HiGain

USER MANUAL

HiGain Line Unit

H2TU-C-202 List 1E
Part Number: 150-2402-15
CLEI Code: VACH4W4C

Revision History of This Manual

Revision	Release Date	Revisions Made
01	November 30, 1999	Initial release.
02	December 10, 1999	Updated the block diagram and card-edge connector and altered the installation figure.
03	April 21, 2000	Updated screens and text for firmware revision. Modified block diagram.
04	January 25, 2002	ADC rebranding - no technical changes.

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 "Appendix E - Abbreviations" on page 59.

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

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OVERVIEW

The HiGain HDSL2 product family from ADC® is the industry's first practical implementation of High bit-rate Digital Subscriber Line 2 (HDSL2). ADC 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 uses the industry's first HDSL2 chipset (ANSI T1/E1.4 compliant) developed by ADC.

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-202 List 1E line unit is the Central Office (CO) side of a T1 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
  - DS1 bridging access
  - Four Status LEDs
  - 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)
  - Bit Error Rate (BER) alarm
  - Remote provisioning
  - Loss of Signal/Alarm Indicator Signal (LOS/AIS) payload alarm
  - Selectable loopback activation codes

- Compatible with 200 and 400 mechanics, high-density shelves
- Digital Data Service (DDS) latching loopback
- Payload (PL) and HiGain (HG) loopback source identification
- Network Management and Administration (NMA) interface
- Margin Alarm threshold (MAL)

COMPATIBILITY

The H2TU-C-202 is designed to mount in 200/400 mechanics, high-density shelves. For a list of compatible shelves see "Appendix C - Compatibility" on page 57.

APPLICATIONS

HiGain HDSL2 systems provide a cost-effective, easy-to-deploy method for delivering DS1 High Capacity Digital Service (HCDS) over a single copper pair. HiGain HDSL2 systems support a multitude of network connections and system models (see 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.

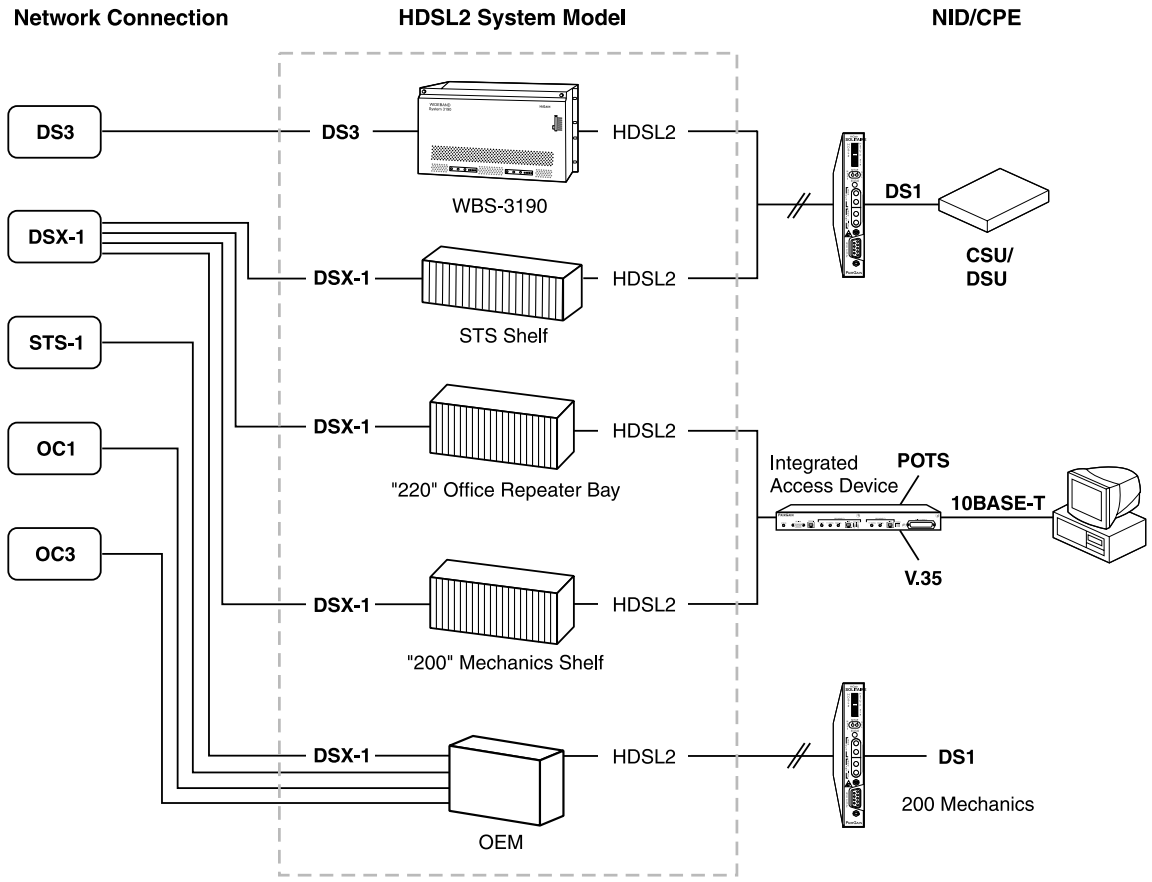


Figure 1. *HDSL2 System Model*

HIGAIN REGENERATORS

For applications without regenerators (doublers), the H2TU-C-202 is directly connected to an H2TU-R remote unit by one HDSL2 cable pair. The H2TU-C-202 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, for instance:

- The H2TU-C-202 List 1E 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-202 will support regenerators.

FRONT PANEL

Figure 2 shows the H2TU-C-202 List 1E front panel. Table 1 on page 5 describes the front-panel components. For pinout diagrams of the H2TU-C card-edge connector and craft port, refer to "Appendix A - Specifications" on page 51.

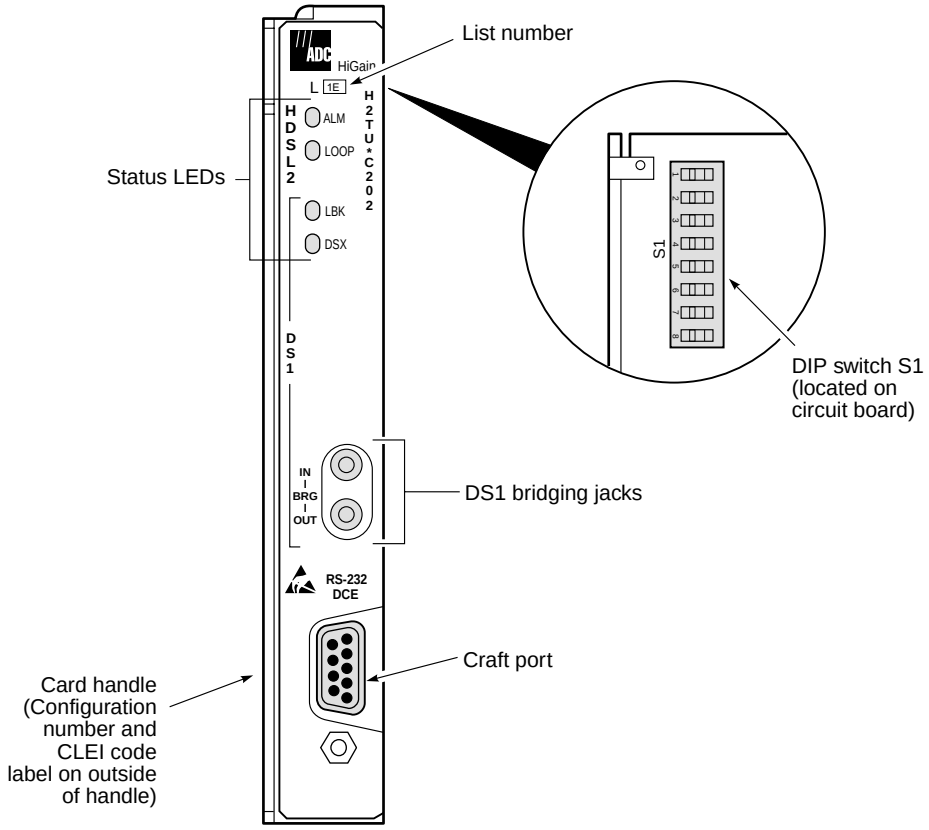


Figure 2. *H2TU-C-202 List 1E Front Panel*

Table 1. *Front-Panel Description*

Front-panel Features	Function
List number	Identifies the list number of the H2TU-C-202.
DIP switch S1	A switch bank, located on the board, containing eight switches. (See Figure 3 and Table 2 on page 6 for details.)
Status LEDs	
ALM	Solid red when a fuse alarm is present. Flashes red once per second when a local alarm is present. Flashes red five times per second when a remote alarm is present. Off when no alarm is present.
LOOP	Solid green while all HDSL2 spans are up. Flashes green once per second during a loop acquisition on the span. Flashes green five times per second when a margin or loop attenuation threshold is exceeded.
LBK	Solid yellow when the H2TU-C-202 is in the NLOC or CREM loopback mode. Flashes yellow five times per second when the system is armed. Off when the system is not armed or in loopback mode.
DSX	Solid green when DSX-1 signal is present and no alarm is present. Flashes green once per second for BPV, FERR, UAS, or CRC DSX-1 error. Flashes green five times per second when network side framing or line code provisioning does not match the DSX-1 signal being received. Off when DSX-1 signal is not present.
DS1 bridging jacks	Provides non-intrusive bridging jack access to (IN) and from (OUT) the HDSL2 span at the DSX-1 interface. Allows the two DS1 payloads to be monitored.
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.
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	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: Digit 1 - Last digit of shipment year Digits 2 and 3 - Shipment month Digits 4, 5, and 6 - Configuration number The configuration number identifies the version of the product. New configuration numbers usually accompany changes in the last two characters of the CLEI code. The configuration number is also 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-x**01**.

ON-BOARD DIP SWITCH S1

The H2TU-C-202 circuit board has an 8-position DIP switch, S1 (see Figure 3). The functions of DIP switch S1 are listed in Table 2.

DIP switch S1 is the only means by which the options it controls can be set. The maintenance terminal screens showing these option settings are read-only.

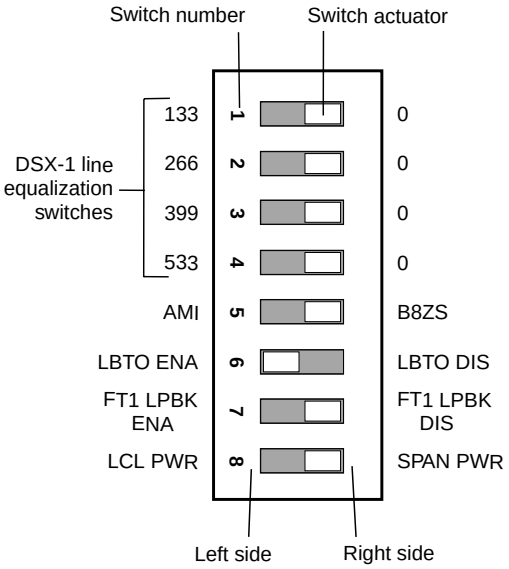


Figure 3. *DIP Switch S1*

Table 2. *Functions of DIP Switch S1 (default settings are in boldface type)*

Left Side Options	Switch Number	Right Side Options
Sets the Equalizer for 133 to 265 feet	1 (a)	Sets the Equalizer to **0**
Sets the Equalizer for 266 to 398 feet	2 (a)	Sets the Equalizer to **0**
Sets the Equalizer for 399 to 532 feet	3 (a)	Sets the Equalizer to **0**
Sets the Equalizer for 533 to 655 feet	4 (a)	Sets the Equalizer to **0**
Selects line code Alternate Mark Inversion (AMI)	5	Selects line code Bipolar with 8-zero Substitution **(B8ZS)**
Enables the Loopback Timeout (LBTO) to **120 minutes** after initiation	6	Disables 120 minute LBTO and replaces it with NONE, no timeout
Enables system response to DDS latching loopback commands for Fractional T1 (FT1) loopback capability and enables CP disconnect and trouble indication	7	**Disables** system response to DDS latching loopback commands for Fractional T1 (FT1) loopback capability and disables CP disconnect and trouble indication
Configures the system for local powering	8	Configures the system for **Span powering**

(a) Only one of the DSX-1 line equalization switches (1 - 4) can be selected at a time. If more than one switch is enabled, the lowest value setting has priority.

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.

