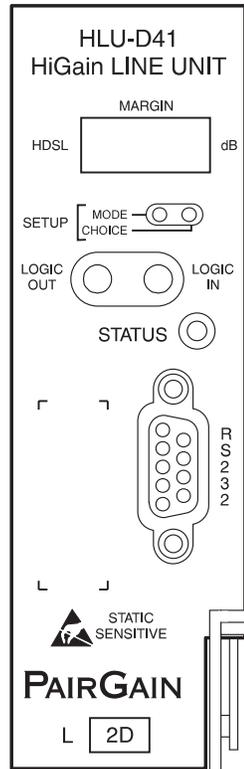


# HIGAIN LINE UNIT

Model	List Number	Part Number	CLEI Code
HLU-D41	2D	150-1260-24	T1L2BE0AAA



**PAIRGAIN TECHNOLOGIES, INC.**  
**ENGINEERING SERVICES TECHNICAL PRACTICE**  
**SECTION 150-441-124-01**

**Revision History of this practice.**

June 12, 1997  
A) Initial Release

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## USING THIS TECHNICAL PRACTICE

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The following conventions are used in this practice:

- Keys that are pressed on the keyboard are enclosed in brackets.  
Press the <Enter> key.
- Options selected using the front panel Mode and Choice Setup buttons and the Maintenance Terminal menus are italicized.  
The *Network Loopback* option can be set to *Enable* or *Disable*.
- Fields are identified with quote marks.  
Table 14 lists the "Alarm" messages and descriptions.

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



**A note informs you of special circumstances.**



**A caution indicates the possibility of equipment damage.**



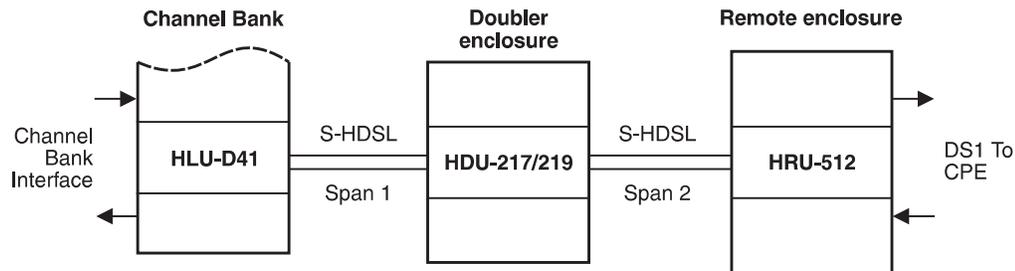
**A warning indicates the possibility of personal injury.**



## A. PRODUCT OVERVIEW

### 1. Description and Features

- 1.1** This technical practice describes the PairGain® HiGain™ HLU-D41 List 2D, a HiGain Line Unit (HLU) which functions as the Central Office (CO) side of a repeater-less Fractional T1 (FT1) transmission system. The HLU-D41 can be plugged into a channel unit slot of a D4 channel bank or an SLC-96 channel bank. This practice describes using the HLU-D41 with and without HiGain Doubler Units (HDUs). The software version number for this release is 2.3.
- 1.2** Figure 1 shows a basic HiGain configuration for an FT1 Single-pair High-bit-rate Digital Subscriber Line (S-HDSL) circuit. The HLU-D41 is installed at the CO channel bank and the HRU-512 is housed in a remote enclosure at the Customer Premises Equipment (CPE) site. The optional HDU-217 or HDU-219 installed in a doubler enclosure provides the ability to double or even triple the transmission distance range for customer applications located outside the Carrier Service Area (CSA). The CSA includes loops up to 12000 feet of AWG 24 or 9000 feet of AWG 26 wire, including bridged taps.

