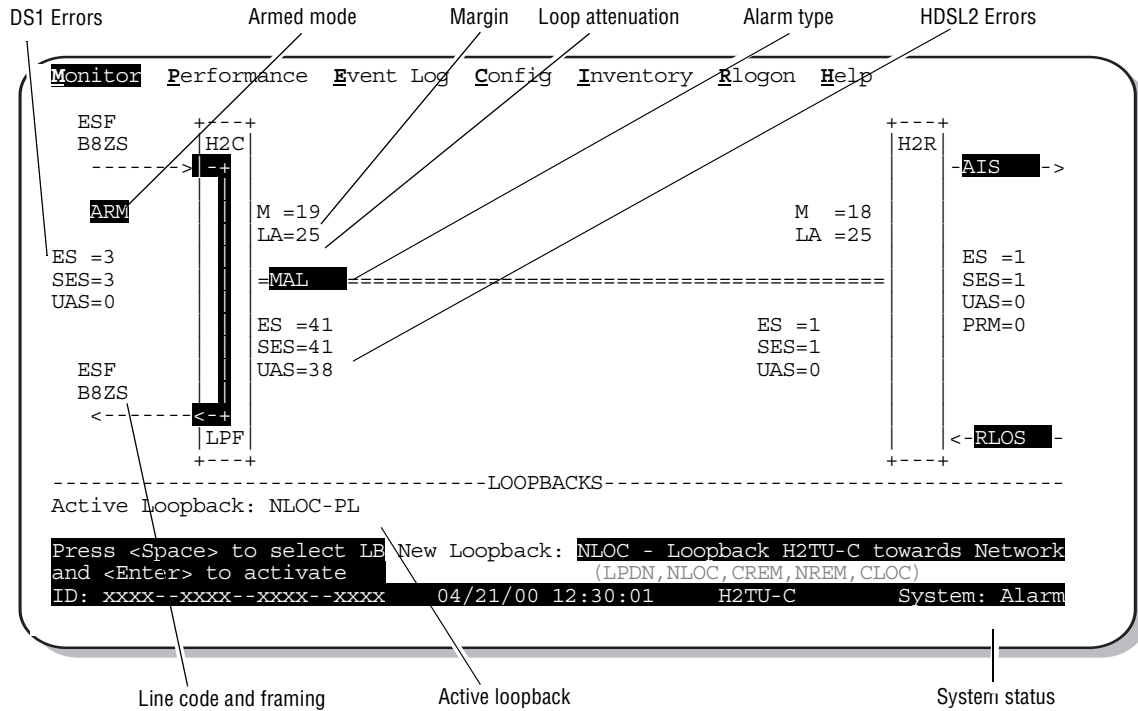


Figure 17. Monitor Screen - Active Loopback with Alarms

- 2 To initiate a loopback, press the **SPACEBAR** to cycle through the loopback choices. Press **ENTER** to select your choice.
 When prompted with the message: Are you sure (Y/N) ?, press **Y** to initiate the loopback or **N** to cancel. For more information about loopbacks and troubleshooting, see “Testing” on page 42.
- 3 To initiate a loopdown of all active loopbacks, press the **SPACEBAR** to select **LPDN**, then press **ENTER**.
 When prompted with the message: Are you sure (Y/N) ?, press **Y** to initiate the loopdown or **N** to cancel.

Table 14. Monitor Screen Descriptions

Field	Description
Active Loopback	An active loopback is indicated on the lower third of the Monitor screen. Available loopbacks are indicated by gray text. See Table 21 on page 46 for a summary of the HiGain HDSL2 loopback codes.
Alarm type	Indicates the type of alarm.
Armed mode	Indicates the system is in an armed state and ready for an intelligent repeater (IR) loopback command.
Code type	Type of DS1 line coding used (AMI or B8ZS).
DS1 ES Count	Errored Seconds—The sum of the Errored Seconds-Line (ES-L) and Errored Seconds-Path (ES-P) counts detected on the DS1 input over a 24-hour period. Errors included are: DS1 Frame errors and ESF CRC errors.
DS1 SES Count	Severely Errored Seconds—The sum of the DS1 Severely Errored Seconds-Line (SES-L) and Severely Errored Seconds-Path (SES-P) counts over the last 24 hours.
DS1 UAS Count	Unavailable Errored Seconds—The number of seconds during which the DS1 input signal was absent over a 24-hour period.
Frame type	Type of DS1 framing detected at the input stream (SF, ESF, or UNFR).

Table 14. Monitor Screen Descriptions (Cont.)

Field	Description
HDSL2 ES Count	Errored Seconds—The number of 1-second intervals that contained at least one CRC or LOSW error. This value is a running total of the last 24 Hours.
HDSL2 SES Count	Severely Errored Seconds—The number of 1-second intervals that contain at least 50 CRC errors or one or more LOSW defects. (An LOSW defect occurs when at least three consecutive HDSL frames contain one or more frame bit errors.) This value is a running total of the last 24 hours.
HDSL2 UAS Count	Unavailable Errored Seconds—The number of seconds the HDSL2 loop is unavailable. This occurs after 10 contiguous HDSL SES and is retired after 10 contiguous non-SES seconds. This value is a running total of the last 24 hours.
ID	Circuit identification (ID) number.
LA	Loop Attenuation—Indicates the attenuation of the Overlapped Pulse Amplitude Modulation Transmission with Interlocking Spectra (OPTIS) pulse from the distant end. The value is related to the loop attenuation at 196 kHz and should be kept under 35 dB.
LPF	Line Power Feed—Indicates the HDSL2 line power is on.
M	Margin—The signal-to-noise ratio at all HDSL2 ports, relative to a 10^{-7} Bit Error Rate.
MAL	Margin Alarm—Indicates the margin on HDSL2 loop has dropped below the threshold (0 to 15dB) as set by the operator.
PL (or HG)	PL displays when the loopback was initiated by a command embedded in the DS1 data path payload (PL). HG displays when the loopback was initiated from a HiGain (HG) front panel or by a HiGain maintenance terminal loopback command.
PRM	The sum of the Performance Report Messaging-Near End (PRM-NE) and Performance Report Messaging-Far End (PRM-FE) counts.
System Status	The presence or absence of an alarm condition is indicated on the lower right corner of all screens. Table 20 on page 42 lists the front-panel system alarms.

USING THE PERFORMANCE SCREENS TO VIEW PERFORMANCE DATA

The Performance screens display:

- CRC statistics for the HDSL2 or DS1 interface in 31-day, 48-hour, 25-hour and current history reports.
- Alarm statistics for the HDSL2 ([Figure 20 on page 37](#)) or DS1 interfaces ([Figure 21 on page 38](#)) on a continuous basis.

To access the Performance history screens:

- 1 Press **P** to select the Performance screen.
- 2 Press the **SPACEBAR** to select either interface (**H2TU-C DS1**, **H2TU-R DS1**, **H2TU-C HDSL2** or **H2TU-R HDSL2**), then press **ENTER**.
- 3 Press the **SPACEBAR** to select the type of statistics (**Current**, **Alarm History**, **25 Hour History**, **48 Hour History**, or **31 Day History**), then press **ENTER**.

Performance History at the DS1 Interface

Figure 18 is an example of an H2TU-R 31-day DS1 performance screen as viewed from the line unit. In addition, there are 48-hour, 25-hour, and current statistic screens for the DS1 interface for the H2TU-R as well as the H2TU-C. Table 15 on page 35 describes the acronyms used in the performance history screens.

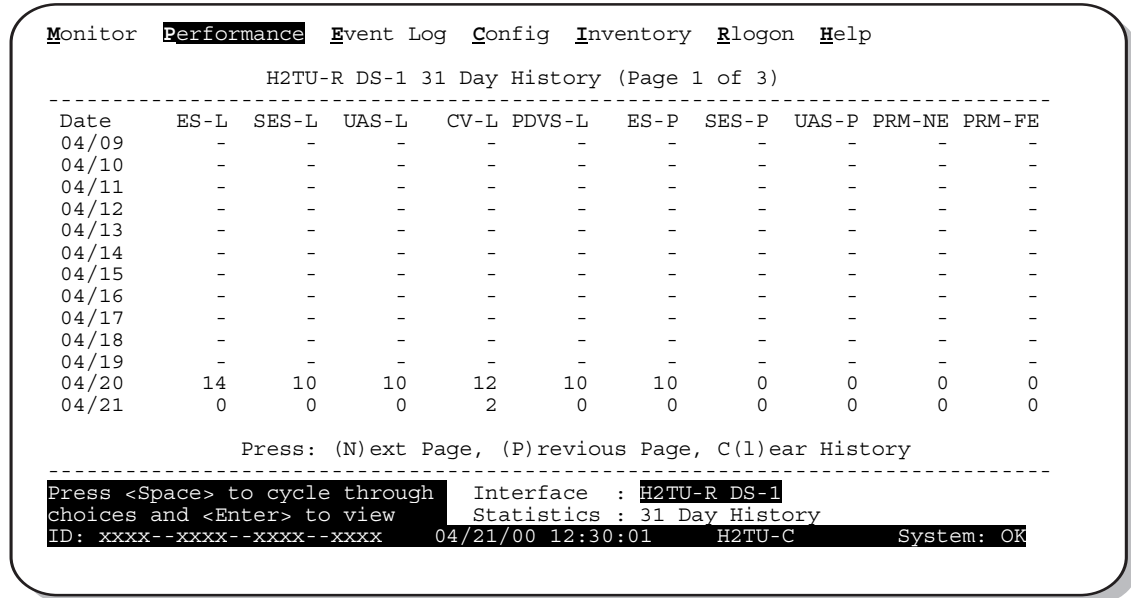


Figure 18. H2TU-R DS1 31-day Performance History

Table 15. Error Acronyms Used on the DS1 Performance History Screens

Error Acronym	Description	Error Acronym	Description
ES-L	Errored Seconds - Line Seconds with BPV ≥ 1 .	SES-P	Severely errored seconds - Path Seconds with SES or CRC(ESF) ≥ 320 or FE ^(d) (SF) ≥ 8 ($F_T + F_S$).
SES-L	Severely errored seconds - Line Seconds with BPV plus EXZ ≥ 1544 or LOS ≥ 1 .	UAS-P	Unavailable seconds - Path A second of unavailability based on SES-P or AIS ≥ 1 .
UAS-L	Unavailable seconds - Line Seconds with LOS ≥ 1 .	PRM-NE ^(a)	Performance Report Monitoring - Near End The PRM from CPE indicates errors, and the signal received from the network at the remote is error-free.
CV-L	Code Violation - Line Total BPV count.	PRM-FE ^(a)	Performance Report Monitoring - Far End The PRM from the network indicates errors, and the signal received from the CPE is error-free.
PDVS-L	Pulse Density Violation Seconds - Line Seconds with excessive zeroes (AMI = 16 zeroes, B8ZS = 8 zeroes).	B8ZSS ^(b)	B8ZS Monitored Seconds Seconds with B8ZS detection when AMI option is active.
ES-P	Errored Seconds - Path Seconds with SEF ^(c) , CRC (ESF) or FE ^(d) (SF) ≥ 1 .	MSEC ^(b)	Monitored Seconds of the current (15 minute/1 hour/1 day) screen.