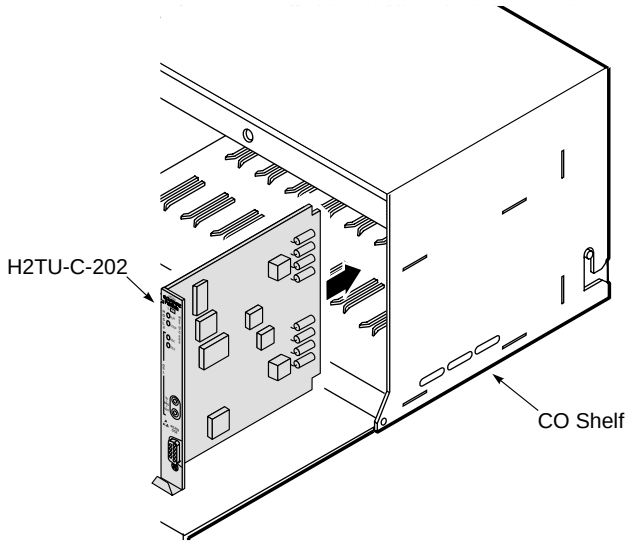


Figure 4. *Installing the H2TU-C List 1E into a Shelf*

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 and slide 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 card guides until properly seated.

VERIFICATION

Once the H2TU-C-202 is installed, verify that it is operating properly. To do this, monitor the four status LEDs.

Verification without a Downstream Device

If there is no downstream device installed:

1 Verify that the H2TU-C powers up. The four status LEDs illuminate and report the status. (See Table 1 on page 5 for status LED descriptions.)

2 Verify that the H2TU-C attempts to communicate with downstream devices (the LOOP LED flashes green). Even if a downstream device is not present, 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 LOOP LED illuminates.)

2 Verify that the H2TU-C attempts to communicate with downstream devices (the LOOP LED flashes green). One of the following occurs:

- If downstream devices are successfully identified and the HDSL2 loop synchronizes, the H2TU-C LOOP LED lights a steady green.
- If downstream devices are not successfully identified, the H2TU-C will:
  - attempt communication again and the LOOP LED will keep flashing
  - repeat the cycle until a downstream device is detected

  Connect the H2TU-C- 202 to the maintenance terminal to monitor the alarm messages on the terminal.

3 If there is more than one span, verify that each subsequent span synchronizes normally by monitoring the LOOP LED.

4 If a remote unit is installed, verify that the last span synchronizes normally. The H2TU-C LOOP LED should light a steady green.

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 the H2TU-C or H2TU-R inputs, then the DSX LED is off.
- If a valid DS1 signal is being supplied to the H2TU-C and H2TU-R, then DS1 alarm indications should be absent and the LOOP LED should light a steady green.

PROVISIONING REQUIREMENTS

Refer to "Provisioning" on page 10 for instructions on configuring and monitoring the H2TU-C-202.

After a successful installation, complete the following tasks:

1 Set the date and time (see "Setting Date and Time" on page 13).

2 Set the circuit ID numbers (see "Setting Circuit ID Numbers" on page 14).

3 Make any desired changes to configuration (see "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 Config Menu. This ensures the collection of accurate and meaningful data. (See "Clearing the History, Alarm, and Event Log Screens" on page 26.)

PROVISIONING

There are two provisioning methods:

- Setting the DIP switch located on the board
- Use a maintenance terminal (ASCII terminal or a PC running terminal emulation software) connected to the H2TU-C craft port (or to an HMU craft port) to access the HiGain HDSL2 maintenance screens (Figure 5 on page 11). This gives you full access to all H2TU-C status, history, inventory, and provisioning screens.

The options set with DIP switch S1 (Figure 3) cannot be set from a maintenance terminal. See "On-board DIP Switch S1" on page 6.

USING A MAINTENANCE TERMINAL

Connecting to a Maintenance Terminal

The craft port on the front panel allows you to connect the H2TU-C-202 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 (Figure 2 on page 4) on the H2TU-C-202 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 (emulating 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 HDSL2 maintenance terminal screens allow you to monitor, provision, and troubleshoot an H2TU-C-202 system.

To select a menu from the HiGain HDSL2 logon screen (Figure 5 on page 11), do one of the following:

- Type the first letter of the menu.
- Use the ← → arrow keys to select a menu, then press ENTER.

Table 3 summarizes the navigational keys. They are also listed in the onscreen Help menu. Table 4 on page 12 describes the menus.

Table 3. *Navigational Keys for the Solitaire 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.

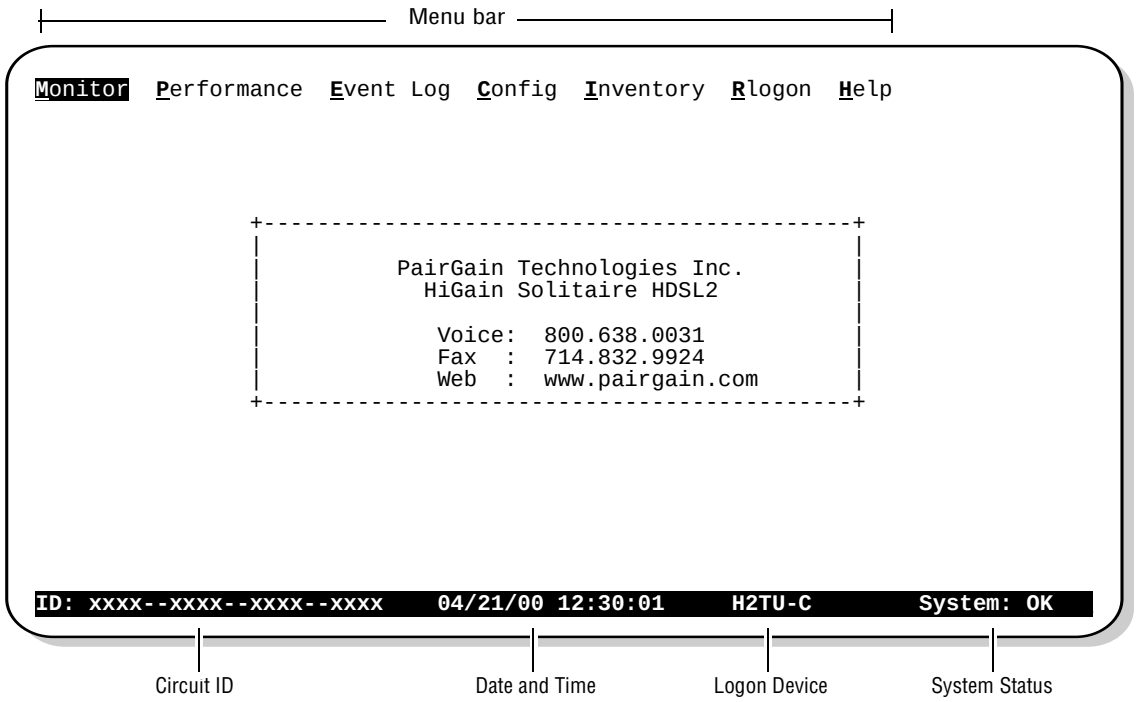


Figure 5. *Logon Screen*

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, ADC 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	Remote logon can be performed from the H2TU-C or the H2TU-R. The screen displays "**R**logout" when the H2TU-C or H2TU-R is remotely logged on to 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 a 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-202 is successfully installed, perform these basic provisioning tasks:

- Set date and time
- Set circuit ID numbers
- Make any necessary configuration changes
- Clear history, alarm, and event log screens to ensure accurate data

Setting Date and Time

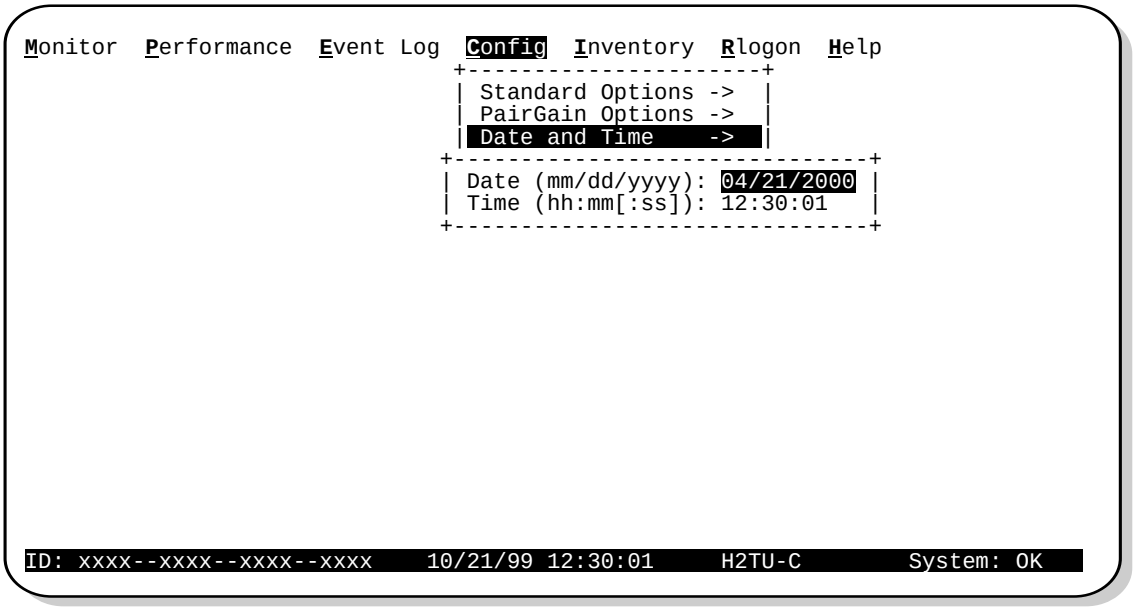


Figure 6. *Configuration Menu - Date and Time*

1. Press C to select the Config menu.
2. Use the ↑ and ↓ arrow keys to select **Date and Time**, then press ENTER.
3. Enter the date in the format indicated, then press ENTER.
4. Enter the time in the format indicated (entering seconds is optional), then press ENTER.

Setting Circuit ID Numbers

The Inventory screen 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-202     H2TU-R-402
List     : 1E             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     : VACHKW4CAA     VARHJUUCAA
Mfg. Date: 04/05/00       04/05/00

--------------------  Circuit and Unit Identifications  ---------------------

Circuit ID   : xxxx--xxxx--xxxx--xxxx
H2TU-R ID    : yyyy--yyyy--yyyy--yyyy



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

Figure 7. *Inventory Screen*

1. Press **I** to select the Inventory screen.
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 (Figure 8) allows you to make the following types of system configuration changes:

- Standard options (Figure 9 on page 16)
- ADC options (Figure 10 on page 16)
- Date and time (see "Setting Date and Time" on page 13)
- Master clear (see "Clearing the History, Alarm, and Event Log Screens" on page 26)
- Reset to factory default configuration (Figure 11 on page 25)

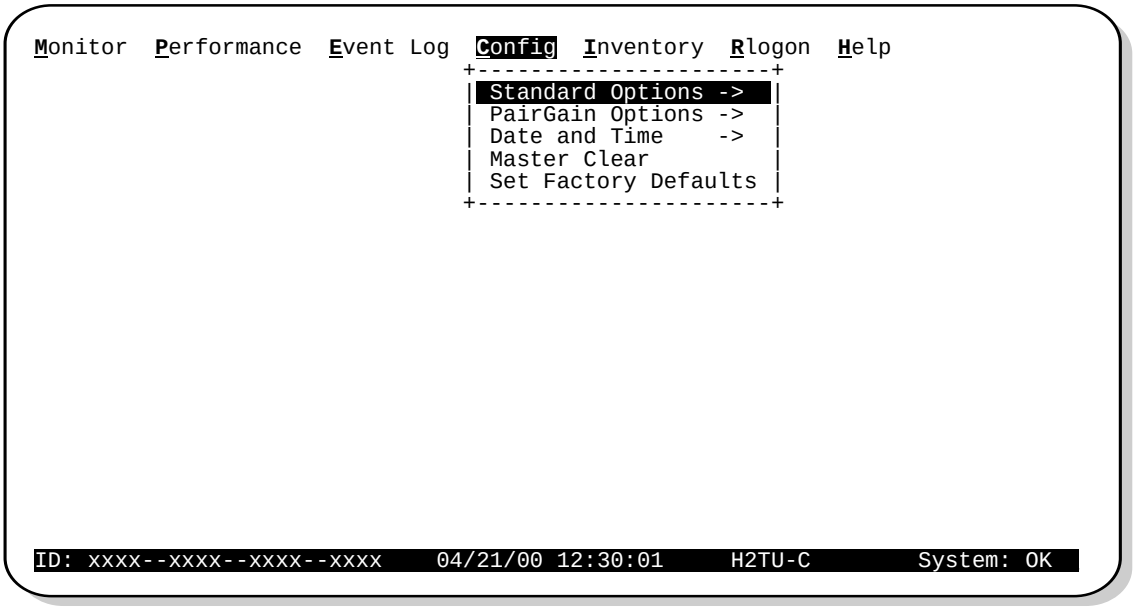


Figure 8. *Configuration Menu*

Making Changes to Standard and PairGain Options

Figure 9 and Figure 10 on page 16 show the Standard and PairGain configuration options. Standard options are those that are supported by HiGain HDSL2 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 17 and Table 6 on page 18. 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.