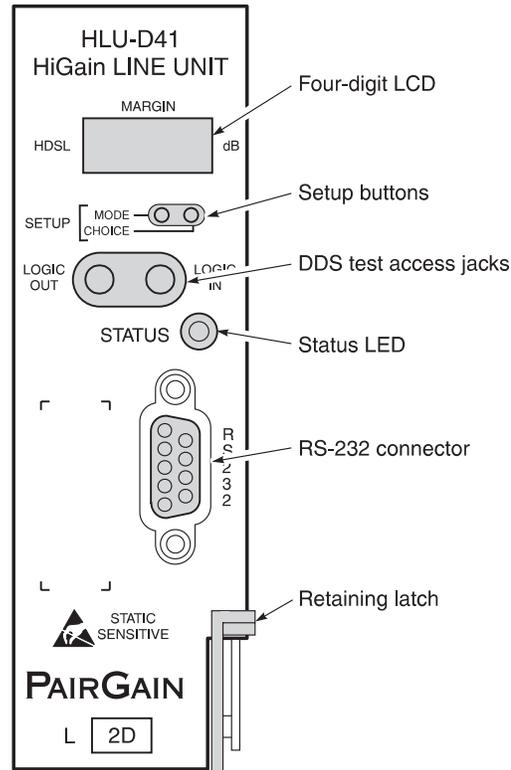


*Figure 1. Typical HiGain S-HDSL System*

#### 1.3 HLU-D41 List 2D features

- Selectable payload bandwidth from 64 kbps (one channel) to 768 kbps (12 channels) in 64 kbps increments over the full CSA
- Front panel:
  - DS1 splitting and bridging access
  - Status LEDs and user option setup buttons
  - LCD display of HDSL margin, configuration parameters, and alarms
- Automatic front panel display power saving timer
- RS-232 connector for setting options from the Maintenance Terminal
- Responds to Digital Data Service (DDS), Network Element Interface (NEI), and Office Channel Unit (OCU) loopback codes
- Provisionable idle code (7F or FF) on unused channels
- Lightning and power cross protection on S-HDSL interface
- 200V power feed can line power two spans (one doubler and one remote, or two doublers and a locally-powered remote)

**1.4 Front Panel.** Figure 2 and Table 1 describe the HLU-D41 front panel. The four-digit LCD and the status LEDs indicate different system states.



*Figure 2. HLU-D41 Front Panel*

*Table 1. HLU-D41 Front Panel Components*

Name	Function
Four-digit LCD	Shows HDSL conditions, system options, messages and alarm states (see Section 12). Alarm messages are listed in Section 6.
Mode and Choice Setup buttons	Set system options (see Section 12).
DDS test access jacks	Bantam jacks designated as Logic Out and Logic In for high-speed DDS test access.
Status LED	Indicates status, warnings, and alarm conditions (see Table 2).
RS-232 connector	Configured as Data Circuit-Terminating Equipment (DCE) which allows you to control the HLU-D41 through a dumb terminal (or a PC with terminal emulation software).
Retaining latch	Latch used to retain the HLU-D41 in the channel bank.

**Table 2. Status LED Messages**

<b>Color</b>	<b>Definition</b>
Green	Normal operation
Flashing Green	HDSL acquisition
Red	Fuse Alarm
Flashing Red	Minor alarm (For conditions see Section 6.1, Table 5).
Yellow	Self-test in process or a Customer Remote (CREM) or Network Local (NLOC) loopback is in effect.

## 2. Specifications

### S-HDSL

Line Code .....	768 kbps 2B1Q
Output.....	+13.5 dB $\pm$ 0.5 dB at 135 ohms
Line Impedance .....	135 ohms
Start-up Time.....	30 seconds (typical), 60 seconds (maximum) per span
Span Voltage.....	-200 Vdc
Compliance.....	TA-TSY-001210

### Maximum Provisioning Loss

35 dB at 196 kHz, 135 ohms

### Line Clock Rate

Internal Stratum 4 clock

### Maximum Power Consumption

Without doubler .....	10 W
With doubler .....	14 W

### Maximum Heat Dissipation

Without doubler .....	3 W
With doubler .....	6 W

### Electrical Protection

Secondary surge protection on DS1 and HDSL ports. Power cross protection on HDSL ports.

### Environmental

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

### Mounting

Single channel unit slot of a D4 or SLC-96 channel bank.

### DS1

Line Rate .....	1.544 Mbps $\pm$ 200 bps
Line Format .....	AMI, B8ZS or ZBTSI
Frame Format.....	ESF or SF

## Dimensions

Height.....	4.5-inch (11.4 cm)
Width .....	1.4-inch (3.6 cm)
Depth.....	10.1-inch (25.7 cm)
Weight.....	0.7 lb. (.32 kg)

## Margin Indicator

Displays HDSL span Signal-to-Noise Ratio (SNR) margin relative to  $10^{-7}$  Bit Error Ratio (BER) operation

## 3. Applications

- 3.1** This HiGain system provides a cost-effective, easy-to-deploy method for delivering FT1 service over a single metallic pair. Conventional in-line T1 repeaters are not required. Cable pair conditioning, pair separation and bridged tap removal are not required.
- 3.2** General guidelines require that the loop has less than 35 dB of loss at 196 kHz, with 135 ohms driving and terminating impedances. Table 3 provides a guide for the loss of various cable gauges at 196 kHz and 135 ohms. The table applies to the HDSL cable pairs between the HLU, HRU and HDU modules. Without specific insertion loss measurement data, add 3 dB for each bridged tap and 1 dB for each cable gauge change.