(a) Only appears on H2TU-R Performance History screens.

(b) Appears on the DS1 Current Statistics screens.

(c) Severely Errored Frame—Two or more frame bit errors occurring in a 0.75 ms interval for SF or a 3 ms interval for ESF.

(d) FE is a frame bit error.

Performance History at the HDSL2 Interface

Figure 19 is an example of an H2TU-C 31-day HDSL2 performance screen as viewed from the line unit. In addition, there are 48-hour, 25-hour and current statistic screens for the HDSL2 interface at the H2TU-C as well as at the H2TU-R. Table 16 describes the acronyms used in the performance history screens.

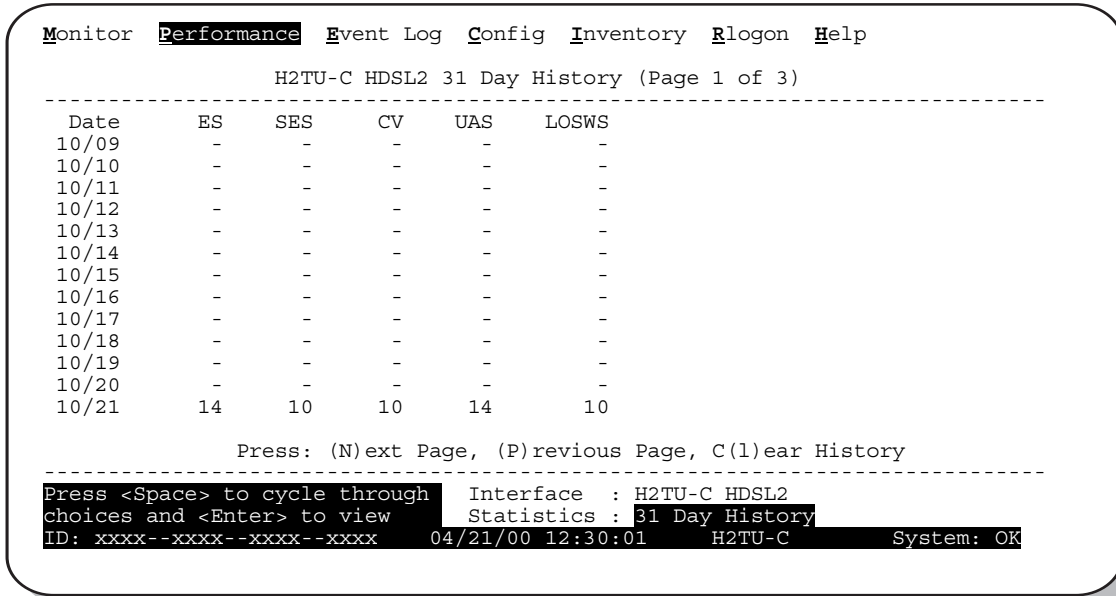


Figure 19. H2TU-C HDSL2 31-day Performance History

Table 16. Error Acronyms Used on the HDSL2 Performance History Screens

Error Acronym	Description
ES	Errored seconds Seconds with HDSL2 CRC ≥ 1 or LOSW ≥ 1
SES	Severely errored seconds Seconds with HDSL2 CRC ≥ 50 or LOSW ≥ 1
UAS	Unavailable seconds Based on 10 contiguous SES occurrences
CV	Code Violation Total count of HDSL2 CRC errors
LOSWS	Loss of Sync Word Second Seconds with LOSW ≥ 1

USING THE PERFORMANCE SCREENS TO VIEW ALARM DATA

To access the alarm history screens:

- 1 Press **P** to select the Performance menu.
- 2 Press the **SPACEBAR** to select an interface (**H2TU-C DS1**, **H2TU-R DS1**, **H2TU-C HDSL2** or **H2TU-R HDSL2**), then press **ENTER**.
- 3 Press the **SPACEBAR** until **Alarm History** is selected, then press **ENTER**.
 - Press **N** or **P** to page through the alarm history screens.
 - Press **L** to clear the selected alarm history screen.

Alarm History at the DS1 Interface

The Alarm History screen reports DS1 statistics for the H2TU-C, shown in [Figure 20](#) below, and the H2TU-R, shown in [Figure 21 on page 38](#), on a continuous basis. The types of alarms reported are described in [Table 17 on page 38](#). Current alarms are shown in reverse video.

Alarm	First	Last	Status	Count
SPTE			OK	0
SPTF			OK	0
LLOS	04/16/00 00:00	04/16/00 00:45	ALARM	12
LAIS			OK	0
DBER	04/16/00 00:37	04/16/00 00:45	OK	7

Press: C(1)ear Alarm History

Press <Space> to cycle through choices and <Enter> to view Interface : H2TU-C DS-1
 Statistics : Alarm History

Figure 20. H2TU-C DS1 Alarm History Screen

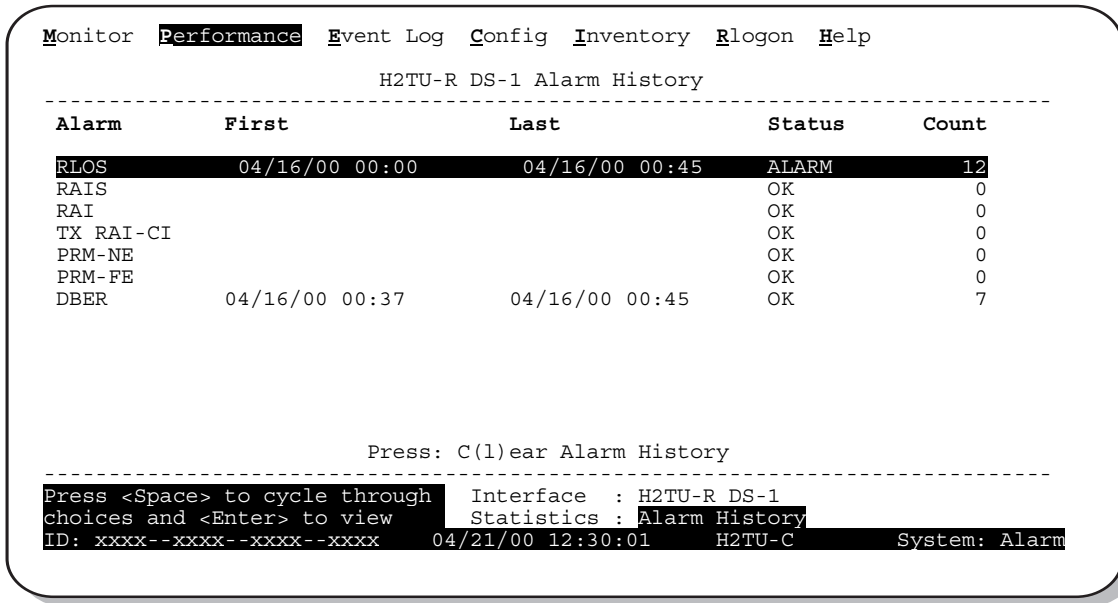


Figure 21. H2TU-R DS1 Alarm History Screen

Table 17. DS1 Alarm Descriptions

Screen Alarm	Front-panel Alarm	Description
H2TU-C DS1 Alarms (see Figure 20 on page 37)		
RLOS ^(a)	RLOS	Remote Loss of Signal— Loss of the H2TU-R DS1 input signal.
RAIS	RAIS	Alarm Indication Signal—AIS is being detected at the H2TU-R DS1 input port. By default (see Figure 24 on page 44) AIS-CI ^(a) is sent toward the network.
RAI	RRAI	Remote Alarm Indication—Indicates an RAI alarm (yellow) from the CPE with errors from the line unit or network.
TX RAI-CI	TRCI	Transmit RAI-CI— Customer Installation—Upon reception of an RAI (yellow alarm) from the CPE, the H2TU-R sends a RAI-CI toward the network if the network signal received at the H2TU-R is clear. If the network signal is impaired (LOS, AIS or LOF), then the RAI is automatically passed on to the network. This is applicable to SF or ESF framing. In an all SF environment, RACI must be enabled to convert SF RAI to SF RAI-CI.
PRM-NE	PRMN	Performance Report Monitoring - Near End—The count of the PRM-NE register at the H2TU-R exceeds the 10 ⁻⁶ BER threshold at 648 events since 12:00:00 AM.
PRM-FE	PRMF	Performance Report Monitoring - Far End—The count of the PRM-FE register at the H2TU-R exceeds the 10 ⁻⁶ BER threshold at 648 events since 12:00:00 AM.
DBER	DBER	Bit Error Rate—The DS1 BER has exceeded the built-in 24-hour threshold limits of approximately 10 ⁻⁶ .
H2TU-R DS1 Alarms (see Figure 21 above)		
SPT E	Split Equipment	A test mode initiated by the HMU which splits the AUX port's DSX-1 payload and sends it to the MUX port.
SPT F	Split Facilities	A test mode initiated by the HMU which splits the facility DS1 payload from the AUX port #1 and sends it to the MUX port.

Table 17. DS1 Alarm Descriptions (Cont.)

Screen Alarm	Front-panel Alarm	Description
LLOS ^(a)	LLOS	Local Loss of Signal—Loss of the H2TU-C DSX-1 input signal.
LAIS	LAIS	Local Alarm Indication Signal—Indicates an AIS (all ones) pattern is being transmitted from the local DS1 output port.
DBER	DBER	Bit Error Rate—The DS1 BER has exceeded the built-in 24-hour threshold limits of approximately 10^{-6} .

(a) AIS-CI is a modified AIS alarm pattern. Equipment not suited to detect AIS-CI still detects this signal as an AIS. AIS-CI is sent toward the network indicating that an LOS (RLOS) or AIS (RAIS) has been received from the CPE.

Alarm History at the HDSL2 Interface

Figure 22 shows the H2TU-C HDSL2 alarm history and Table 18 describes the alarms.

```

Monitor Performance Event Log Config Inventory Rlogon Help
H2TU-C HDSL2 Alarm History
-----
Alarm      First           Last           Status        Count
-----
MTAE                      OK             0
MTAF                      OK             0
ALOSW      04/16/00 00:00 04/16/00 00:45 ALARM         12
MAL                      OK             0
LA                      OK             0
HBER      04/16/00 00:37 04/16/00 00:45 OK             7
SHORT                      OK             0
GND                      OK             0
OPEN                      OK             0
-----
Press: C(1)ear Alarm History
-----
Press <Space> to cycle through choices and <Enter> to view
ID: xxxx--xxxx--xxxx--xxxx 04/21/00 12:30:01 H2TU-C System: Alarm
Interface : H2TU-C HDSL2
Statistics : Alarm History

```

Figure 22. H2TU-C-319 HDSL2 Alarm History Screen

Table 18. HDSL2 Alarm Descriptions

Screen Alarm	Front-panel Alarm	Description
MTAE	MTAE	Metallic Test Access Equipment—The H2TU-C is in its MTA/LOSW test state.
MTAF	MTAF	Metallic Test Access Facility— The H2TU-C is in its MTA/LOSW test state.
LOSW	LOSW	Loss of Sync Word—The HDSL2 loop has lost synchronization.
MAL	MAL	Margin—The margin on the HDSL2 loop has dropped below the minimum threshold value set for the system.
LA	LA	Loop Attenuation—The attenuation on the HDSL2 loop has exceeded the maximum value set for the HDSL2 loop attenuation threshold.
HBER	HBER	Block Error Rate—The HDSL2 BER has exceeded the set threshold limits of 10 ⁻⁶ or 10 ⁻⁷ .
POWER FEED SHORT ^(a)	SHRT	Indicates a short between the Tip and Ring of the HDSL2 pair.
POWER FEED GND ^(a)	GND	The HDSL2 loop is grounded.
POWER FEED OPEN ^(a)	OPEN	Indicates a line power open condition.