The settings for the LBTO, DS1, and EQL options shown in Figure 9, and the PWRF and FT1 options shown in Figure 10 are read-only; they are set with on-board DIP switch S1. (See "On-board DIP Switch S1" on page 6.)

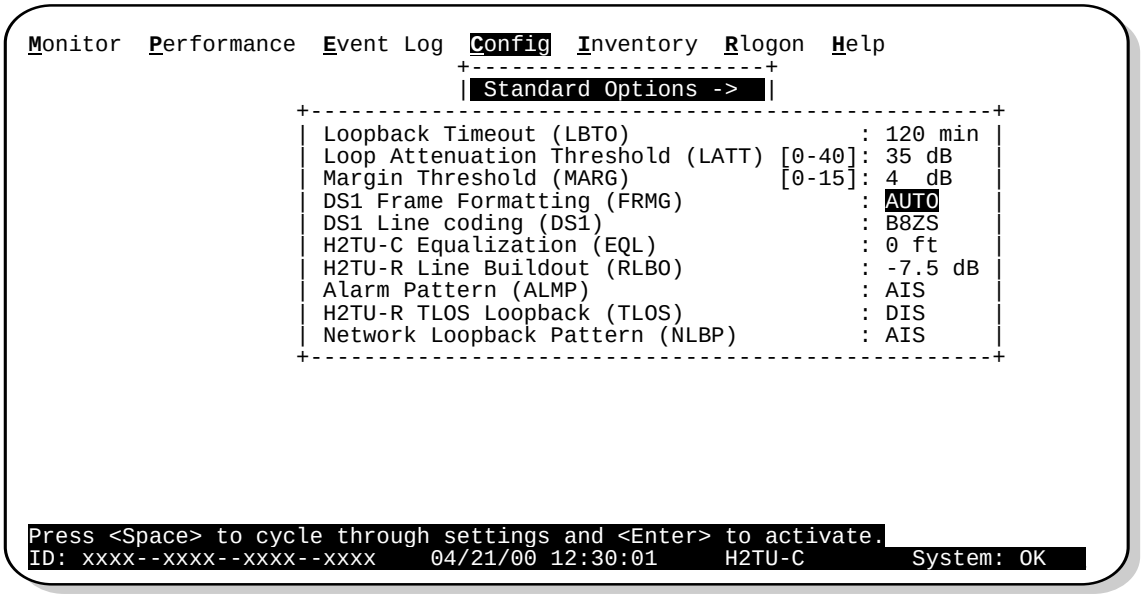


Figure 9. *Configuration Screen – Standard Options (Defaults Shown)*

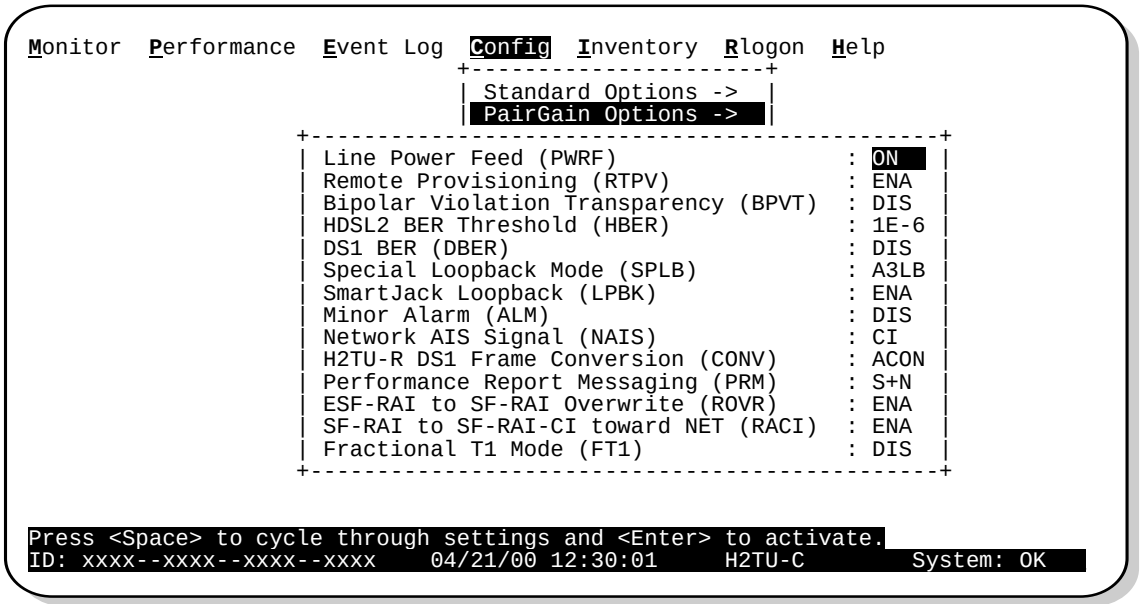


Figure 10. *Configuration Screen – PairGain Options (Defaults Shown)*

Table 5 lists the Config screen Standard Options and describes their available settings. Selections in **bold** typeface are the factory default settings.

Table 5. *H2TU-C-202 List 1E Config Screen Standard Options*

Standard Options	Screen Code	Settings	Description
Loopback Timeout (a)	LBTO	NONE	Disables automatic time-out cancellation of all loopbacks.
		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. Zero disables the alarm.The loop attenuation threshold can only be set through the HiGain HDSL2 maintenance screens.
		35 dB	Default value.
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 (a)	DS1	**B8ZS**	Places both the H2TU-C and H2TU-R into their B8ZS modes.
		AMI	Places both the H2TU-C and H2TU-R into their AMI modes.
H2TU-C Equalization (a) See "Equalization (EQL) Option." on page 19.	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		Sets the DS1 receive level output toward the Customer Interface (CI). Can only be set through the HiGain HDSL2 maintenance screens.
		0 dB	Sets the DS1 RLBO level toward the CI to 0 dB.
		-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 HDSL2 system to output an AIS payload at its DS1 ports for LOSW and DS1 LOS. For priority resolution, see Figure 25 on page 41.
		LOS	Enables the HiGain HDSL2 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. For priority resolution, see Figure 25 on page 41.
		DIS	Disables TLOS logic loopback.
Network Loopback Pattern	NLBP	**AIS**	Enables the H2TU-R to transmit AIS towards the CI for any network loopback. For priority resolution, see Figure 25 on page 41.
		LOS	Enables the H2TU-R to transmit LOS towards the CI for any network loopback.

(a) Can only be set by DIP switch S1 (see "On-board DIP Switch S1" on page 6).

Table 6 lists the Config screen PairGain Options and describes their available settings. Selections in **bold** typeface are the factory default settings.

Table 6. *H2TU-C-202 List 1E Config Screen PairGain Options*

PairGain Options	Screen Code	Settings	Description
Line Power Feed [a]	PWRF	OFF	Disables powering to the HDSL2 pair.
		ON	Keeps the HDSL2 line voltage at the nominal -185 Vdc.
Remote Provisioning	RTPV	**ENA**	Enables remote provisioning.
		DIS	Disables remote provisioning.
Bipolar Violation Transparency See "Bipolar Violation Transparency (BPVT) Option" on page 20.	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 HDSL2 transparent to BPVs.
		DIS	Disables BPV Transparency.
HDSL2 BER Threshold See "HDSL2 BER (HBER) Option" on page 19 and "System Alarm Output Pins" on page 54.	HBER	**1E-6**	System alarm relay contact closes and the Status LED flashes red when the Block Error Rate exceeds 10^{-6}. (Block Error Rate is based on the definition of Bit Error Rate.)
		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 T1 BER threshold.
		DIS	Prevents the generation of a system alarm due to T1 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 pins 22 and 30 when a system alarm condition occurs.
		DIS	Disables the generation of the output alarm on pins 22 and 30 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. For priority resolution, see Figure 25 on page 41.
		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 20.	CONV	OFF	Framing determined by the DS1 frame formatting option.
		ACON	Auto (ACON) detection of framing and potential frame conversion at the remote.
		FCON	Auto detection of framing and forced frame format conversion (FCON) at the H2TU-R.

Table 6. *H2TU-C-202 List 1E Config Screen PairGain Options (Cont.)*

PairGain Options	Screen Code	Settings	Description
Performance Report Messaging	PRM	SPRM	The H2TU-R generates Supplemental PRM (SPRM) very second if no PRM is received from the CPE within 5 seconds of a reset or if an LOS/AIS/OOF condition occurs. TL1 commands and response 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 in addition to the existing PRM every second. TL1 commands and response are enabled.
		S + N	The H2TU-R generates an NPRM which is tagged on to 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 See "ESF RAI to SF RAI Overwrite (ROVR) Option" on page 24.	ROVR	**ENA**	If the CONV option is set to FCON or ACON, an ESF T1 payload from the network with an embedded RAI pattern is converted to an SF-RAI pattern towards the CI at the H2TU-R.
		DIS	Prevents conversion to an SF-RAI pattern.
SF-RAI to SF-RAI-CI Toward NET See "SF RAI to SF RAI-CI Toward Network (RACI) Option" on page 24.	RACI	**ENA**	Allows a DS1 SF-RAI (yellow alarm) signal received by the H2TU-R to be converted to an SF-RAI-CI signal towards the network.
		DIS	Prevents conversion of the DS1 SF-RAI.
Fractional T1 Mode [(a)] See "Fractional T1 (FT1) Option" on page 22.	FT1	ENA	Enables system response to DDS latching loopback commands for fractional T1 applications and enables CPE disconnect or trouble indication. See Figure 25 on page 41 for LOS/AIS response priorities.
		DIS	Disables system response to DDS latching loopback commands for fractional T1 applications and CPE disconnect or trouble indications.

(a) Can only be set by the on-board DIP switch (see "On-board DIP Switch S1" on page 6).

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 T1 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.

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-202 improves compatibility with Digital Loop Carrier (DLC) feeder applications because of its ability to transmit T1 BPV occurrences between its T1 interfaces. This feature is required to support protection switching in DLC applications. Each DLC terminal must be able to monitor the integrity of its Receive T1 payload and then switch to the protect line when the integrity of the path drops below specific user selected limits. An essential requirement of this feature is the need for each DLC terminal to detect BPVs in its T1 input. Standard HDSL systems correct T1 BPVs at the input and therefore prevent them from being detected by the DLC terminals to which they are connected. The H2TU-C-202 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 T1 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 T1 bits up to a maximum of 12000 (BER=7.7 x 10^{-3}). This maximum rate is more than adequate since it exceeds the maximum 10^{-3} BER required by most DLC systems.

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.

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 towards 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 Out-of-Frame (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 towards the network as well as the network ESF to SF towards 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 towards 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 lists the HiGain HDSL2 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 below and Table 10 on page 22 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 NET > CPE NET < CPE	FCON Option 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		
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

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 commands of ENA 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 loopback they initiate.

Table 12. *HiGain Loopback vs. Latching Sequence*

HiGain 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 HiGain 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 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 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 towards the network for a CI LOS fault condition must be replaced by the new patterns listed in Table 13 on page 24 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 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
			Framing	Payload	FDL			
1	ENA	SF	SF	01111110	N/A	LOS/AIS	01111110 UNFR	RCV RLOS/RAIS XMT IDLE
2	ENA	ESF	ESF	01111110	X(a)	LOS/AIS	01111110 UNFR	RCV RLOS/RAIS XMT IDLE
3	ENA	LOS/AIS	SF	01111110	N/A	LOS/AIS	01111110 UNFR	RCV RLOS/RAIS XMT IDLE
4	ENA	LOS/AIS	SF	PL	X(a)	SF/PL	AIS	RCV LLOS/LAIS
5	ENA	LOS/AIS	SF	PL	X(a)	ESF/PL	AIS	RCV LLOS/LAIS

(a) Don't care bit

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 thus overwrite bit 2 of every DS0 channel with a zero.

If the ROVR option is disabled, it prevents conversion of a network ESF payload with an embedded RAI pattern. Disabling the ROVR option 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, towards 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 towards 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.

Resetting the H2TU-C

Resetting the H2TU-C to its original factory settings may cause interruption of service. Please note that this reset feature has no effect on the option settings that are controlled by the DIP switch.