*Table 3. HDSL Loss Over Cables*

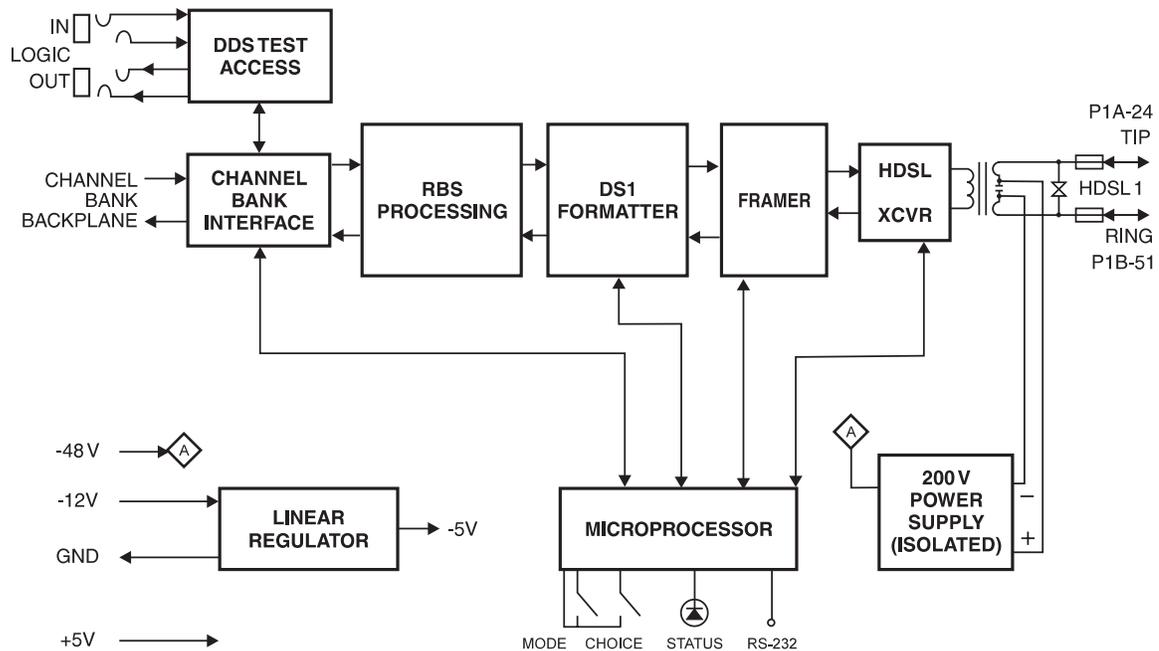
Cable Gauge	Loss at 196 kHz (dB/kft)	Ohms per kft
26/0.4 mm	3.88	83
24/0.51 mm	2.84	52
22/0.61 mm	2.18	32
19/0.91 mm	1.54	16

**3.3** HiGain systems:

- Operate with any number of other T1, Plain Old Telephone Service (POTS), DDS or other HiGain systems sharing the same cable binder group.
- Can be used with customers requiring FT1 service on a temporary or permanent basis.
- Provide a means of quickly deploying service in advance of fiber-optic transmission systems.
- Are easily installed allowing service to be provided within hours. Fiber optic systems can be installed at a leisurely pace and cut-over from the installed HiGain system when convenient to do so. The installed HiGain system can then be easily removed and utilized elsewhere.