(a) Appears only on the H2TU-C HDSL2 interface.

USING THE EVENT LOG TO TRACK SYSTEM EVENTS

To view a running log of system events, press **E** to select the Event Log. The Event Log displays the date and time of the 100 most recent events (most recent displayed first) and provides a description of each event. [Table 19 on page 41](#) lists the event log messages.

Do one of the following:

- Press **N** or **P** to page through the event log.
- Press **T** to return to the top of the log.
- Press **L** to clear the event log.



Figure 23. System Event Log

Table 19. *Event Log Entry Messages List*

Event Log Messages
Any DS1 Alarm History reset
Any DS1 PM register reset
Any HDSL2 Alarm History reset
Any HDSL2 PM register reset
Any Loop Down (any segment)
Any Loop Up (any segment)
Any provisioning option change: <provisioning mnemonic>: changed from <old> to <new>
CPE DBER alarm (1 day threshold crossed of any PM data except PRM-NE or PRM-FE)
CPE DS1 AIS begins / ends
CPE DS1 LOS begins / ends
CPE PRM-NE BER alarm (<i>at the remote only</i> : 1 day threshold crossed of PRM-NE: trouble on CPE receive)
Current statistics reset
Event Log reset
H2TU-R Power up / down
HDSL2 DC pair open begins/ends on any segment
HDSL2 Ground fault begins/ends on any segment
HDSL2 HBER alarm (threshold crossed) on any segment.
HDSL2 loop attenuation (threshold crossed) on any HDSL2 I/F
HDSL2 margin alarm (threshold crossed) on any HDSL2 I/F
HDSL2 unavailability begins / ends on any segment
Master zero reset
NTWK DBER alarm (1 day threshold crossed of any PM data)
NTWK DS1 LOS begins / ends
NTWK PRM-FE BER alarm (<i>at the remote only</i> : 1 day threshold crossed of PRM-FE: trouble on NTWK far end)
NTWN DS1 AIS begins / ends
Power Feed Open begins / ends
Power Feed Short begins / ends
RAI begins / ends
LRAI begins / ends (RAI-CI sent from the remote toward the network)

TESTING

This section provides information about front-panel system alarms, LOS/AIS response, the OCT55 test procedure, and loopback testing.

FRONT-PANEL SYSTEM ALARMS

Table 20 lists H2TU-C-319 alarm states in order of priority as they appear on the front panel. These alarms correlate with the alarms displayed on the alarm history screens, as described in “Using the Performance Screens to View Alarm Data” on page 37, however, the screens provide a more detailed analysis. More than one alarm condition can exist at any given time, but only one message can be displayed on the front panel. For multiple alarms, only the highest priority alarm displays.

Table 20. Front-Panel System Alarms Summary

Front-Panel Message ^(a)	Alarm	Description	To Inhibit:
POWER FEED SHRT ^(b)	Short	A short exists between the Tip and Ring of the HDSL2 pair.	Cannot be inhibited.
POWER FEED GND ^(b)	Ground	The HDSL2 loop is grounded.	Cannot be inhibited.
POWER FEED OPEN ^(b)	Open	A line power open condition exists.	Cannot be inhibited.
LOSW ^(b)	Loss of Sync Word ^(c)	The HDSL2 loop has lost synchronization.	Cannot be inhibited.
MTA	Metallic Test Access	The H2TU-C is in its MTA/LOSW test state.	Sets MTA option to disabled.
SPT	Split Equipment	A test mode initiated by the HMU which splits the AUX port's DSX-1 payload and sends it to the MUX port.	Sets ADS1 option to MUX or CTHR.
SPTF	Split Facilities	A test mode initiated by the HMU which splits the facility DS1 payload from the AUX port #1 and sends it to the MUX port.	Sets ADS1 option to MUX or CTHR.
LLOS ^(b)	Local Loss of Signal	Loss of the DSX-1 input signal.	Cannot be inhibited.
RLOS ^(b)	Remote Loss of Signal	Loss of the H2TU-R DS1 input signal.	Cannot be inhibited.
LAIS	Local Alarm Indication Signal	Indicates an AIS (all ones) pattern is being transmitted from the local DS1 output port.	Cannot be inhibited.
RAIS	Alarm Indication Signal at the H2TU-R	Indicates an AIS (all ones) pattern is being received at the H2TU-R DS1 input port.	Cannot be inhibited.
RRAI	Remote Alarm Indication	Remote Alarm Indication at the H2TU-R Indicates an RAI alarm (yellow) from the CPE with errors from the line unit or network.	Cannot be inhibited.
LRAI	Remote Alarm Indicator - Customer Installation	Indicates an RAI alarm (yellow) from the CPE with an error-free signal from the line unit or network.	Cannot be inhibited.
TRCI	Remote Alarm Indication - Customer Installation	Upon reception of an RAI (yellow alarm) from the CPE, the H2TU-R sends RAI-CI toward the network if the network signal received at the H2TU-R is clear. If the network signal is impaired (LOS, AIS or LOF), then the RAI is passed on to the network unaltered.	Cannot be inhibited.
MAL ^(b)	Margin Alarm	The margin on the HDSL2 loop has dropped below the minimum threshold value set for the system.	Set the Margin Alarm Threshold option to 0 (zero).
LA ^(b)	Loop Attenuation	The attenuation on the HDSL2 loop has exceeded the maximum value set for the HDSL2 loop attenuation threshold.	Set the HDSL2 Loop Attenuation Threshold option to zero.
DBER	DS1 Bit Error Rate	The DS1 BER has exceeded the set 24-hour threshold limit of approximately 10^{-6} .	Select DIS for the DBER system option.
HBER ^(b)	HDSL2 Block Error Rate	The HDSL2 BER has exceeded the set threshold limits of 10^{-6} or 10^{-7} .	Select NONE for the HBER system option.

Table 20. *Front-Panel System Alarms Summary (Cont.)*

Front-Panel Message ^(a)	Alarm	Description	To Inhibit:
PRMN	Performance Report Messaging - Near End	H2TU-R PRM-NE BER threshold has been exceeded.	Set DBER threshold to DIS.
PRMF	Performance Report Messaging - Far End	H2TU-R PRM-FE BER threshold has been exceeded.	Set DBER threshold to DIS.

(a) The message, ALRM, displays prior to any alarm message.

(b) Only these alarms assert the System Alarm bus on Pin H of the card edge connector, if the alarm system is set to ENABLE.

(c) When the HDSL2 loop loses sync word (LOSW), a system alarm condition exists. The H2TU-C-319 enters the acquiring mode, the front panel status LED flashes red, and the ACQ or SIG message displays instead of the ALRM message.

Alarm Option for the Digital Loop Carrier Feed

To improve HiGain compatibility with the switch-to-protect features used in the Digital Loop Carrier (DLC) feeder applications, the H2TU-C-319 has an Alarm Pattern (ALMP) option that allows you to select either an AIS or LOS DS1 output payload for the following alarms:

- LOSW on any loop
- DS1 LOS

Retiring System Alarms

To retire a system alarm, press the SEL button and execute an Alarm Cut Off (ACO). An ACO turns the alarm off and replaces the ALRM message with an ACO message. The second part of the ALRM message, which defines the cause of the alarm, remains. Both parts of the message remain until the alarm condition clears or another higher priority alarm occurs.

Remote LOS/AIS Response

Figure 24 shows the different ways the H2TU-R can respond to the network, depending on the configuration of the TLOS, NLBP, FT1, ALMP, and NAIS configuration options described in Table 5 on page 18 and Table 6 on page 19.

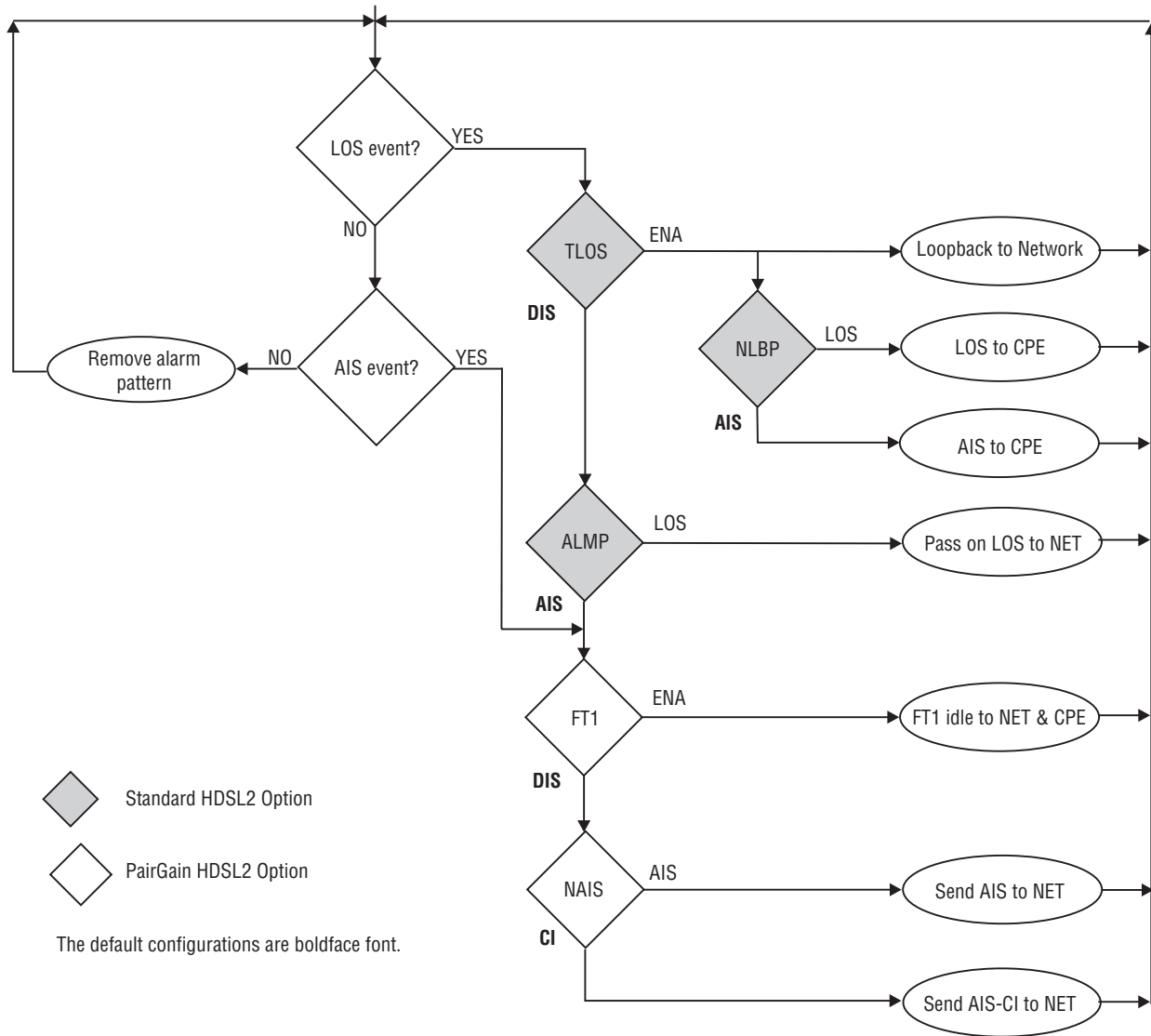


Figure 24. H2TU-R LOS/AIS Response Priorities

OCT55 TEST PATTERN WITH AMI LINE CODE

The OCT55 test pattern can be used in unframed mode to stress the system and verify data integrity. In an SF or ESF framing mode, excessive zero anomalies may occur, which causes the H2TU-C to report ES, SES and UAS errors according to ANSI T1.231-1997.