To reset the H2TU-C-202 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 are certain you want to reset the H2TU-C, or press N to cancel this action.

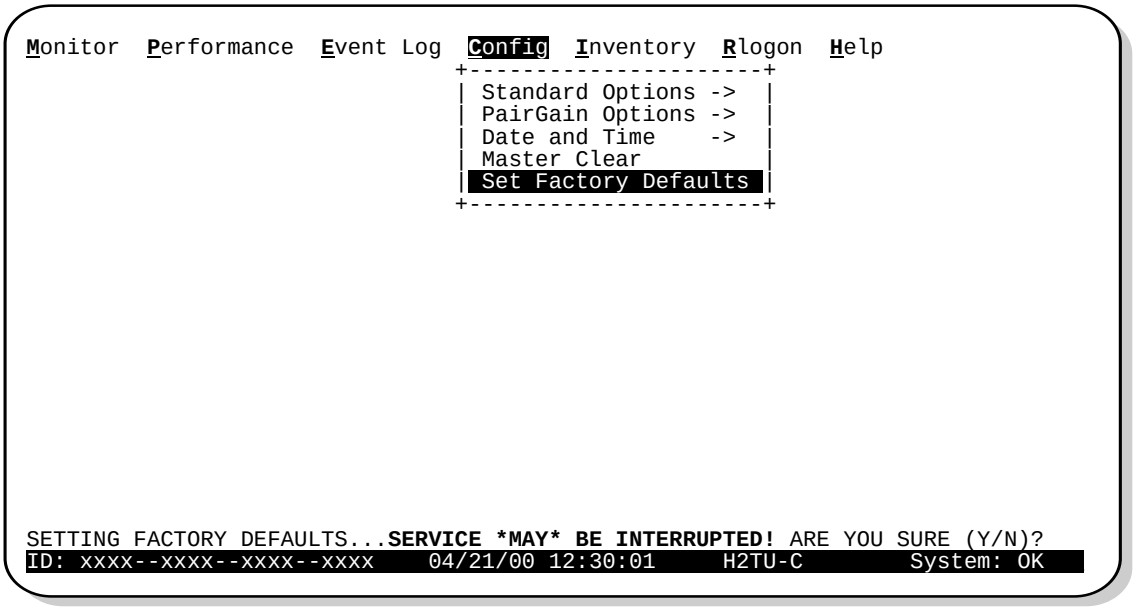


Figure 11. *Configuration Menu - Set to Factory Defaults*

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.

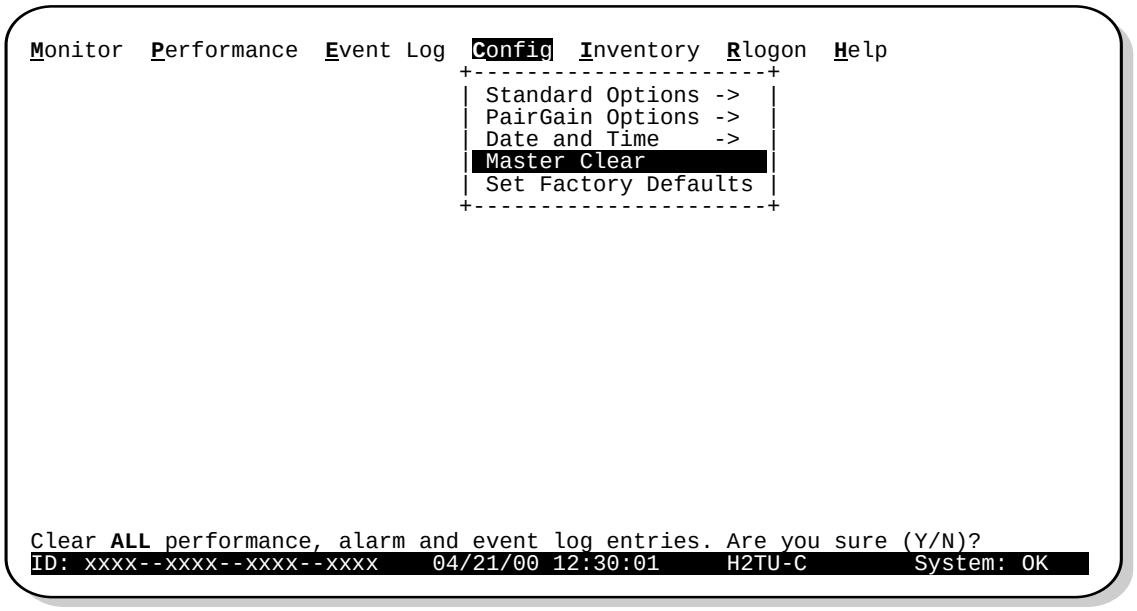


Figure 12. *Configuration Menu - Master Clear*

To clear the Event Log, type **E** to select the Event Log screen, then type **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**) and 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 36.
4. Press **L** to clear the screen.

To clear ALL history, alarm, and event log screens by this method:

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-202 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, 25-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

Future product enhancements will support up to two regenerators with three HDSL2 spans, as shown in Figure 13.

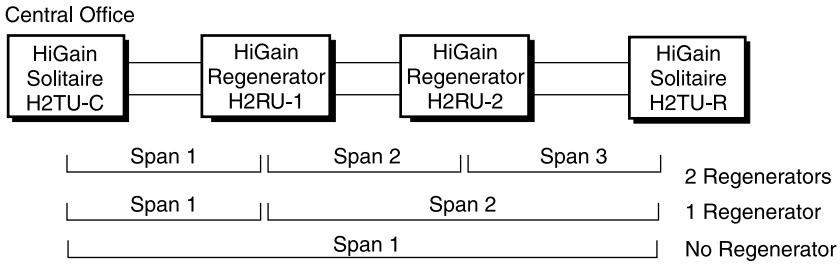


Figure 13. *System Spans*

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 14 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. See Table 14 on page 29 for screen field descriptions.

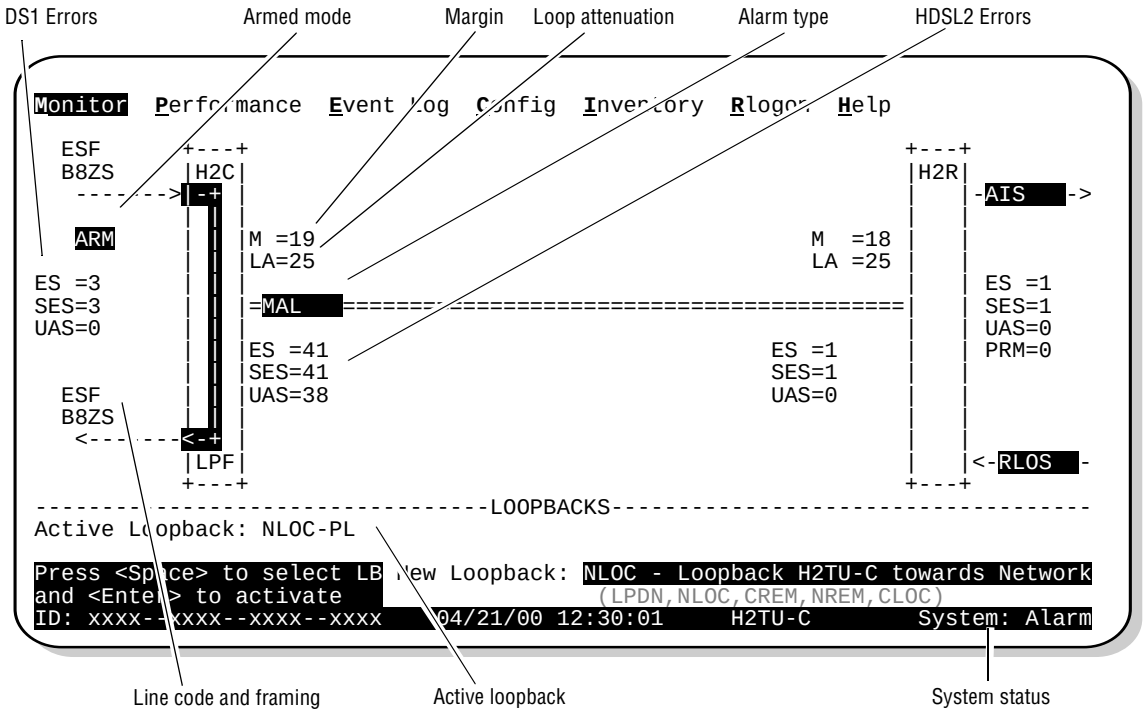


Figure 14. *Monitor Screen - Active Loopback with Alarms*

2 To initiate a loopback, press the **SPACEBAR** to cycle though 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 40.

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 44 for a summary of the HiGain HDSL2 loopback codes and activation methods.
Alarm type	Indicates type of alarm.
Armed mode	Indicates system is in an armed state and ready for loopback commands.
Code type	Type of DS1 line coding used (B8ZS or AMI).
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, BPV, 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 used on the input stream (SF, ESF or UNFR).
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.
PL (or HG)	PL is displayed when the loopback was initiated by a command embedded in the DS1 data path payload (PL). HG is displayed when the loopback was initiated from a HiGain (HG) front panel or by a HiGain maintenance terminal loopback command.
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 196 kHz loss of the cable pair. The loop attenuation is a more direct indication of the loop attenuation to the OPTIS signal than is the 196 kHz loss. The normal HiGain HDSL2 LA operation range is from 0 to 40 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.
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. `System: OK` indicates that there are no alarms present. `System: Alarm` indicates the presence of an alarm. Refer to "Using the Performance Screens to View Alarm Data" on page 35.

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 21) or DS1 interfaces (Figure 22 on page 36) 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 15 below and Figure 16 on page 31 are examples of the H2TU-R 31-day history and H2TU-C 25-hour history DS1 performance screens, respectively, as viewed from the line unit. In addition, there are 48-hour and current history statistic screens for the DS1 interface for the H2TU-R, as well as for the H2TU-C. Table 15 on page 31 describes the acronyms used in the performance history screens.

```
Monitor  Performance  Event Log  Config  Inventory  Rlogon  Help

                H2TU-R DS-1 31 Day History (Page 1 of 3)
-------------------------------------------------------------------------------
 Date     ES-L  SES-L  UAS-L   CV-L PDVS-L   ES-P  SES-P  UAS-P PRM-NE PRM-FE
 04/09       -      -      -      -      -      -      -      -      -      -
 04/10       -      -      -      -      -      -      -      -      -      -
 04/11       -      -      -      -      -      -      -      -      -      -
 04/12       -      -      -      -      -      -      -      -      -      -
 04/13       -      -      -      -      -      -      -      -      -      -
 04/14       -      -      -      -      -      -      -      -      -      -
 04/15       -      -      -      -      -      -      -      -      -      -
 04/16       -      -      -      -      -      -      -      -      -      -
 04/17       -      -      -      -      -      -      -      -      -      -
 04/18       -      -      -      -      -      -      -      -      -      -
 04/19       -      -      -      -      -      -      -      -      -      -
 04/20      14     10     10     12     10     10      0      0      0      0
 04/21       0      0      0      2      0      0      0      0      0      0

              Press: (N)ext Page, (P)revious Page, C(l)ear History
-------------------------------------------------------------------------------
Press <Space> to cycle through  Interface  : H2TU-R DS-1
choices and <Enter> to view     Statistics : 31 Day History
ID: xxxx--xxxx--xxxx--xxxx    04/21/00 12:30:01     H2TU-C        System: OK
```

Figure 15. *H2TU-R DS1 31-day Performance History*

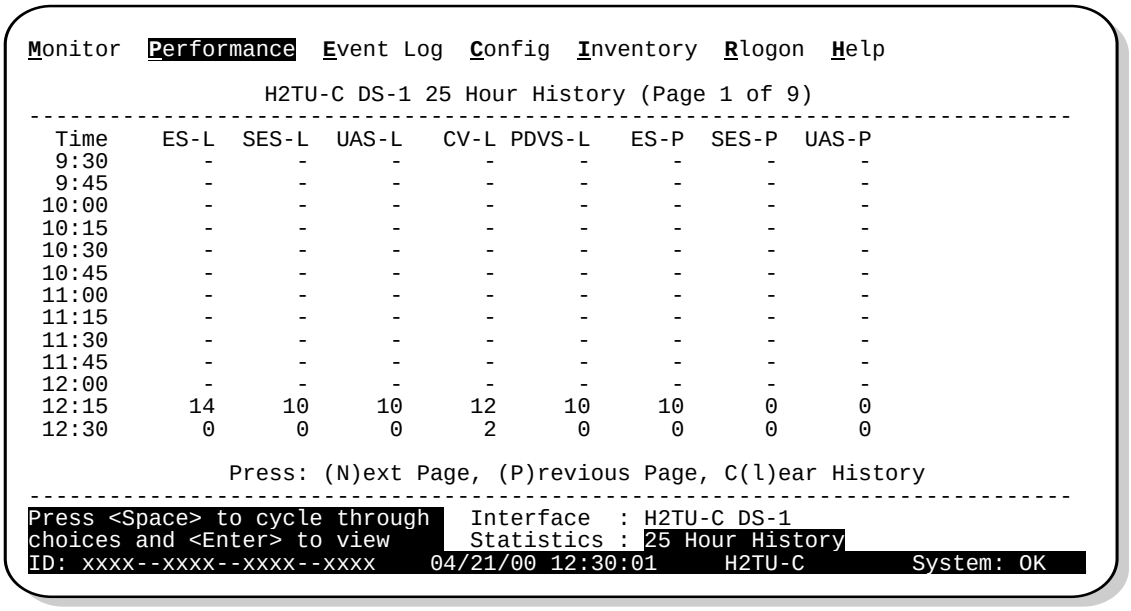


Figure 16. *H2TU-C DS1 25-hour Performance History*

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 17 is an example of a 31-day HDSL2 performance screen as viewed from the H2TU-C. The HDSL2 interface has 31-day, 48-hour, 25-hour and current statistic screens for the H2TU-C. Table 16 describes the acronyms used in the performance history screens.