## 4. Functional Operation

4.1 The HLU-D41 block diagram is shown in Figure 3.



*Figure 3. HLU-D41 Block Diagram*

The HLU-D41 uses one PairGain Technologies 2B1Q HDSL transceiver to establish a full duplex 784 kbps data link to the remote unit in the following sequence:

- 1 Multiplexed DS0 channels are extracted from the channel bank backplane. The number of channels extracted is determined by the *BAND* option setting using the front panel Mode and Choice Setup buttons, or the *DS0 BANDWIDTH* option using the Maintenance Terminal menus.
- 2 The DS0 channels optioned for A/B Robbed Bit Signaling (RBS) are properly formatted, then the DS0 channels are passed to the DS1 formatter which builds a DS1 signal.
- 3 The formatter inserts DS1 framing information and generates the Idle Code (7F or FF) to complete a 12 DS0 payload for the half-DS1 signal, then the half-DS1 signal is passed to the HDSL framer.
- 4 The framer bit stuffs the half-DS1 signal into the HDSL payload envelope and adds the required HDSL overhead.
- 5 The 784 kbps HDSL signal is encoded by the single pair transceiver into a 2B1Q signal.
- 6 The 2B1Q signal is coupled to the twisted pair line by a transformer in the line interface, which allows the line interface to provide lightning and power cross protection.
- 7 The 784 kbps signal from the remote HDSL transceiver is received by the HDSL line interface.
- 8 The single pair transceiver does a two-wire to four-wire conversion of the signal using echo-canceling technology, then the signal to be transmitted toward the channel bank is processed by the HDSL framer which monitors its signal quality.
- 9 Detected errors are reported to the micro-processor, the payload is extracted, and up to 12 DS0 channels are transmitted to the channel bank, with the DS1 formatter locating the first DS0 in

the payload. An 8-bit microprocessor is used to monitor and control the HLU-D41. Provisioning status information is provided either through the HLU-D41 Maintenance Terminal menus or the front panel Mode and Choice Setup buttons, to the microprocessor. The microprocessor communicates with the HDSL framer for signal status and configures the circuit bandwidth at the DS0 channel interface.

## 5. Power Consumption and Powering the Remote Unit

- 5.1 The primary power demands of an HLU-D41 on the channel bank power supply are listed in Table 4 on a per slot basis.

**Table 4. Power Consumption and Power Dissipation**

Power*	Per Slot
Maximum Power Consumption	
Line-powered remote unit	14 W
Locally-powered remote unit	10 W
Maximum Power Dissipation	
Line-powered remote unit	6 W
Locally-powered remote unit	3 W
The worst case conditions under which these parameters are measured include a 9,000 ft., 26 AWG loop configuration.	

- 5.2 The maximum number of channel bank slots that can be occupied by HLU-D41 units is a function of the type of bank and the capabilities of its common power supply. The limiting factor is the drain on the bank's +5V power supply. The HLU-D41 draws 295mA of +5V power when the HRU is locally powered and 325mA when the HRU is line powered. The worst case +5V current drain for D4 common equipment is 1.2A.

- 5.3 **Line and Local Powering of the Remote Unit.** The HLU-D41 is designed to either power the HRU-512 over the HDSL cable pair, or allow the HRU-512 to be powered from the remote end. The HLU-D41 determines the power state of the HRU-512 before attempting to apply line power:

- If the HRU-512 is remotely powered, the HLU-D41 does not apply line power.
- If the HRU-512 is not remotely powered, the HLU-D41 applies power to the HRU-512 over the HDSL cable pair.

The line power supply can be turned on or off by using the *PWRF* (power feed) system option setting and is automatically shut down in the presence of line short circuits or a microprocessor failure.

The HRU-512 also provides from 14 mA (long loop) to 16 mA (short loop) of metallic sealing current toward the HLU-D41, when the HRU-512 is locally powered. To enable the sealing current capability when the HRU-512 is locally powered, connect JP2 across both terminals.

To configure the system for HLU-D41 line powering

- 1 At the HRU-512, connect JP2 across just one of the two terminals. These are the factory default settings.
- 2 Enable the *PWRF* option setting using the front panel setup buttons, or the Maintenance Terminal menus using the *POWER* option in the System Settings menu.

See the *PairGain Technologies HiGain-1 FT1 Remote Unit, Model HRU-512, Issue 1 Technical Practice* (Part No. 150-512-100-02) for further information.