LOOPBACK OPERATION

HiGain has a family of loopback options for analyzing circuit functionality. The loopback signal is transmitted and returned to the sending device for comparison. This allows you to verify the integrity of the HDSL2 channels to the H2TU-C, the H2TU-C DSX-1 interface and the DS1 channels to the customer. Loopback options include:

- Generic Loopback (GNLB) options, including the SmartJack (SMJK) option, as described in [Table 21 on page 46](#)
- Special Loopback (SPLB) options, as described in “[Special Loopback Commands](#)” on [page 47](#) and the following command tables:
 - Addressable Repeater Loopback commands: A2LB, as described in [Table 22 on page 52](#)
 - Addressable Repeater Loopback commands: A3LB, A4LB, as described in [Table 23 on page 54](#)

Loopback commands can be initiated by:

- Selecting the loopback type using the MODE and SEL buttons on the H2TU-C front panel or the Manual Loopback button on the H2TU-R
- Selecting the loopback type from the Monitor menu when connected to the craft port of the H2TU-C or H2TU-R
- Entering the loopback code into the test equipment connected to the H2TU-C or H2TU-R



HiGain HDSL2 only supports one active loopback when initiated from in-band commands or from the loopback screens. However, SmartJack loopback can be present along with one other network loopback.

In addition, whenever the loopback button on the H2TU-R is used to initiate a loopback, both NREM and CLOC are activated which loops the H2TU-R in both directions.

Generic Loopback Commands

The HiGain HDSL2 Generic Loopback (GNLB) commands allow you to use inband codes to loop up either NLOC (4-in-7) or NREM (3-in-7) toward the network. In addition, these inband codes loop up CREM (6-in-7) or CLOC (5-in-7) toward the customer. Either loopup condition can be terminated (looped down) with the 3-in-5, SMJK loop-down code. All inband codes must be present for at least 5 seconds before the HiGain HDSL2 system responds. HiGain HDSL2 also supports NRGx regenerator loopbacks to the network and CRGx regenerator loopbacks toward the customer. TLOS is a logic loopback caused by loss of the DS1 input from the CI.

[Figure 25](#) summarizes the available loopbacks in the system, and [Table 21 on page 46](#) summarizes the HiGain HDSL2 generic loopback commands. “[GNLB Test Procedures](#)” on [page 50](#) describes the test procedures when using the GNLB mode.

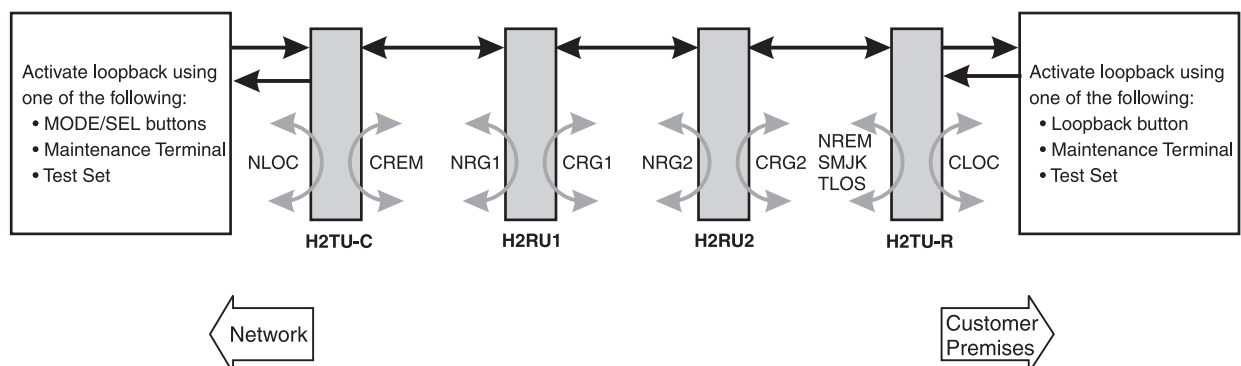


Figure 25. Loopback Summary

Table 21. Summary of HiGain HDSL2 Loopback Codes and Activation Methods

Loopback	Code	Description	Method of Activation		
			Test Set	Craft Port	MODE/SEL
NLOC	1111000 4-in-7	DSX-1 signal is looped back to the network at the H2TU-C.	X	X	X
NRG1	110000 2-in-6	DSX-1 signal is looped back to the network at the regenerator 1.	X	X	X
NRG2	111000 3-in-6	DSX-1 signal is looped back to the network at the regenerator 2.	X	X	X
NREM	1110000 3-in-7	DSX-1 signal is looped back to the network at the H2TU-R.	X	X	X
CLOC	1111100 5-in-7	Signal from the customer is looped back to the customer at the H2TU-R.	X	X	X
CRG1	111100 4-in-6	Signal from the customer is looped back to the customer at regenerator 1.	X	X	X
CRG2	111110 5-in-6	Signal from the customer is looped back to the customer at regenerator 2.	X	X	X
CREM	1111110 6-in-7	Signal from the customer is looped back to the customer at the H2TU-C.	X	X	X
SMJK LpUp (PL)	11000 2-in-5	SmartJack Loopup or NID payload (PL) code. Invokes H2TU-R loopback toward network.	X		
SMJK LpUp (ESF-DL)	1111-1111- 0100-1000	SmartJack Loopup or NID (ESF-DL) code. Invokes H2TU-R loopback toward network.	X		
SMJK LpDn (PL)	11100 3-in-5	SmartJack Loopdown or NID payload (PL) code. Removes SMJK, NLOC, NREM, CLOC, CREM, CRGx, and NRGx.	X		
SMJK LpDn (ESF-DL)	1111-1111- 0010-0100	SmartJack Loopdown or NID (ESF-DL) code. Removes SMJK, NLOC, NREM, CLOC, CREM, CRGx, and NRGx.	X		



HiGain HDSL2 systems feature the SmartJack option, which can emulate a Network Interface Device (NID) for the purpose of loopback testing of the HiGain HDSL2 circuit. SMJK and NREM loopbacks perform the same functions but their initiation differs. SMJK indicates that the loopback was initiated by the 2-in-5 inband command. NREM, on the other hand, is initiated by the 3-in-7 inband command or by a command issued from the maintenance terminal or the MODE and SEL buttons.

Use the inband commands to enable or disable the SMJK loopback options. The H2TU-C-319 system setting is normally enabled to recognize all inband SmartJack loopback commands.

Special Loopback Commands

In addition to the GNLB loopback command mode, a HiGain HDSL2 system can be configured for one of three special loopback command modes. These are selected from the maintenance terminal System Settings screen (see [Table 5 on page 18](#)) or by using the MODE and SEL buttons (see [Figure 26 on page 51](#)). Once a loopback mode is activated, other loopback commands can be sent by a test set connected to the craft port of the H2TU-C or H2TU-R (see [Table 22 on page 52](#) and [Table 23 on page 54](#) for list of SPLB commands).

A2LB through A4LB are special, addressable, repeater loopback modes that are supported by the H2TU-C-319. These loopback modes provide the HiGain HDSL2 system with sophisticated maintenance and troubleshooting tools. A2LB is patterned after the Teltrend addressable T1 repeater loopbacks. A3LB and A4LB are patterned after the Wescom addressable T1 repeater loopbacks.

All three SPLBs have been enhanced to handle the specific requirements of the following HiGain HDSL2 customers:

- A2LB (Teltrend) = Southwestern Bell
- A3LB (Wescom) = New England Telephone, Bell Atlantic
- A4LB (Wescom Mod 1) = New York Telephone

A2LB can be configured to do one of the following:

- Block the arming code (after 2 seconds) from exiting the H2TU-C into the network, and replace it with the AIS code.
- Unblock the AIS code by executing the Far-End Activate code.

A3LB differs from A4LB in that A3LB supports the additional (1-in-6) SMJK loopback command.



A HiGain HDSL2 system may take longer than normal to respond to inband loopback commands when its framing mode is set to UNFR and the inband commands are set in either an SF or ESF mode. The frame bits override the command bits and cause errors in the command sequence. These errors cause the HiGain HDSL2 system to reject some sequences.

Manual Loopback Session

A manual loopback session allows you to select any one of the HiGain HDSL2 loopbacks listed in [Table 21 on page 46](#) with the exception of SmartJack loopbacks, which can only be issued by inband commands.

Setting the Loopback Time-out Option

Before initiating a loopback session, verify that the Loopback/MTA Time-out parameter is set to the desired setting.

- 1 Use the MODE and SEL buttons as described in [“Setting Options through MODE and SEL” on page 10](#).

The Loopback Time-out parameter is also user-selectable from the System Settings screen when using a maintenance terminal.

- 2 Select the desired setting:
 - NONE (time-out disabled)
 - 20 minutes
 - 60 minutes
 - 120 minutes (default setting)

Activating Manual Loopback Mode



With the exception of SmartJack, any of the HiGain HDSL2 loopbacks can be executed using the MODE and SEL buttons.

When executing a manual loopback session using the MODE and SEL buttons:

- The next loopback option can be displayed by pressing the MODE button, however, the previously activated loopback remains active until the SEL button is pressed, which activates the new loopback.
- If neither button is pressed for a period of 30 seconds and no loopback is in effect, the manual loopback session terminates and the display returns to normal mode.
- If any loopback is in effect, the 30-second time-out is inhibited. The active loopback and the manual loopback session continue until the loopback times out in accordance with the LBTO setting.
- Only the SMJK loopback can exist with other network loopbacks at any given time.
- If there is an active loopback, pressing the MODE and SEL buttons for 3 or more seconds terminates any active loopback, ends the manual loopback session and returns the display to normal mode.

To initiate a manual loopback session:

- 1 Press both the MODE and SEL buttons on the front panel for at least 3 seconds. The following message appears on the front-panel display:
MAN LPBK NLO?
- 2 Press SEL to activate NLOC. The display changes to MAN LPBK NLOC.
- 3 Press MODE to advance to the next available loopback (CRE?, NRE?, CLO?, NR1?, CR1?, NR2?, CR2?).
- 4 Press SEL to activate the selected loopback. The previous loopback is terminated.