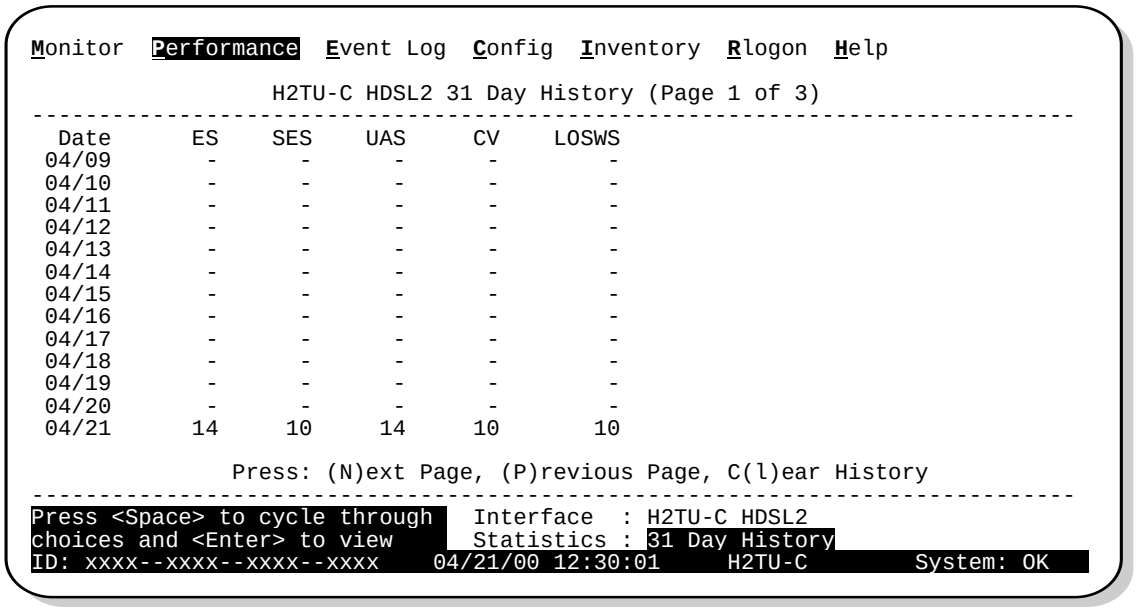


Figure 17. *H2TU-C HDSL2 31-day Performance History*

Table 16. *Error Acronyms Used in 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

Current Statistics Screens for the DS1 Interface

Examples of current statistics screens are shown below. Figure 18 and Figure 19 show statistics for the DS1 interface at the remote unit and line unit, respectively. These screens report 1-day, 1-hour, and 15-minute statistics. Refer to Table 15 on page 31 for descriptions of the kinds of errors reported on these screens.

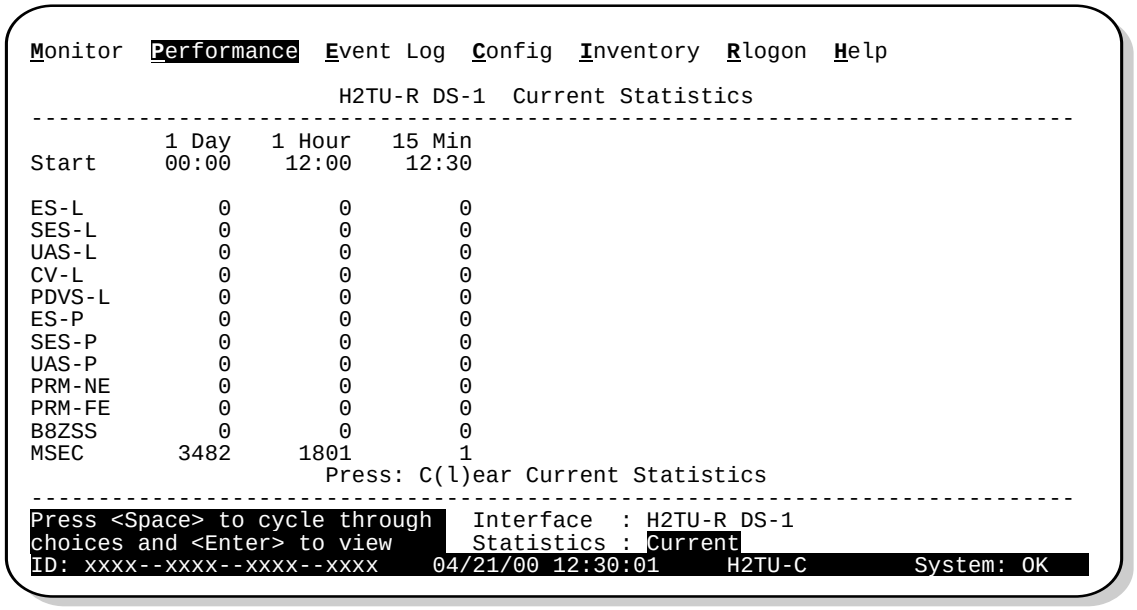


Figure 18. *H2TU-R DS1 Current Statistics*

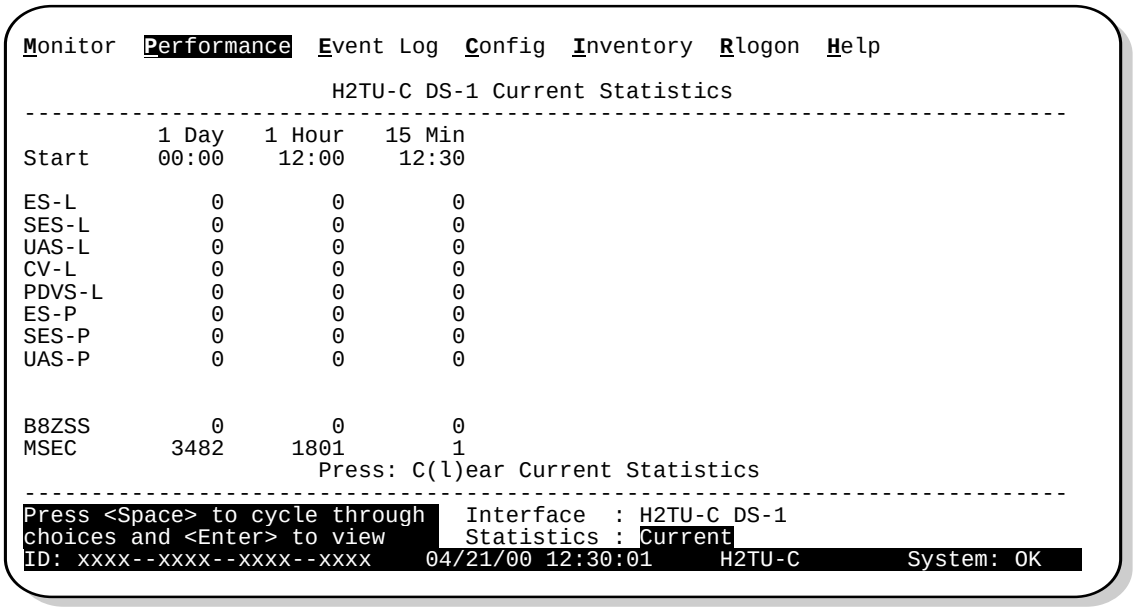


Figure 19. *H2TU-C DS1 Current Statistics*

Current Statistics for HDSL2 Interface

Figure 20 shows statistics for the HDSL2 interface at the H2TU-C. This screen reports 1-day, 1-hour, and 15-minute statistics. Refer to Table 15 on page 31 for descriptions of the kinds of errors reported on this screen.

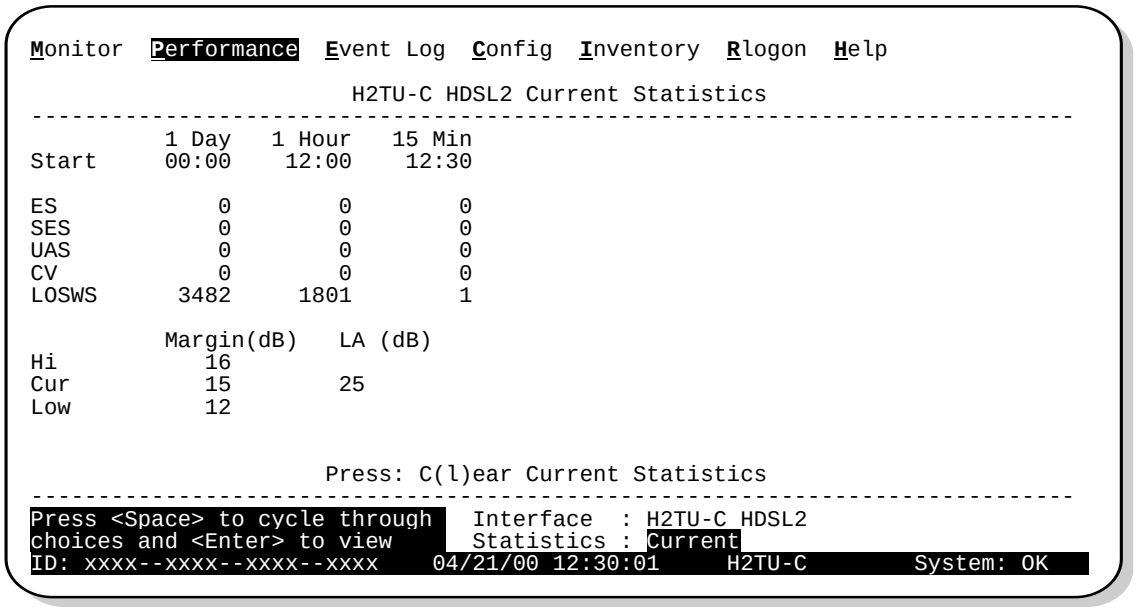


Figure 20. *H2TU-C HDSL2 Current Statistics*

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.