- 5.4 Power Conversion.** The HLU-D41 contains two separate power converters. The linear regulator converts the D4 channel bank dc power (+5 Vdc and -12 Vdc) to logic power for the HLU-D41 circuits. The line power supply converts the D4 channel bank dc power (-48 Vdc) to a -200 Vdc feed to power the HRU-512.
- 5.5** A Pulsecom 325A Power Converter, or equivalent, supplies 5A at +5V, allowing up to 11 HLU-D41 units per D4 channel bank.
- The 325A D4 channel bank power converter supplies 3A at +5V. That leaves 1.8A for the 48 channel slots or 37mA per slot. This translates to 1.8/.325A or a maximum of five (5) HLU-D41 units per D4 channel bank (two to three units per digroup).
- The PCU SLC-96 power converter supplies 3.2A at +5V. This leaves 2A for the 48 dual channel slots, which translates to 2/.325 or a maximum of six (6) HLU-D41 units per SLC-96 channel bank. If the enhanced PCU 325A converter, which supplies 5A is used, a maximum of 12 HLU-D41 units per SLC-96 channel bank can be used. Apply these same rules to calculate the maximum number of HLU units per channel bank for channel bank power supplies with different capacities.
- 5.6 Front Panel LCD Power Saving Timer.** The four-digit front panel LCD is activated when power is initially applied to the line unit. To conserve power, the display remains active for only four minutes if neither the Mode or Choice setup buttons are pressed. The use of either button re-activates the four-digit display and restarts the four minute power saving timer.

## 6. Alarms

- 6.1 Front-Panel Alarm Displays.** The HLU-D41 Status LED flashes red for the duration of a minor alarm condition. Table 5 lists the HLU-D41 alarms that can be displayed in the front-panel LCD (these alarm conditions display in the "Alarms" field of the View Span Status screen as well). The message "ALRM" appears one time in the front panel LCD prior to the display of the alarm condition message.
- The front panel message that accompanies each alarm condition is listed in the "Alarm" column.
  - Since more than one alarm condition can exist at any time, but only one message can be displayed, only the highest priority alarm is displayed if more than one alarm condition exists.
  - The alarms are listed in their order of priority.

*Table 5. Alarm Conditions*

Alarm	Reason
LOSW	The HDSL loop has lost sync.
MOOS	The channel bank is out of sync.
RLOS	Loss of HRU-512 DS1 input signal.
HES	The HDSL Loop has exceeded the 24 hour user-selected Errored-Seconds Cyclic Redundancy Check (CRC) threshold (set at front panel using the <i>ESAL</i> option or at the System Settings menu using <i>ES ALARM THRES</i> ).
DS1	The total number of Bipolar Violations (BPV) at the HRU-512 DS1 input has exceeded the 24-hour user-selected threshold (set at the front panel using the <i>DS1</i> option or at the System Settings menu using <i>DS1 LINE CODE</i> ).
MAL	The margin on the HDSL Loop has dropped below the minimum threshold value set using the Margin Alarm Threshold option as described in Section 18.12.

- 6.2 Provisioning the HLU-D41 Alarms.** The HLU-D41 alarms are provisioned via the front-panel Setup buttons or provisioning menus:
- The ALRM HES and ALRM DS1 alarms can be suppressed by selecting *NONE* for the Errored Seconds Alarm (ESAL) system option using the Mode and Choice Setup buttons (see Section 12) or the Maintenance Terminal menus (see Section 18.6).
  - The MAL alarm can be disabled by setting the margin alarm threshold to 0.
  - A Minor Alarm can be turned off by pressing the Choice Setup button on the front panel. This also replaces the ALRM message displayed at the LCD front panel with the ACO (Alarm Cut Off) message. The second part of the ALRM message, which defines the cause of the alarm, remains. Both messages remain until the alarm condition clears or another alarm occurs.
- 6.3** When the HDSL loop loses sync word (LOSW), a minor alarm condition exists but because the HLU-D41 enters a self test cycling mode, the front panel LED lights yellow instead of red and the Self Test message is displayed instead of an ALRM message.



See Table 14 in Section 16 for alarm messages that display in the "Alarms" field of the View Span Status screen.