Once a loopback is selected and activated, the loopback stays active until it times out (based on the LBTO setting). When a loopback times out, the display then returns to the normal display mode.

You can terminate loopbacks manually and exit the MAN LPBK mode by simultaneously pressing the MODE and SEL buttons for 3 or more seconds. If no loopback is active, the MAN LPBK mode automatically terminates after 30 seconds.

All loopbacks can be initiated by inband commands in the DS1 payload or by a command from the HiGain HDSL2 system (front-panel buttons or maintenance screen selections). Therefore, whenever a loopback is active, the method by which it was activated is indicated in the Loopback and Status screens by the annotation HG (HiGain) or PL (Payload) adjacent to the identified loopback. For example, NREM-HG indicates that the loopback was initiated by the HiGain HDSL2 system.



SMJK loopback commands are only activated by inband commands.

ACTIVATING MANUAL METALLIC TEST ACCESS

A Metallic Test Access (MTA) test mode can be initiated with the front panel MODE and SEL buttons in the same way the manual loopbacks can be initiated. This choice is presented at the end of the MAN LPBK sequence of choices.

To initiate a manual MTA session:

- 1 Press both the MODE and SEL buttons on the front panel for at least 3 seconds. The following message appears on the front-panel display:
MAN LPBK NLO?
- 2 Press MODE to advance to the last choice in the following sequence: CRE?, NRE?, CLO?, NR1?, CR1?, NR2?, CR2?, MTA?.
- 3 Press SEL to activate the MTA test mode. This terminates any active loopbacks.
- 4 Once selected, the display changes to MAN MTA.

Once the MTA mode is selected and activated, it remains active until it times out based on the LBTO setting. When it times out, the display then returns to the normal display mode.

You can also manually terminate the MTA state and exit the MAN LPBK mode by simultaneously pressing the MODE and SEL buttons for 3 or more seconds. If no loopback or MTA is active, the MAN LPBK mode automatically terminates after 30 seconds.

LOOPBACK TEST PROCEDURES

The following sections provide step-by-step test procedures for verifying the integrity of the HDSL2 channels at every module location as well as the DS1 channels to the customer and the local DSX-1 interface.

General Troubleshooting Tips

If trouble is encountered on the DSX-1 interfaces of the H2TU-C, verify that the:

- H2TU-C is making a positive connection with its shelf connector.
- H2TU-C internal equalizer is set to the correct distance range, as shown in [Table 5 on page 18](#). All equalizers should be set to the distance from the DSX-1 to the shelf.

The DS1 transmit and receive sides of the MUX DSX-1 port have splitting access jacks and miniature, 210-series, bridging jacks as shown in [Figure 2 on page 4](#). Connecting one cable between the two bridging jacks and another between the two LINE jacks splits the IN and OUT and creates metallic loopbacks toward both the DSX-1 and the H2TU-C-319. If separate plugs are inserted into both LINE jacks with the other end disconnected, the BRG jacks can be used to send and receive test patterns toward the DSX-1. The AUX DSX-1 port has no resident test jack access.



The equalizer settings only apply to the specific DSX-1 port selected by the ADS1 option, MUX or AUX. The unselected port defaults to an equalizer setting of zero.

GNLB Test Procedures

Figure 26 on page 51 is a graphical representation of the various loopback configurations with the associated GNLB commands shown. Table 21 on page 46 details the command descriptions.

To perform the GNLB loopback test procedure:

- 1 Have the CO tester send the NREM (3-in-7) inband loopup code for 5 seconds. You should be able to observe the NREM message on the front-panel display. The Status LED on the front panel should be green, and the loopback mode should also be identified on the Span Status screen.
- 2 Have the CO tester transmit a DS1 test signal toward the H2TU-C and verify that the returned (looped) signal to the test set is error-free.
- 3 If step 2 fails, have the CO tester transmit the (3-in-5) inband loopdown code.
- 4 Have the CO tester send the NLOC (4-in-7) inband loopup for 5 seconds. You should be able to observe the NLOC message on the front-panel display. The Status LED on the front panel should be yellow, and the loopback mode should also be identified on the Span Status screen.
- 5 Repeat Step 2. If the test passes, the problem is in the downstream direction. If it fails, the problem is in the upstream direction.

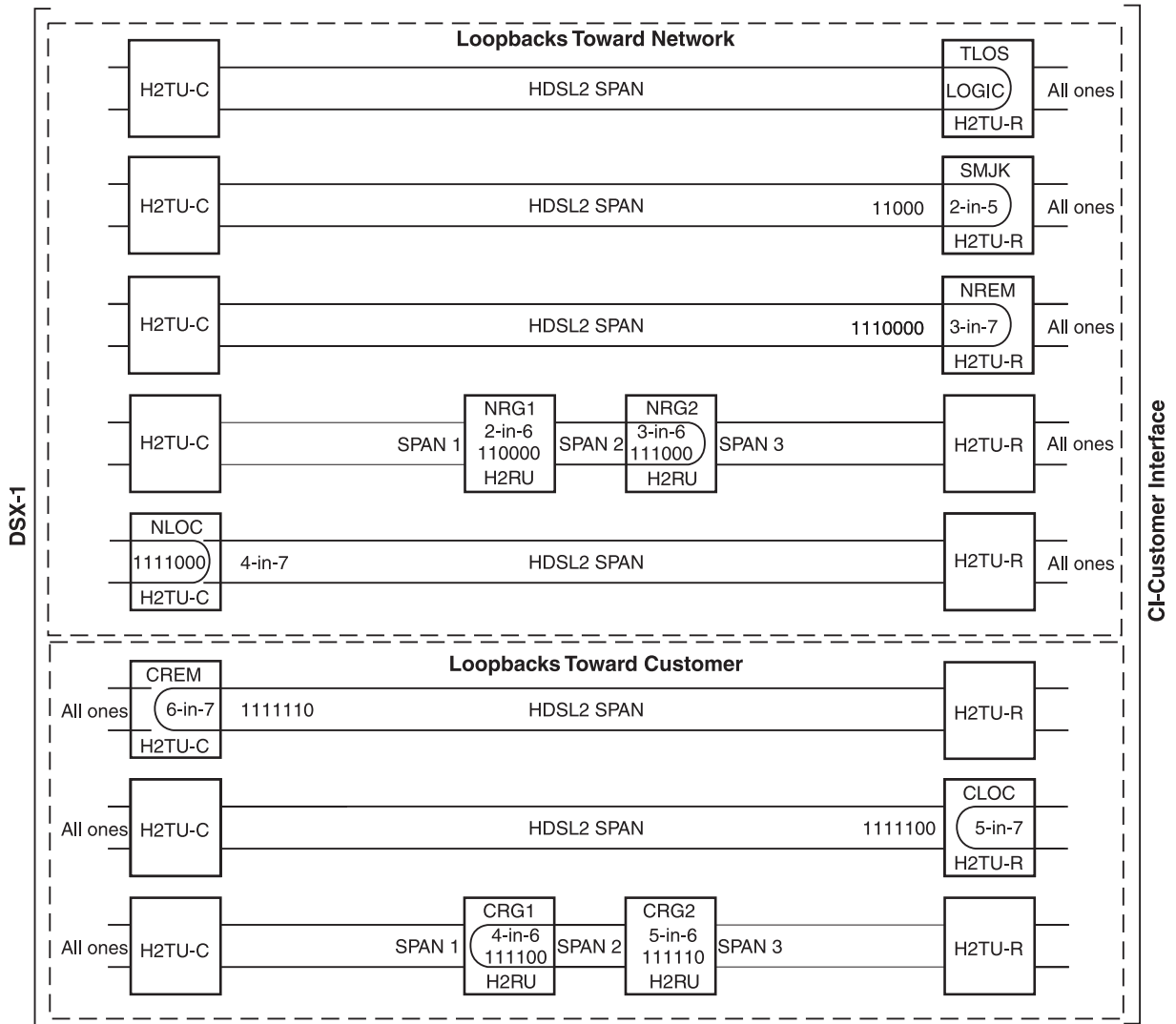


Figure 26. Loopback Modes

A2LB Test Procedures

Using the codes listed in [Table 22](#), a network tester can activate NLOC, NRG or NREM loopbacks (or SMJK, if enabled). A tester at the customer premises can activate CLOC, CRG or CREM loopbacks. All loopbacks shown in [Table 22](#) can also be initiated from the H2TU-C front-panel MODE and SEL buttons (see “[Setting Options through MODE and SEL](#)” on page 10). Information specific to HiGain HDSL2 regenerators is shown in bold type.

Table 22. *Addressable Repeater Loopback Commands (A2LB)*

Name	Description	Binary Code ^(a) (Hexadecimal Equivalent)
ARMING or NI LPBK (inband)	Arming code	11000-11000 ...
ARMING or NI LPBK (ESF Data Link)	Arming code	1111-1111-0100-1000 (FF48)
IR LPDN or DISARM (inband)	Disarming code	11100-11100 ...
IR LPDN or DISARM (ESF Data Link)	Disarming code	1111-1111-0010-0100 (FF24)
IOR LPBK (NLOC and CREM) 230-232 bit errors 229-231 bit errors ^(b)	H2TU-C loopup	1101-0011-1101-0011 (D3D3)
ILR-1 LPBK (NRG1 and CRG1 10 bit errors) ^(b)	Regenerator-1 loopup	1100-0111-0100-0001 (C741)
ILR-20 LPBK (NRG2 and CRG2 200 bit errors)	Regenerator-2 loopup	1100-0111-0101-0100 (C754)
ILR-2 LPBK (NREM and CLOC 20 bit errors)	H2TU-R loopup	1100-0111-0100-0010 (C742)
IR LPDN	Loopdown (H2TU-C, H2RU, or H2TU-R)	1001-0011-1001-0011 (9393)
IR QUERY LPBK	Query loopback	1101-0101-1101-0101 (D5D5)
IR ALTERNATE QUERY LPBK	Alternate query loopback	1101-0101-1110-1010 (D5EA)
TIME-OUT OVERRIDE	Loopback time-out override	1101-0101-1101-0110 (D5D6)
FAR END NI ACTIVATE	Unblock AIS	1100-0101-0101-0100 (C554)
IOR POWER DOWN (H2TU-C) ^(c)	Removes HDSL2 line power	0110-0111-0110-0111 (6767)

(a) The left-most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} BER on the facility. The entire arming and loopback sequence can also be initiated at the remote H2TU-R location.

(b) The H2TU-R identifies CREM (and the H2TU-C identifies NLOC) with 231 bit errors, including the frame bits. When framed data is being sent in the Auto framing mode, the number of the 231 bit errors detected by the test set varies from 229 to 231, depending on whether or not the test set counts frame errors as bit errors, and on the number of frame bits contained in the block of 231 error bits. The H2TU-R and H2TU-C generate this bit pattern in a series of discontinuous bursts containing 20-bit errors each, including frame bits. Those test sets that do not count frame error bits as data bit errors will indicate fewer bits than the H2TU-R and H2TU-C transmit for a CI and NI loopback.