4 Press N or P to page through the alarm history screens.

5 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 (Figure 21) and the H2TU-R (Figure 22 on page 36) on a continuous basis. The types of alarms reported are described in Table 17 on page 36. Current alarms are shown in reverse video.

```
Monitor  Performance  Event Log  Config  Inventory  Rlogon  Help

                          H2TU-C DS-1 Alarm History
-------------------------------------------------------------------------------
 Alarm        First                Last                 Status      Count

 LLOS         04/16/99 12:01       04/19/99 05:45       ALARM          12
 LAIS                                                   OK              0
 DBER         04/17/99 09:37       04/20/99 03:38       OK              7









                          Press: C(l)ear Alarm History
-------------------------------------------------------------------------------
Press <Space> to cycle through   Interface  : H2TU-C DS-1
choices and <Enter> to view      Statistics : Alarm History
ID: xxxx--xxxx--xxxx--xxxx    04/21/00 12:30:01     H2TU-C        System: Alarm
```

Figure 21. *H2TU-C DS1 Alarm History Screen*

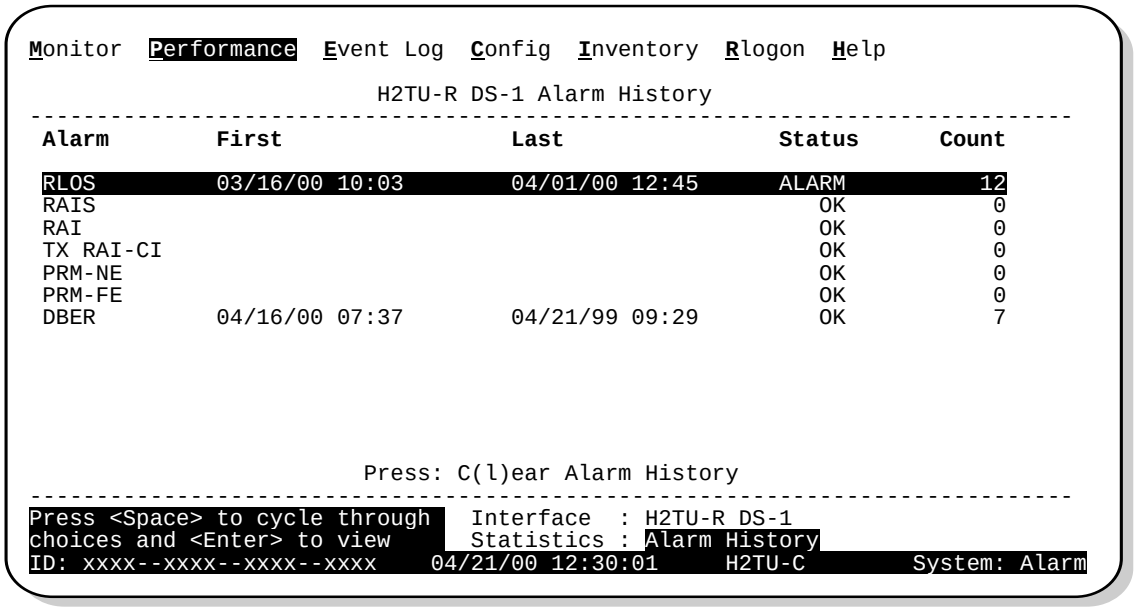


Figure 22. *H2TU-R DS1 Alarm History Screen*

Table 17. *DS1 Alarm Descriptions*

Screen Alarm	Description
H2TU-C DS1 ALARMS (see Figure 21 on page 35)	
LLOS [a]	Local Loss of Signal—Loss of the H2TU-C DSX-1 input signal.
LAIS	Local Alarm Indication Signal—Indicates an AIS (all ones) pattern is being transmitted from the local DS1 output port. The ALMP option determines whether AIS (default) or LOS is sent towards the CPE.
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 22)	
RLOS [a]	Remote Loss of Signal— Loss of the H2TU-R DS1 input signal.
RAIS	Remote Alarm Indication Signal—Indicates an AIS (all ones) pattern is being received at the H2TU-R DS1 input port. By default AIS-CI [b] is sent towards the network (see Figure 25 on page 41).
RAI	Remote RAI - Remote Alarm Indication at the H2TU-R—Indicates an RAI alarm (yellow) from the CPE with errors from the line unit or network.
TX RAI-CI	Transmit RAI-CI - Remote Alarm Indication at the H2TU-R—Upon reception of an RAI (yellow alarm) from the CPE, the H2TU-R sends a RAI-CI towards 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. 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	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	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	Bit Error Rate—The DS1 BER has exceeded the built-in 24-hour threshold limits of approximately 10^{-6}.

(a) This is a DS1-specific alarm that also issues a minor alarm (sent to the management unit or the backplane), if enabled.
(b) 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 23 shows the H2TU-C HDSL2 alarm history, and Table 18 describes the alarms.

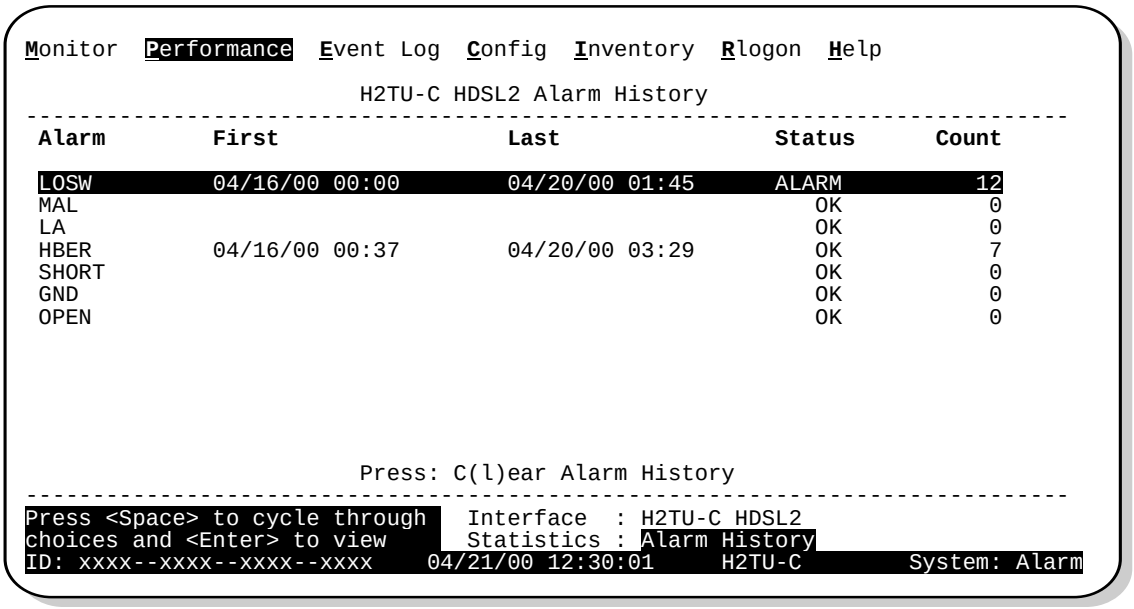


Figure 23. *H2TU-C HDSL2 Alarm History Screen*

Table 18. *HDSL2 Alarm Descriptions*

Screen Alarm	Description
LOSW	Loss of Sync Word—The HDSL2 loop has lost synchronization.
MAL	Margin—The margin on the HDSL2 loop has dropped below the minimum threshold value set for the system.
LA	Loop Attenuation—The attenuation on the HDSL2 loop has exceeded the maximum value set for the HDSL2 loop attenuation threshold.
HBER	Block Error Rate—The HDSL2 BER has exceeded the set threshold limits of 10^{-6} or 10^{-7}.
SHORT (a)	Indicates a short between the Tip and Ring of the HDSL2 pair.
GND (a)	The HDSL2 loop is grounded.
OPEN (a)	Indicates a line power open condition.

(a) Appears only at 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.

- 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.

```
Monitor  Performance  Event Log  Config  Inventory  Rlogon  Help

                        System Event Log (Page 1 of 7)
--------------------------------------------------------------------------------
#   Location        Date and Time         Entry

1   System          04/21/00 12:25:00     DS1 Alarm Register reset
2   System          04/21/00 12:25:00     HDSL2 Alarm Register Reset
3   System          04/21/00 12:25:00     DS1 Performance Register Reset
4   System          04/21/00 12:25:00     HDSL2 Performance Register Reset
5   System          04/21/00 00:13:32     Time set 12:25:00
6   System          03/16/00 00:13:27     Date set 10/21/99
7   H2TU-C          03/16/00 00:13:27     NLOC: Loop-down
8   H2TU-C          03/16/00 00:11:16     NLOC: Loop-up
9   H2TU-R          03/16/00 00:10:43     DS1 LOS Alarm: End
10  H2TU-R          03/16/00 00:10:30     DS1 LOS Alarm: Begin
11  System          03/16/00 00:04:11     DS1C: AUTO to AMI
12  H2TU-C          03/16/00 00:00:40     HDSL2 LOSW Alarm: End
13  H2TU-C          03/16/00 00:00:02     HDSL2 LOSW Alarm: Begin
14  - Empty -
15  - Empty -

        Press: (N)ext Page, (P)revious Page, (T)op of Log, C(l)ear Log
ID: xxxx--xxxx--xxxx--xxxx    04/21/00 12:30:01     H2TU-C        System: OK
```

Figure 24. *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 (*at the remote only*: 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 (1day threshold crossed of any PM data)
NTWK DS1 LOS begins / ends
NTWK PRM-FE BER alarm (*at the remote only*: 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
TX RAI-CI begins / ends (RAI-CI sent from the remote towards the network)

TESTING

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

SYSTEM ALARMS

Table 20 provides a summary of the system alarms displayed on the H2TU-C-202 alarm history screens (see "Using the Performance Screens to View Alarm Data" on page 35).

Table 20. *System Alarms Summary*

Message on Screen	Alarm	Description	To Inhibit
SHRT [a]	Short	A short exists between the Tip and Ring of the HDSL2 pair.	Cannot be inhibited.
GND [a]	Ground	The HDSL2 loop is grounded.	Cannot be inhibited.
OPEN [a]	Open	A line power open condition exists.	Cannot be inhibited.
LOSW [a]	Loss of Sync Word	The HDSL2 loop has lost synchronization.	Cannot be inhibited.
LLOS [a]	Local Loss of Signal	Loss of the DSX-1 input signal.	Cannot be inhibited.
RLOS [a]	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	Remote Alarm Indication Signal	Indicates an AIS (all ones) pattern is being received at the H2TU-R DS1 input port.	Cannot be inhibited.
RAI	Remote RAI—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.
TX RAI-CI	Transmit RAI-CI—Remote Alarm Indication at the H2TU-R	Upon reception of an RAI (yellow alarm) from the CPE, the H2TU-R sends RAI-CI towards 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 [a]	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 [a]	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 threshold limits of approximately 10^{-6}.	Select DIS for the DBER system option.
HBER [a]	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.
PRM-FE	Performance Report Messaging - Far End	Indicates H2TU-R PRM-NE BER threshold is exceeded.	Set DBER threshold to DIS.
PRM-NE	Performance Report Messaging - Near End	Indicates H2TU-R PRM-NE BER threshold is exceeded.	Set DBER threshold to DIS.

(a) Only these alarms assert the System Alarm bus on pins 22 and 30 of the card-edge connector (when the ALM option is enabled).

Alarm Option for Digital Loop Carrier (DLC) Feed

To improve HiGain HDSL2 compatibility with the switch-to-protect features used in DLC feeder applications, the H2TU-C-202 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

Remote LOS and AIS Response

Figure 25 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 17 and Table 6 on page 18.