## B. INSTALLATION

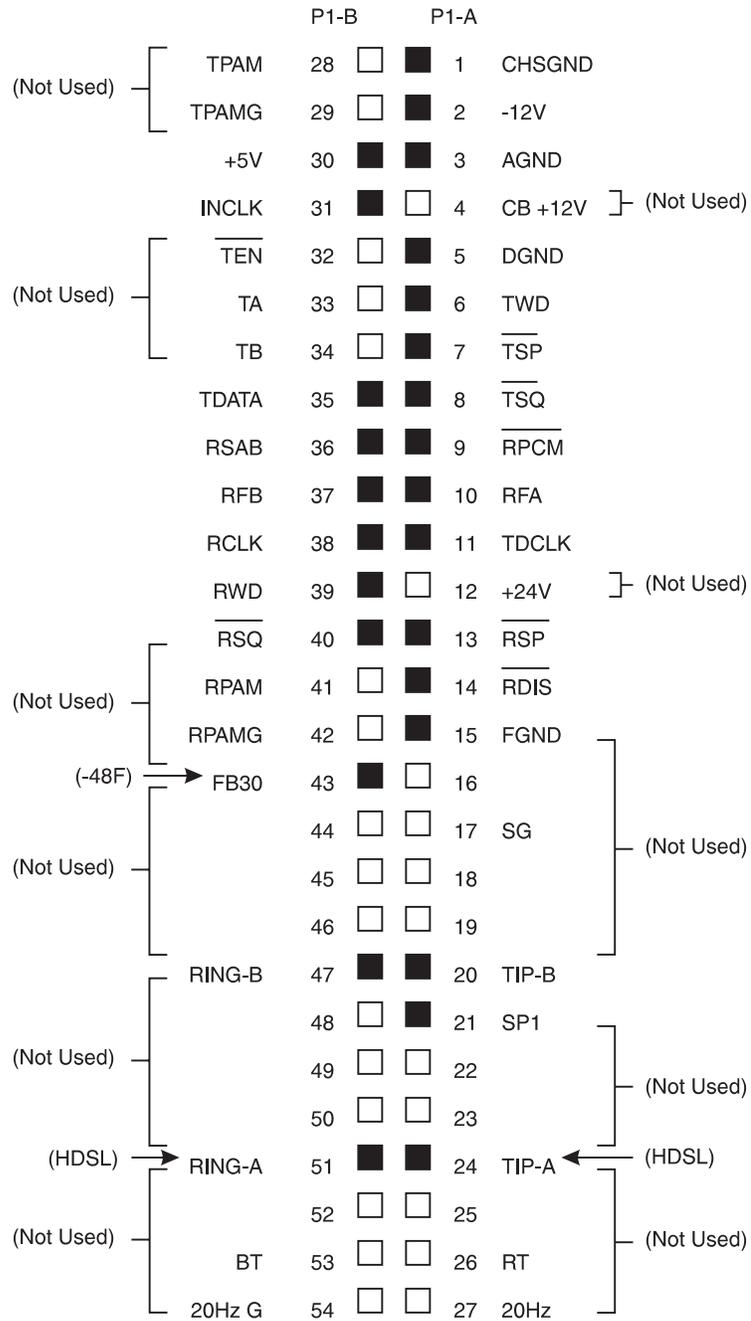
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### 7. Inspecting Your Shipment

- 7.1** When you receive the equipment, inspect it for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to PairGain.
- 7.2** Your shipment should consist of:
- One HLU-D41 List 2D
  - This document

## 8. HLU-D41 Card Edge Pin-Out Diagram

**8.1** The HLU-D41 occupies one slot in an AT&T-type D4 channel bank or equivalent SLC-96 bank. The card edge pin-out diagram for the HLU-D41 is shown in Figure 4.



Highlighted pins are used by the HLU-D41. All other pins are D4 Channel Bank signals.

**Figure 4.** HLU-D41 Card Edge Pin-outs

- 8.2** More than one HLU-D41 may be installed in a channel bank. The physical time slots are identical to the electrical DS0 time slots in D4 banks. Physical slots match the DS0 time slots as shown in Table 6. Depending on the slot position of the HLU-D41 and its bandwidth, certain channel bank slot positions will not be available for use by other line units.

*Table 6. Channel Bank Slot Positions*

Physically Installed Channel Slot	Number of Provisioned Time Slots	Next Available DS0 Time Slot
1	8	9
12	6	18
20	4	24
20	6	not recommended



The last example in Table 6 is not recommended because its bandwidth exceeds the 24-slot single digroup limit. This would require the HLU-D41 to wrap around and add time slots 1 and 2 to 20 through 24. Most channel banks have a gaped clock which prohibits this wrap feature.