(c) The IOR Power Down code must remain present for the duration of the power down mode. When this code is removed, the HiGain HDSL2 system returns to its normal unlooped and unarmed state.

To perform the A2LB test procedures:

- 1 Send the inband Arming and NI LPBK code 11000 to the H2TU-C for at least 5 seconds.
- 2 Monitor the output of the H2TU-C for the return of the pattern. Return of the pattern indicates one of the following:
 - The H2TU-R has looped up, if the SMJK Loopback option is enabled.
 - An external NID has looped up, if the SMJK Loopback option is disabled, and the H2TU-C and H2TU-R have been armed.

- 3 Verify, if possible, that the H2TU-R Loopback LED is either flashing yellow at 4-second intervals (indicating that the system is armed), or is a steady yellow (indicating that it is both armed and in SMJK loopback). The H2TU-C Status LED also flashes yellow when the system is armed.



If the Arming code is not returned after 5 seconds, the system may be armed but there is no active loopback.

- 4 Once armed, the H2TU-C can be looped back by sending Intelligent Office Repeater (IOR) LPBK activation code 1101-0011-1101-0011 (D3D3) for at least 5 seconds. You should observe the following activation response pattern in the order presented:
 - a 2 seconds of AIS (all ones pattern)
 - b 2 seconds of returning data pattern
 - c 231 logic errors, including the frame bit, occurring in the returned pattern comprising:
 - 10 errors, if ILR-1 (Regenerator 1) was sent
 - 200 errors, if ILR-20 (Regenerator 2) was sent
 - 20 errors, if ILR-2 (H2TU-R) was sent
 - d Normal looped data

This error pattern repeats every 20 seconds as long as the IOR loopback pattern is being sent. This also applies to ILR, Time-out Override, and Query commands.



Some Intelligent Repeater (IR) test sets do not count frame errors as bit errors when the test pattern is framed and the H2TU-C-319 is set to the Auto framing mode. To improve compatibility with those test sets, the H2TU-C generates 200 (NRG2 and CRG2) and 231 (NLOC and CREM) ID bit errors. As a result, the H2TU-C may indicate one more or one less bit error, depending on the test set type and the number of frame bits contained in the block of errored bits. To avoid this uncertainty, ADC recommends sending unframed IR commands.

The H2TU-C-319 is now in logic loopback if the IOR NLOC loopback command was sent. The Time-out Override command or a Loopdown command can override the selection made for the loopback time-out, as described in “[Setting the Loopback Time-out Option](#)” on page 47. If the Time-out Override code 1101-0101-1101-0110 (D5D6) is received after activating a loopback, then the automatic timed expiration of the loopback is inhibited. If this Time-out Override is sent, then the only way to loop the H2TU-C down is to do one of the following:

- Issue the IR (Intelligent Repeater) LPDN (loopdown) code 1001-0011-1001-0011 (9393).
- Issue the NI LPDN and Disarm inband code 11100 or the ESF-DL code (FF24).



The Time-out Override function is only valid for the current active loopback. The automatic time-out timer is restored during subsequent loopback sessions.

- 5 Once the test is complete, do one of the following:
 - If the system is to loopdown but remain Armed, send the IR (Intelligent Repeater) LPDN code for universal loopdown.
 - If all the equipment is to be looped down, disarmed and returned to normal operation, send the disarm inband code 11100 or the ESF-DL code (FF24).



The Armed mode has an automatic time-out of 120 minutes but this timer is reset to 120 for any of the following events:

- Loopback terminates (manually or time-out)
- Query
- Alternate query
- Far-End activate
- Another ARM command

This timer is inhibited while any of the valid command codes are being sent. Once the codes are removed, the timer restarts at 120.

A3LB and A4LB Test Procedures

The H2TU-C-319 can be looped back by sending the Addressable Office Repeater (AOR) LPBK activation code 1111-1111-0001-1110 (FF1E) for at least 5 seconds. This causes the H2TU-C to enter the NLOC state. The Loopback Time-out setting, described in “[Setting the Loopback Time-out Option](#)” on page 47, determines the duration of this loopback unless it is overridden by the reception of a second identical 16-bit loopup command before the timer expires. When this time-out override state exists, the only way to loop the H2TU-C down is to issue one of the three loopdown commands listed in [Table 23](#). The automatic time-out mode is restored during subsequent loopback sessions.

[Table 23](#) summarizes the codes required to execute Addressable 3 and 4 (A3LB and A4LB) repeater loopback commands. All code sequences must be present for at least 5 seconds. Information specific to HiGain HDSL2 regenerators is shown in bold.

Table 23. Addressable Repeater Loopback Commands (A3LB and A4LB)

Name	Description	Binary Code ^(a) (Hexadecimal Equivalent)
NLOC	H2TU-C loopup from NI	1111-1111-0001-1110 (FF1E)
CREM	H2TU-C loopup from CI	0011-1111-0001-1110 (3F1E)
NRG1	H2RU regenerator 1 loopup from NI	1111-1111-0000-0100 (FF04)
CRG1	H2RU regenerator 1 loopup from CI	0011-1111-0000-0100 (3F04)
NRG2	H2RU regenerator 2 loopup from NI	1111-1111-0000-0110 (FF06)
CRG2	H2RU regenerator 2 loopup from CI	0011-1111-0000-0110 (3F06)
NREM	H2TU-R loopup from NI	1111-1111-0000-0010 (FF02)
CLOC	H2TU-R loopup from CI	0011-1111-0000-0010 (3F02)
SMJK	H2TU-R loopup from NI	11000-11000-11000 ...
SMJK	H2TU-R loopup from NI ^(b)	100000 100000 100000 ...
SMJK	H2TU-R loopup from NI (ESF-DL)	1111-1111-0100-1000 (FF48)
Loopdown	H2TU-C and H2TU-R loopdown from NI OR CI	11100-11100-11100 ...
Loopdown	H2TU-C and H2TU-R loopdown from NI OR CI	100-100-100 ...
Loopdown	H2TU-C and H2TU-R loopdown from NI OR CI (ESF-DL)	1111-1111-0010-0100 (FF24)

(a) The left-most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} Bit Error Ratio (BER) on the facility. The entire arming and loopback sequence can also be initiated at the remote H2TU-R location.

(b) Not supported by A4LB.

APPENDIX A - SPECIFICATIONS

Power

Line Voltage	0, -185 Vdc
CO Supply	-48 Vdc nominal (-42.5 Vdc to -56.5 Vdc) See “Power Consumption” and “Maximum Power Dissipation” and “Maximum Current Drain” on page 56.
Electrical Protection	Secondary surge and power cross protection on HDSL2 ports. Requires external primary protection.
Fusing	Internal; connected to “FUSE ALARM” output on pin 10

Environmental

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

Physical

Height	4.750 in. (12.10 cm)
Width	0.625 in. (1.59 cm)
Depth	10 in. (25.4 cm)
Weight	0.5 lb. (.23 kg)
Mounting	3192 mechanics shelf

HDSL2

Line Code	1.552 Mbps OPTIS
Transmission	Full duplex
Media	One non-loaded, copper, two-wire cable pair
Output	+13.8 dBm \pm 0.5 dB at 135 Ω (0-450 kHz) at CO side; +13.5 dBm \pm 0.5 dB at 135 Ω (0-350 kHz) at remote side
Line Impedance	135 Ω
Maximum Provisioning Loss	35 dB at 196 kHz
Start-up Time	30 sec. typical, 1 min. maximum per span

DSX-1

DSX-1 Line Impedance	100 Ω
DSX-1 Pulse Output	6 V ^{pk-pk} pre-equalized for 0-655 feet of ABAM cable
DSX-1 Input Level	+1.5 to -7.5 dB DSX

System

One-way DS1 Delay	<400 μ s per span without regenerators
Wander (Looped)	Meets MTIE T1.101 requirements
Wideband Jitter (Looped)	0.2 UI maximum
Narrowband Jitter (Looped)	0.1 UI maximum

POWER CONSUMPTION

The maximum power consumption and heat dissipation depends upon the type of remote and regenerator units in the system and the CPE power setting.

The three most important power parameters of an H2TU-C are its maximum power consumption, its maximum power dissipation and its maximum current drain.

Table 24 describes line-powered circuits on 9 kft, 26 AWG loops without a regenerator.

Table 24. H2TU-C-319 Power Parameters—No Regenerator

H2TU-R Model No.	H2TU-R CPE Power	-42.5 Vdc Power Consumption (Watts)		Heat Dissipation (Watts)		-42.5 Vdc Current (mA)	
		Typical	Maximum	Typical	Maximum	Typical	Maximum
H2TU-R-402		12.75	13.75	6.50	7.50	300.00	325.00

MAXIMUM POWER DISSIPATION

The Maximum Power Dissipation measures the power that is converted into heat that builds up within the unit. It contributes to the total heat generated in the space around the unit. It is used to determine the maximum number of fully loaded shelves per bay that does not exceed the maximum allowable power dissipation density in watts per square foot to comply with GR-63.

In COs, the maximum power dissipation for open-faced, natural convection-cooled mountings is limited to 134.7 watts per square foot per GR-63-CORE. The footprint of a standard 28-slot, 23-inch HMS-317 shelf is 7.024 square feet. Therefore, the maximum bay dissipation is limited to 946 watts. Use this limit and the parameters in Table 24 to determine the maximum number of H2TU-C circuits that can occupy one CO bay.



This is a worst case situation since it assumes the entire CO is subjected to the maximum power density. More favorable conditions would permit increasing the number of shelves per bay without jeopardizing the CO thermal integrity.

The thermal loading limitations imposed when using the H2TU-C in a Controlled Environmental Vault (CEV) or other enclosures are determined by applying its power parameters to the manufacturer's requirements for each specific housing.

The -42.5 Vdc Power Consumption is the maximum total power that the H2TU-C consumes or draws from the shelf power source. This parameter is needed when the H2TU-C is in a location remote to the CO it is serving. It determines the battery capacity required to maintain an 8-hour, stand-by battery reserve for emergency situations. Battery capacity, therefore, limits the maximum number of line units which can be installed in a remote enclosure. Use the data in Table 24 on page 56 to perform this analysis.

MAXIMUM CURRENT DRAIN

The Maximum Current Drain is the maximum current drawn from the shelf power supply when it is at its minimum voltage (-42.5 Vdc). This determines the shelf fusing requirements. Use the -42.5 Vdc current data in Table 24 on page 56 to determine the shelf fusing requirements for your particular H2TU-C applications.

H2TU-C-319 CARD-EDGE CONNECTOR

Figure 27 shows the pin assignments of the card-edge connector on the H2TU-C-319 List 2E card. The function of its segments (S1, S2, and S3) are described beginning with “Test Access” on page 26. Note that only the set of Standard 3192 alphanumeric connector pins to Segment 3 (A through L and 1 through 10) are labeled on the backplane of the HMS-358 shelf. The outer set of pin numbers are for reference only and do not appear on the backplane. The AUX DSX-1 Segment 1 port can be accessed either by its wire wrapped pins or from mass connector P11 (TX) and P10 (RX) on the HMS-358 backplane.