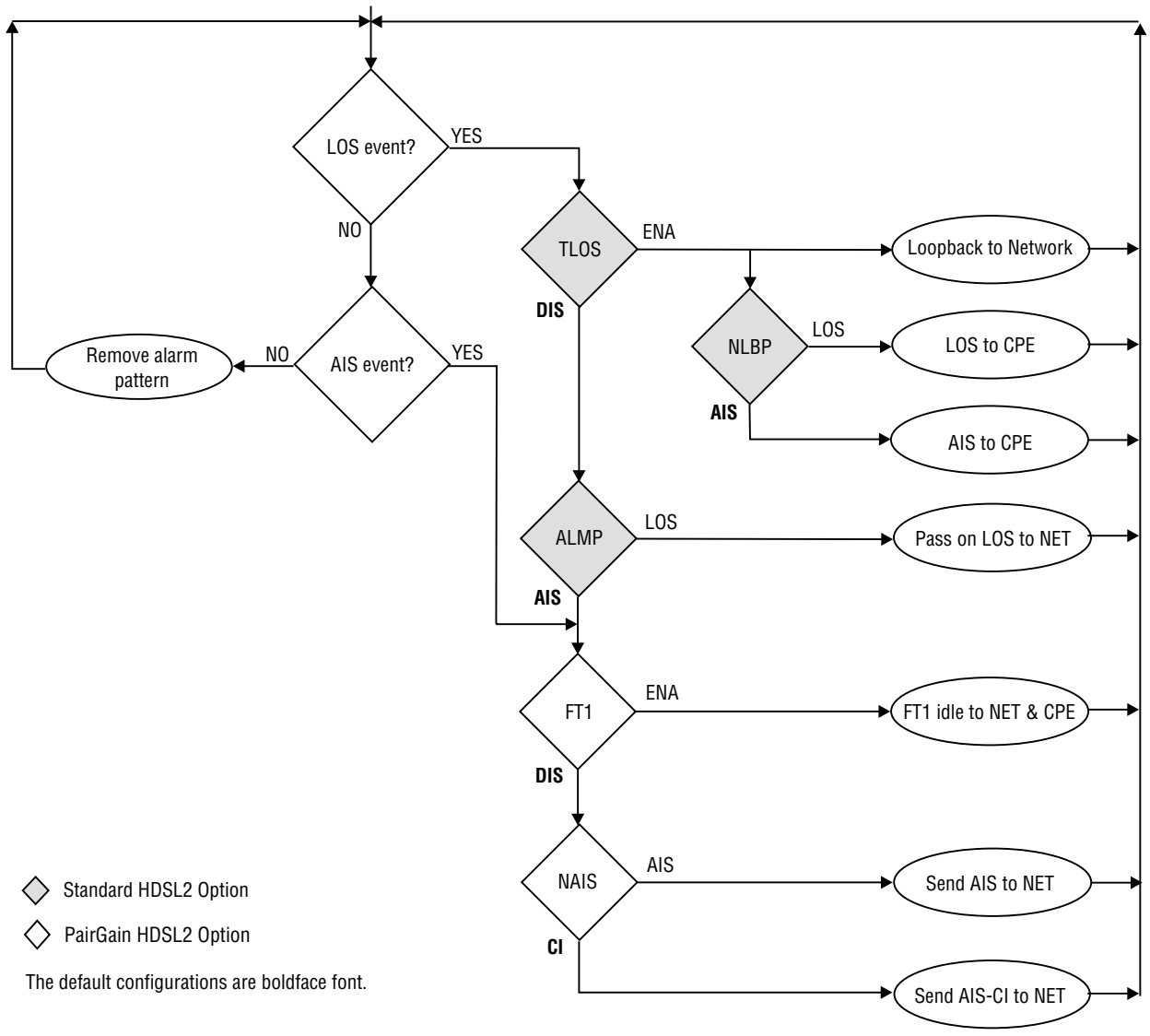


Figure 25. *H2TU-R LOS and AIS Response Priorities*

OCT55 TEST PATTERN WITH AMI LINE CODE

The OCT 55 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 HDSL2 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 (see Table 21 on page 44)
- Special Loopback (SPLB) options (see "Special Loopback Commands" on page 45 and in the following command tables:
  - Addressable Repeater Loopback commands: A2LB (see Table 22, "Addressable Repeater Loopback Commands (A2LB)," on page 48)
  - Addressable Repeater Loopback commands: A3LB, A4LB (Table 23 on page 50)

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. However, SmartJack loopback can be present along with one other network loopback.

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) towards the network. In addition, these inband codes loop up CREM (6-in-7) or CLOC (5-in-7) towards 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 NRG*x* regenerator loopbacks to the network and CRG*x* regenerator loopbacks towards the customer. TLOS is a logic loopback caused by loss of the T1 input from the CI.

Figure 26 on page 43 summarizes the available loopbacks in the system, and Table 21 on page 44 summarizes the HiGain HDSL2 generic loopback commands. See "GNLB Test Procedures" on page 47 for the test procedures that apply when using the GNLB mode.

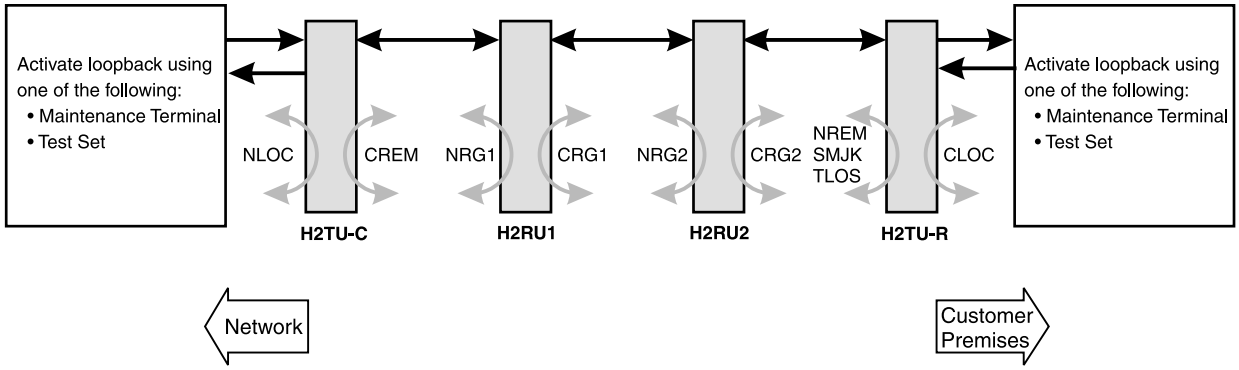


Figure 26. *Loopback Summary*

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

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

Use the inband commands to enable or disable the SMJK loopback options. The H2TU-C-202 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 PairGain Options in the maintenance terminal Config screen (see Table 6 on page 18). 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 48 and Table 23 on page 50 for list of SPLB commands).

A2LB through A4LB are special, addressable, repeater loopback modes that are supported by the H2TU-C-202. 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.

Manual Loopback Session

A manual loopback session allows you to select any one of the HiGain HDSL2 loopbacks listed in Table 21 on page 44 with the exception of SmartJack loopbacks, which can only be issued by inband commands.

Setting the Loopback Time-out Option (LBTO Switch)

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

1 Use the Loopback Time-out parameter from the switch when using a maintenance terminal.

2 Select the desired setting:

- NONE (time-out disabled)
- 120 minutes (default setting)

All loopbacks can be initiated by inband commands in the T1 payload or by a command from the HiGain HDSL2 system (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 HDSL2) 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.

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 interface 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 per Table 6 on page 18. All equalizers should be set to the distance from the DSX-1 to the shelf.

GNLB Test Procedures

Figure 27 is a graphical representation of the various loopback configurations with the associated GNLB commands shown. Also, refer to Table 21 on page 44 for a description of these commands.

To perform the GNLB loopback test procedure:

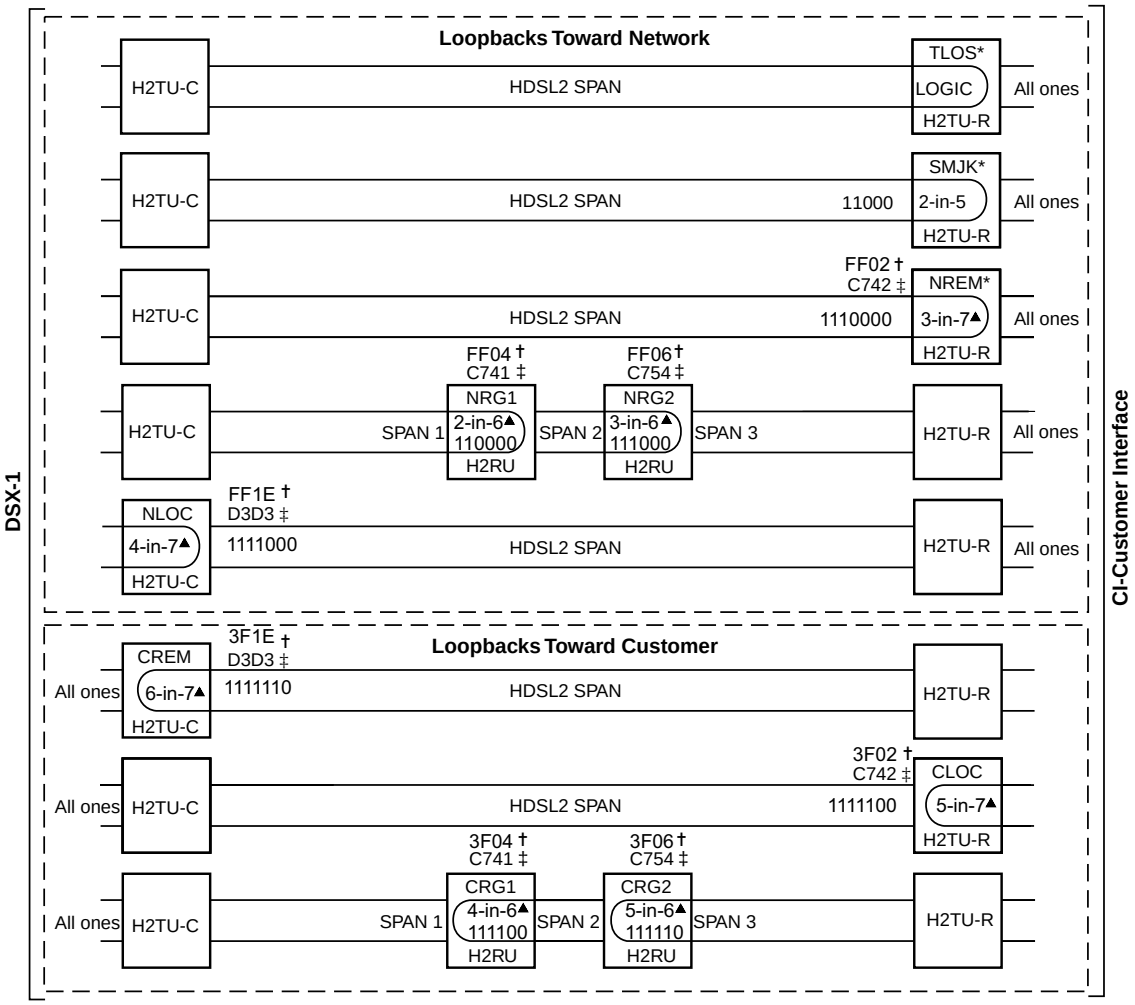
1 Have the CO tester send the NREM (3-in-7) inband loopup code for 5 seconds to loop up the H2TU-R. The loopback mode, NREM, should be identified on the Span Status screen.

2 Have the CO tester transmit a T1 test signal towards the H2TU-C and verify that the signal returned (looped) from the H2TU-R 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. The LBK LED on the front panel should be a steady 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.



* Set the NLBP option to AIS to send AIS (indicated by an all ones pattern) for any network loopback.
† A3LB and A4LB loopback codes.
‡ A2LB loopback codes.
▲ GNLB loopback codes.

Figure 27. *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. 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} Bit Error Rate (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 LBK 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-202 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 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 (see "Setting the Loopback Time-out Option (LBTO Switch)" on page 46). 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 (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-202 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 (see "Setting the Loopback Time-out Option (LBTO Switch)" on page 46) 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 Rate (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 to -56.5 Vdc) (See "Power Consumption" and "Maximum Power Dissipation" and "Maximum Current Drain" on page 52.)
Electrical Protection	Secondary surge and power cross protection on HDSL2 ports. Requires external primary protection.
Fusing	Internal; connected to FUSE ALARM output on pin 25
Environmental	
Operating Temperature	-40 °F to +149 °F (-40 °C to +65 °C)
Operating Humidity	5% to 95% (non-condensing)
Physical	
Height	5.6 in. (14.22 cm)
Width	0.7 in. (1.7 cm)
Depth	5.6 in. (14.22 cm)
Weight	1 lb., 2 oz. (.51 kg)
Mounting	200 and 400 mechanics
HDSL2	
Line Code	1.552 Mbps OPTIS
Transmission	Full duplex
Media	One non-loaded, copper, two-wire cable pair
Output	+16.8 dBm ±0.5 dB at 135 Ω (0-450 kHz) at CO side; +16.5 dBm ±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 $V^{pk\text{-}pk}$ 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 µs 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 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		11.5	12.5	6.0	7.0	270	294

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 HCS-417 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.

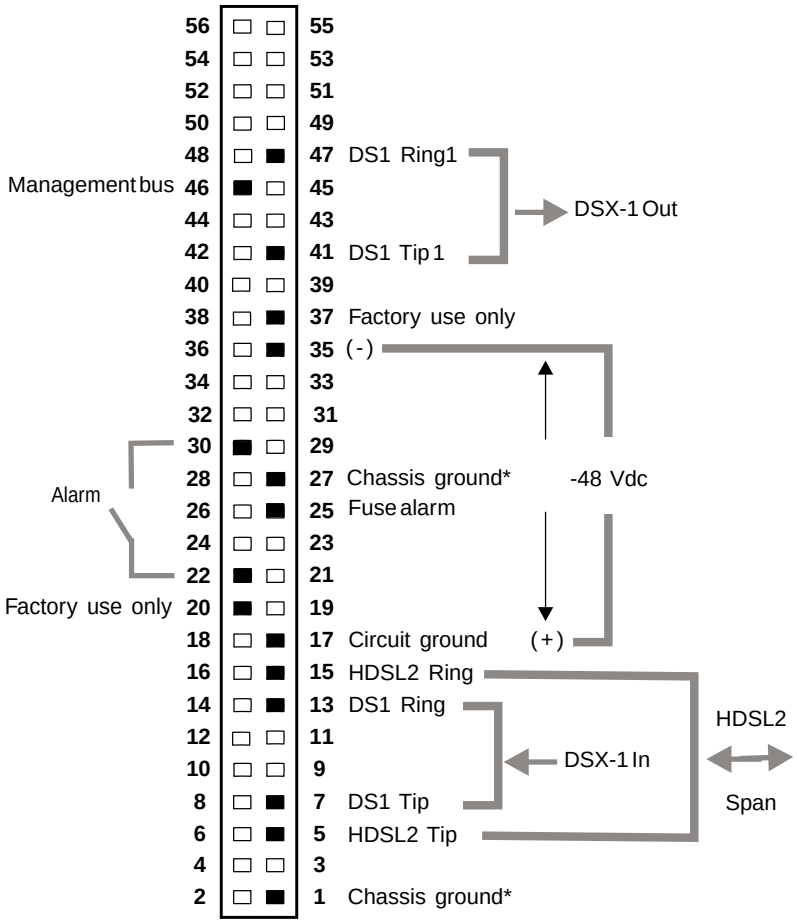
The -42.5 Vdc power consumption is the maximum total power that the H2TU-C consumes or draws from the shelf power source. This parameter is needed when the H2TU-C is in a location remote to the CO it is serving. It determines the battery capacity required to maintain an 8-hour, stand-by battery reserve 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 to perform this analysis.