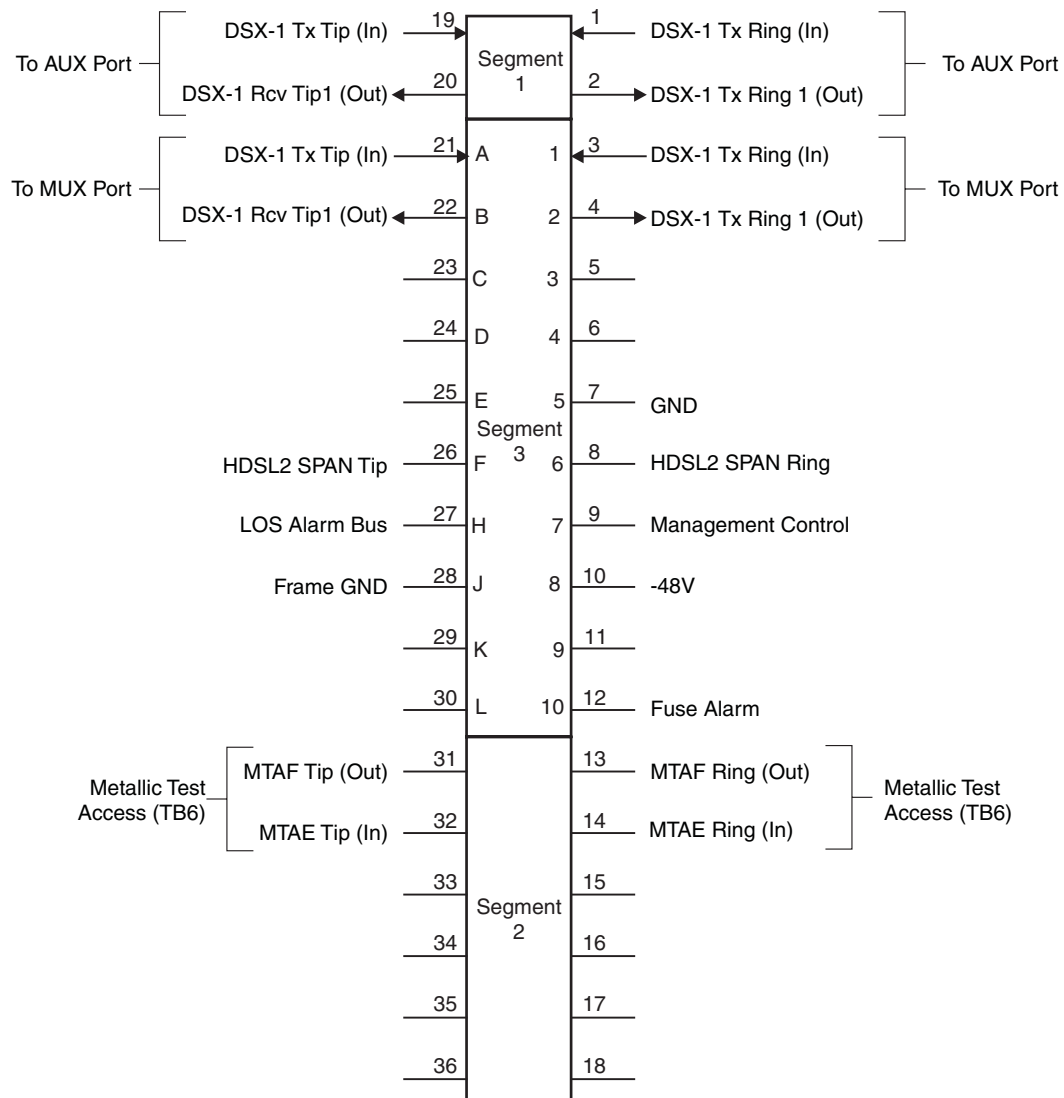


Figure 27. H2TU-C-319 List 2E Card-Edge Connector

Figure 28 shows the generic labeling of the connector as it appears on the backplane with HMS-358 shelf. Note that the H2TU-C-319 List 2E has no connections to Loop B of Group 1. The HMS-358 technical practice refers to Group 1 and Group 2 as Port 1 and Port 2, respectively.

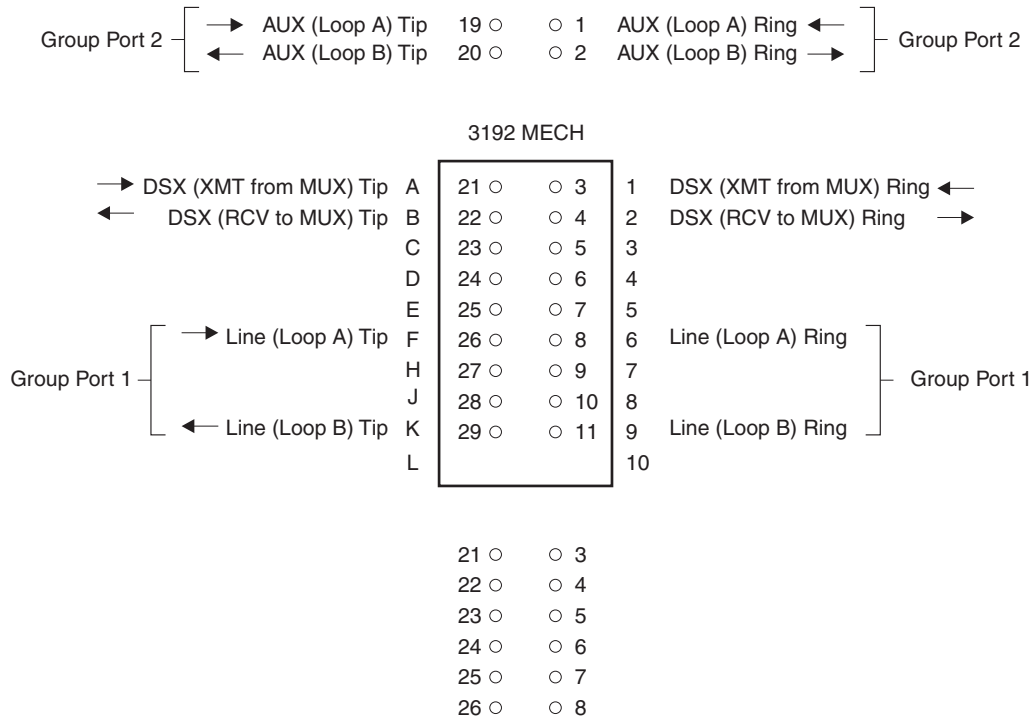


Figure 28. HMS-358 Backplane H2TU-C-319 List 2E Card Edge Connector Labeling

Network Management Control Bus

The H2TU-C provides a Network Management Control Bus on pin 7 of the card-edge connector. This allows the various ADC Management System protocols to manage the H2TU-C through the HMU-319 HiGain Management Unit. Whenever the H2TU-C is under management, the MNGD message displays periodically on the front-panel display.



Some H2TU-C-319 List 2 features are affected when it is under management. Consult the management unit practice for further information.

Fuse Alarm

Pin 10 on the card-edge connector is a Fuse Alarm that is driven to -48 Vdc through a diode whenever its onboard fuse opens. It emulates the function of the Fuse Alarm output from pin 10 on normal, high density (HD) repeaters. Pin 10 is connected to pin 5 of the 1184 Alarm Card (slot 1 in the HD shelf) and causes the 1184 Fuse ALM LED to light when the pin 10 signal is activated. Its normally floating output must never be driven above ground or below -80 Vdc. It can sink a current of 10 mA. The H2TU-C does not support the BPV function (Pin E) of normal HD repeaters.

System Alarm Output Pin

Pin H on the card-edge connector, shown in [Figure 27](#), is the H2TU-C-319 System Alarm output pin. The following notes apply to Pin H:

- Pin H replaces the Local Loss of Signal (LLOS) on normal high-density (3192) repeaters.
- The normally floating output of Pin H can connect to pin 1 of the 1184 or 3192-9F Alarm Card in position 29 of the high density (HD) shelf.
- The H2TU-C forces pin H to +5 Vdc (maximum of 10 mA) for a system alarm condition. Pin H then remains at +5 Vdc for the duration of the alarm condition.
- If the Wescom 1184 Alarm Card is installed in the shelf, its LOS LED lights for every MNRALM.
- The H2TU-C Status LED flashes red for the duration of a system alarm condition.
- Setting the ALM option to DIS only prevents the system alarm bus on Pin H from being activated for a system alarm event. The Status LED still flashes red and the ALRM message still displays.
- “[Front-Panel System Alarms](#)” on [page 42](#) describes the system alarms that activate Pin H.



Pin H must never be taken above +5 Vdc or below -60 Vdc.

CRAFT PORT

[Figure 29](#) shows the pinout for the craft port connector and its connection to a DB-9 or DB-25 connector on a maintenance terminal.

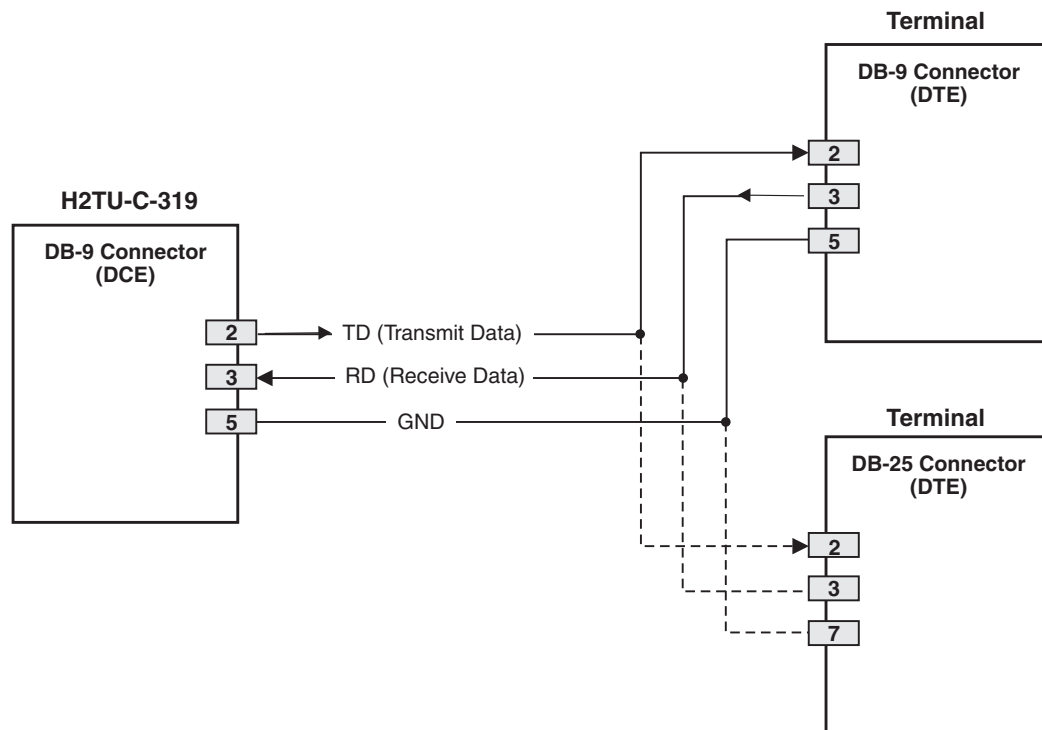


Figure 29. RS-232 Craft Port Pinouts

APPENDIX B - FUNCTIONAL OPERATION

ADC HDSL2 technology provides full-duplex services at standard DS1 rates over copper wires between an H2TU-C and an H2TU-R, which comprise one HiGain HDSL2 system. HiGain HDSL2 systems use ADC Overlapped Pulse Amplitude Modulation (PAM) Transmission with Interlocking Spectra (OPTIS) transceiver systems to establish full-duplex, 1.552 kbps data channels between the H2TU-C-319 and a remotely located H2TU-R.

Figure 30 shows a block diagram of the H2TU-C-319. The H2TU-C-319 receives a 1.544 Mbps DSX-1 data stream from the DSX-1 digital cross connect interface. The H2TU-C contains a DS1 frame synchronizer controlled by an 8-bit microprocessor that determines the type of framing on the DS1 stream and synchronizes to it. The H2TU-C recognizes Superframe (SF), including D4, or Extended Superframe (ESF) framing.

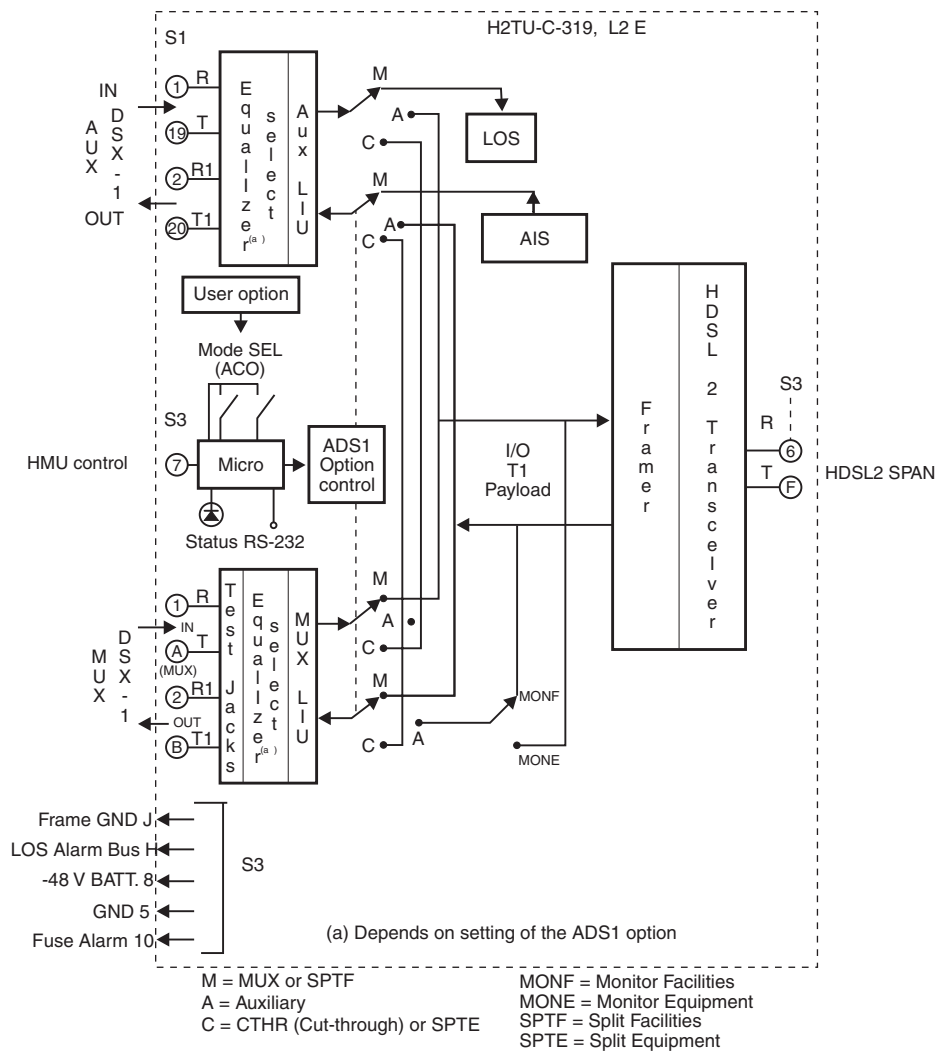


Figure 30. H2TU-C-319 List 2E Block Diagram

TIMING

The low loop wander (0.3 UI max) of an H2TU-C-319, when used with compatible regenerators and remote units, allows the circuit to be used in all critical timing applications, including those that are used to transport Stratum 1 timing.

GROUND FAULT DETECT

The H2TU-C-319 has a Ground Fault Detect (GFD) circuit which detects a ground or a resistive path to ground on any wire of the HDSL2 loop. This makes the product compliant with the Class A2 requirements of GR-1089.

APPENDIX C - COMPATIBILITY

The HiGain HDSL2 system uses HDSL2 transmission technology as recommended by ANSI committee in compliance with the August 1999 T1-E1.4/99-006R5 HDSL2 standards.

The H2TU-C List 2E are designed to mount in the following shelves with 3192 mechanics:

- ADC HMS-317 (28-slot, 23-inch shelf)
- ADC HHS-319 (3-slot, 19-inch horizontal shelf)
- ADC HMS-308 (8-slot remote enclosure)
- Charles Ind. #3192 (28-slot connectorized)
- Charles Ind. #3192-WR (28-slot wire wrap)
- Charles Ind. #343-00 (12- to 14-slot wire wrap)
- Charles Ind. #319-02 (22-slot connectorized)
- Charles Ind. #319-04 (22-slot wire wrap)
- Charles Ind. #340-00 (9-slot to 11-slot wire wrap)
- Larus #1185 (28-slot connectorized)



Charles Ind. 343-00 and 340-00 shelves do not support the H2TU-C-319 System Alarm output on pin H. Also, if slots 1 and 2 of these shelves were wired for the 3408 Fault Locate unit, they must be rewired to accept the H2TU-C-319.

APPENDIX D - 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 (TAC).

Sales Assistance 800.366.3891 extension 73000 (USA and Canada) 952.917.3000 Fax: 952.917.3237	<ul style="list-style-type: none"> • Quotation Proposals • Ordering and Delivery • General Product Information
Systems Integration 800.366.3891, extension 73000 (USA and Canada) 952.917.3000	<ul style="list-style-type: none"> • 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
BIA Technical Assistance Center 800.638.0031 714.730.3222 Fax: 714.730.2400 Email: wsd_support@adc.com	<ul style="list-style-type: none"> • Technical Information • System/Network Configuration • Product Specification and Application • Training (product-specific) • Installation and Operation Assistance • Troubleshooting and Repair/Field Assistance
Online Technical Support	<ul style="list-style-type: none"> • www.adc.com/Knowledge_Base/index.jsp
Online Technical Publications	<ul style="list-style-type: none"> • www.adc.com/library1/
Product Return Department 800.366.3891 ext. 73748 or 952.917.3748 Fax: 952.917.3237 Email: repair&return@adc.com	<ul style="list-style-type: none"> • ADC Return Material Authorization (RMA) number and instructions must be obtained before returning products.
<i>All 800 lines are toll-free in the USA and Canada.</i>	

LIST OF ABBREVIATIONS

A

ACO: Alarm Cut Off
ACQ: Acquisition
ADSI: Active DSX-1
AIS: Alarm Indication Signal
ALRM: Alarm Condition
AMI: Alternate Mark Inversion
AnL: Acquisition n Loop
AUX: Auxiliary
AWG: American Wire Gauge

B

B8ZS: Bipolar with 8-Zero Substitution
BER: Bit Error Rate
BPVT: Bipolar Violation Transparency

C

CLEI: Common Language Equipment Identifier
CO: Central Office
CREM: Customer Remote Loopback
CRGn: Customer Regenerator n Loopback
CSA: Carrier Service Area
CTHR: Cut-through

D

DBER: DS1 Bit Error Rate
DDS: Digital Data Service
DLC: Digital Loop Carrier

E

ECI: Equipment Catalog Item
ES: Errored Seconds
ESD: Electrostatic Discharge
ESF: Extended SuperFrame
ES-L: Errored Seconds-Line
ES-P: Errored Seconds-Path
EXZ: The occurrence of 8 consecutive zeroes for B8ZS or 16 for AMI.

F

FERR: Framing Bit Error
FLDL: Flash Download

G

GFD: Ground Fault Detect
GNLB: Generic Loopback

H

HBER: HDSL2 Block Error Rate
HCDS: High Capacity Digital Service
HDSL2: High bit-rate Digital Subscriber Line 2
HES: HDSL2 CRC Error ,
HG: HiGain

I

ID: Identification

L

LA: Loop Attenuation ,
LAIS: Local Alarm Indication Signal
LATT: Loop Attenuation
LBPV: Local Bipolar Violation ,
LIU: Line Interface Units
LLOS: Local Loss of Signal
LOS: Loss of Signal
LOSW: Loss of Sync Word
LPF: Line Power Feed
LRAI: Local Alarm Indication
 Remote Alarm Indicator

M

MAL: Margin Alarm
MONE: Monitor Equipment
MONF: Monitor Facilities
MSEC: Monitored Seconds
MTA: Metallic Test Access , ,
MTAE: Metallic Test Access Equipment ,
MTAF: Metallic Test Access Facilities
MUX: Multiplexer

N

NLOC: Network Local Loopback ,
NMA: Network Management and Administration
NPRM: Network PRM
NREM: Network Remote Loopback
NRGn: Network Regenerator n Loopback

O

OPTIS: Overlapped Pulse Amplitude Modulation Transmission with Interlocking Spectra

P

PAM: Pulse Amplitude Modulation
PL: Payload
PRM: Performance Report Messaging

PRMF: Performance Report Messaging - Far End
PRM-FE: Performance Report Messaging-Far End
PRMN: Performance Report Messaging - Near End
PRM-NE: Performance Report Messaging-Near End

R

RAIS: Remote Alarm Indication Signal
RLOS: Remote Loss of Signal
RRAI: Remote Alarm Indication

S

SES: Severely Errored Seconds
SES-L: Severely Errored Seconds-Line
SES-P: Severely Errored Seconds-Pat
SF: SuperFrame
SMJK: SmartJack Loopback
SPNn: Span Number
SPRM: Supplemental PRM
SPTE: Split Equipment
SPTF: Split Facilities

T

TRCI: TX RAI-CI Indication - Customer Installation
TUC: Transmission Unit Central Office
TUR: Transmission Unit Remote End

U

UAS: Unavailable Errored Seconds
UNFR: Unframed
UUT: Unit Under Test

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

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

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

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

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

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

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

MODIFICATIONS

Any changes or modifications made to this device that are not expressly approved by ADC DSL Systems, Inc. voids the user’s warranty. All wiring external to the products should follow the provisions of the current edition of the National Electrical Code.

SAFETY STANDARDS COMPLIANCE

The H2TU-C-319 List 2E have 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 D - Product Support”](#) on page 62.

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