MAXIMUM CURRENT DRAIN

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

H2TU-C-202 CARD-EDGE CONNECTOR

Figure 28 shows the card-edge connector on the H2TU-C-202.



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

Figure 28. *H2TU-C-202 List 1E Card-edge Connector*

Network Management Control Bus

The H2TU-C provides a Management Bus on pin 46 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.

Fuse Alarm

Pin 25 on the card-edge connector is a Fuse Alarm that is driven to -48 Vdc through a diode whenever its onboard fuse opens.

System Alarm Output Pins

Pins 22 and 30 on the card-edge connector (see Figure 28) are the H2TU-C-202 System Alarm output pins.

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.

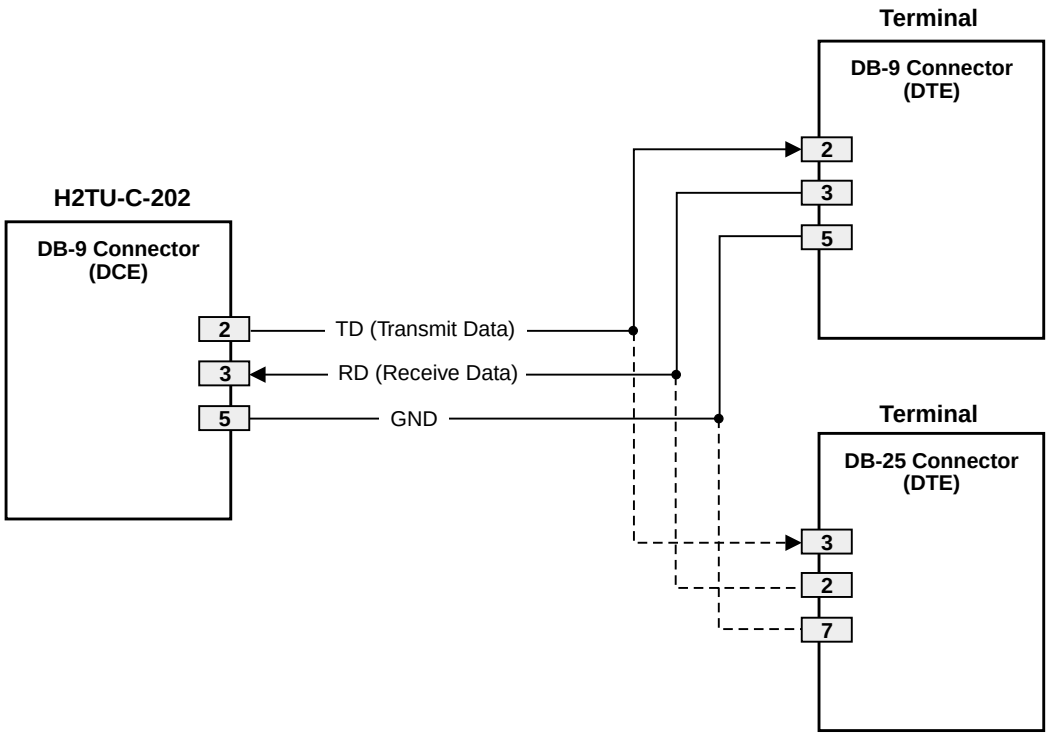


Figure 29. *RS-232 Craft Port Pinouts*

APPENDIX B - FUNCTIONAL OPERATION

ADC's HDSL2 technology provides full-duplex services at standard T1 rates over copper wires between an H2TU-C and an H2TU-R, which comprise one HiGain HDSL2 system. HiGain HDSL2 systems use Overlapped Pulse Amplitude Modulation (OPAM) Transmission with Interlocking Spectra (OPTIS) transceiver systems to establish full-duplex, 1.552 kbps data channels between the H2TU-C-202 and a remotely located H2TU-R.

Figure 30 shows a block diagram of the H2TU-C-202. The H2TU-C-202 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.

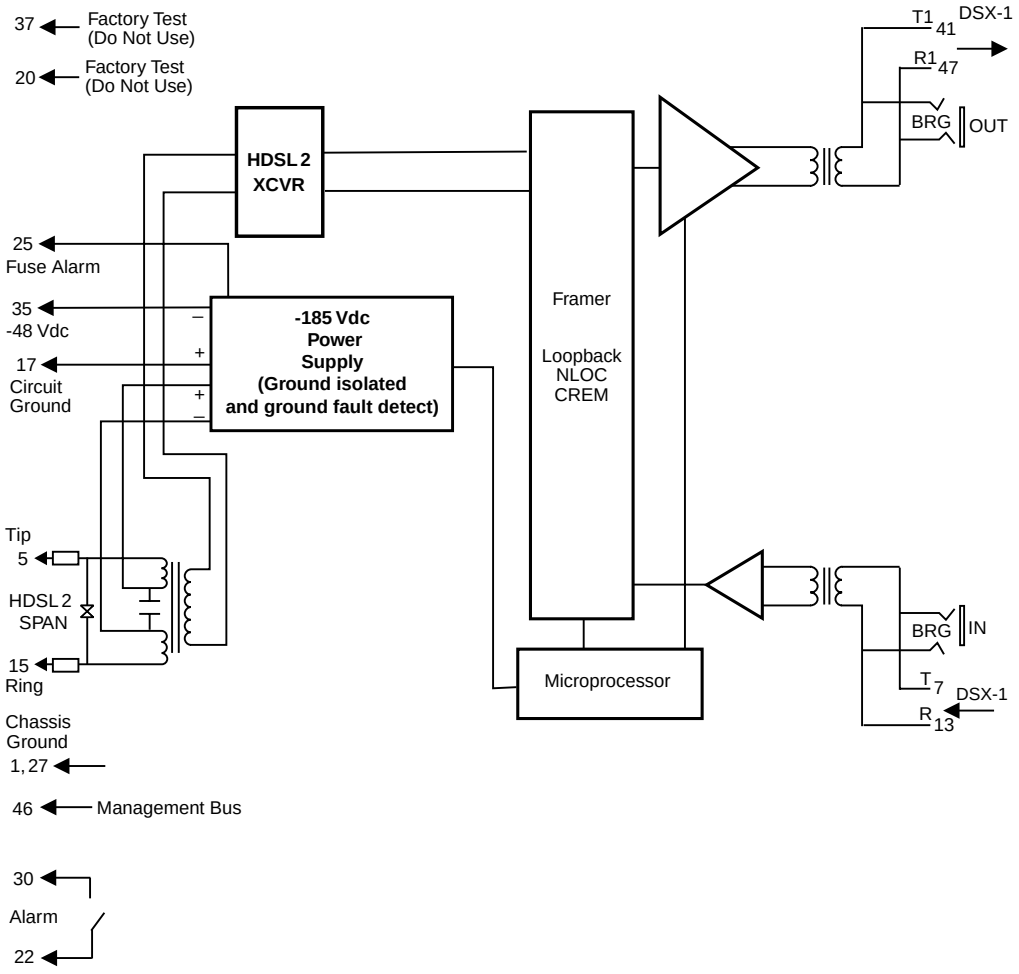


Figure 30. *H2TU-C-202 List 1E Block Diagram*

TIMING

The low loop wander (0.3 UI max) of an H2TU-C, 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 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.

T1 REPEATER SHELVES AND RELATED EQUIPMENT

The H2TU-C-202 List 1E is compatible with the following 200 and 400 mechanics, high-density shelves and enclosures:

- Indoor enclosures
  - HiGain HRE-425 (12-slot)
  - HiGain HRE-204 (4-slot)
  - HiGain HRE-420 (1-slot)
  - HiGain HRE-443 (3-slot)
- Shelves
  - HiGain HCS-340 (3-slot)
- Outdoor enclosures
  - HiGain HRE-454, List 5 and List 6 (4-slot)

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

APPENDIX E - ABBREVIATIONS

A

ACO: Alarm Cut Off
ACON: Auto Conversion of DS1 frame
ADSL: Asymmetric Digital Subscriber Line
AIS: Alarm Indicator Signal
ALM: Alarm
AMI: Alternate Mark Inversion
AWG: American Wire Gauge

B

B8ZS: Bipolar with 8-zero Substitution
BBS: Bulletin Board System
BER: Bit Error Rate
BPV: Bipolar Violation
BPVT: Bipolar Violation Transparency
BRG: Bridge

C

CI: Customer Interface
CLEI: Common Language Equipment Identifier
CLOC: Customer Local Loopback
CO: Central Office
CP: Customer Premises
CPE: Customer Premises Equipment
CRC: Cyclic Redundancy Check
CREM: Customer Remote Loopback
CRG: Customer Regenerator Loopback
CSA: Carrier Service Area
CV: Code Violation

D

DBER: DS1 Bit Error Rate
DDS: Digital Data Service
DIP: Dual In-line Package
DLC: Digital Loop Carrier
DS1: Digital Signal, level 1
DSX-1: DS1 Cross-connect Frame

E

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

F

FCON: Forced Conversion of DS1 Frame
FE: Far End
FT1: Fractional T1

G

GNLB: Generic Loopback

H

H2RU: HiGain HDSL2 Regenerator Unit
H2TU-C: HiGain HDSL2 Line Unit
H2TU-R: HiGain HDSL2 Remote Unit
HBER: HDSL2 Bit Error Rate
HCDS: High Capacity Digital Service
HCS: HiGain Central Office
HDSL2: High bit-rate Digital Subscriber Line 2
HG: HiGain
HMU: HiGain Management Unit
HRE: HiGain Remote Enclosure

I

ILR: Intelligent Line Repeater
IOR: Intelligent Office Repeater
IR: Intelligent Repeater

L

LA: Loop Attenuation
LBTO: Loopback Timeout
LED: Light Emitting Diode
LOS: Loss of Signal
LOSW: Loss of Sync Word
LPF: Line Power Feed

M

M: HDSL2 Margin
MSEC: Monitored Seconds

N

NE: Near End
NI: Network Interface
NID: Network Interface Device
NIU: Network Interface Unit
NLOC: Network Local Loopback
NMA: Network Management and Administration
NPRM: Network PRM
NREM: Network Remote Loopback
NVRAM: Non-volatile Random Access Memory

O

OOF: Out Of Frame
OPTIS: Overlapped Pulse Amplitude Modulation (PAM) Transmission with Interlocking Spectra

P

PDVS: Pulse Density Violation Seconds
PL: Payload
POTS: Plain Old Telephone Service
PRM: Performance Report Messaging
PWRF: Power Feed

R

RAI: Remote Alarm Indication
RLOS: Remote Loss of Signal
RMA: Return Material Authorization

S

SDSL: Symmetrical Digital Subscriber Line
SES: Severely Errored Seconds
SF: SuperFrame
SMJK: SmartJack
SPLB: Special Loopback
SPRM: Supplemental PRM

T

TLOS: Transmit Loss of Signal

U

UAS: Unavailable Seconds

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 sixty (60) months from the date of shipment, the hardware portion of its products will be free of material defects and faulty workmanship under normal use. ADC's obligation, under this warranty, is limited to replacing or repairing, at ADC's option, any such hardware product which is returned during the 60-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-202 List 1E has been tested and verified to comply with the applicable sections of the following standards:

- GR 63-CORE - Network Equipment-Building System (NEBS) Requirements
- GR 1089-CORE - Electromagnetic Compatibility and Electrical Safety
- Binational standard, UL-1950/CSA-C22.2 No. 950-95: Safety of Information Technology Equipment

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ISO 9001
DNV
DNV Certification, Inc.
Certificated Firm

DOCUMENT: 152-202-115-04, REVISION 4

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