- 8.3 Mode III Operation.** The HLU-D41 can be used in SLC-96 banks configured for Mode III (special service) operation. Since SLC-96 channel slots do not receive signaling frame information, SLC-96 HLU-D41 applications cannot be configured for RBS and are restricted to the CLR signaling option. Table 7 shows the relationship between the physical and DS0 time slots for various settings of Band and Slot for the two SLC-96 channel counting options. In addition, Mode III has two channel counting sequences, such that the physical channel slots are not identical to the DS0 time slots. The Mode III D1D and D4 channel counting sequences are shown in Table 8.

*Table 7. Relationship Between Physical Slots and Timeslots in SLC-96 Banks*

Timing mode	Band	Slot*	Physical slot	DS0 time slots	Blocked physical slots
DID	768K	CONT	3	11, 12, 13, 14, 15...22	3, 9, 16, 22, 4, 10, 17, 23, 5, 11, 18, 24
DID	256K	ALT	16	13, 15, 17, 19	16, 4, 17, 5
D4	768K	CONT	5	9, 10, 11...20	5, 17, 6, 18, 7, 19, 8, 20, 9, 21, 10, 22
D4	256K	ALT	18	18, 20, 22, 24	21, 22, 23, 24

\* CONT=Contiguous slot setting  
ALT=Alternating slot setting

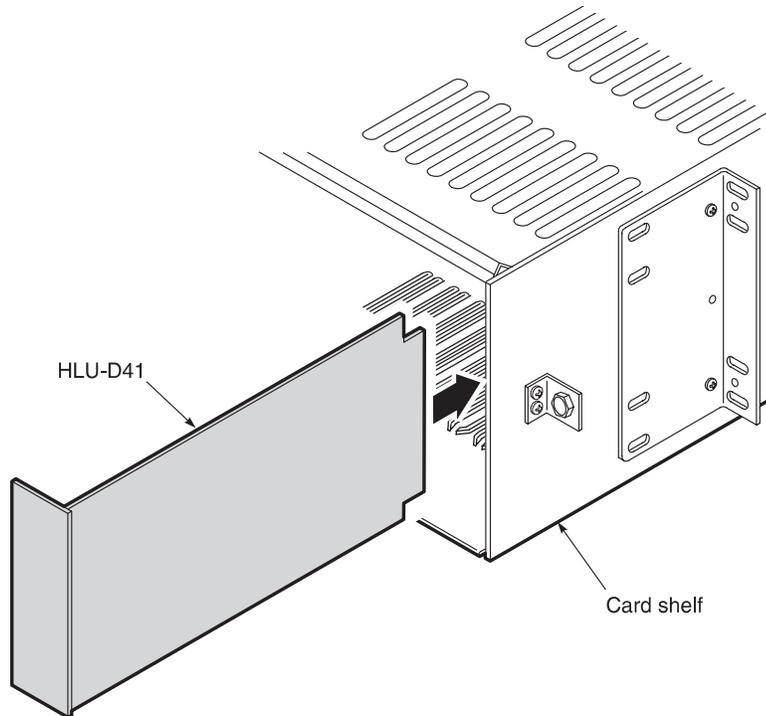
See Section 12 if configuring timeslots using the front panel Mode and Choice Setup buttons, or Section 18.9 if configuring timeslots using the Maintenance Terminal menus.

**Table 8. Channel Counting**

<b>D4 Channel Counting</b>												
Physical Slots	1	2	3	4	5	6	7	8	9	10	11	12
Time Slots	1	2	3	4	5	6	7	8	9	10	11	12
Physical Slots	13	14	15	16	17	18	19	20	21	22	23	24
Time Slots	13	14	15	16	17	18	19	20	21	22	23	24
<b>SLC-96 Mode III D1D Channel Counting</b>												
Physical Slots	1	2	3	4	5	6	7	8	9	10	11	12
Time Slots	3	7	11	15	19	23	4	8	12	16	20	24
Physical Slots	13	14	15	16	17	18	19	20	21	22	23	24
Time Slots	1	5	9	13	17	21	2	6	10	14	18	22
<b>SLC-96 Mode III D4 Channel Counting</b>												
Physical Slots	1	2	3	4	5	6	7	8	9	10	11	12
Time Slots	1	3	5	7	9	11	13	15	17	19	21	23
Physical Slots	13	14	15	16	17	18	19	20	21	22	23	24
Time Slots	2	4	6	8	10	12	14	16	18	20	22	24

## 9. Installing the HLU-D41

9.1 The HLU-D41 is installed in a single-channel unit slot of a D4 or SLC-96 channel bank (Figure 5).



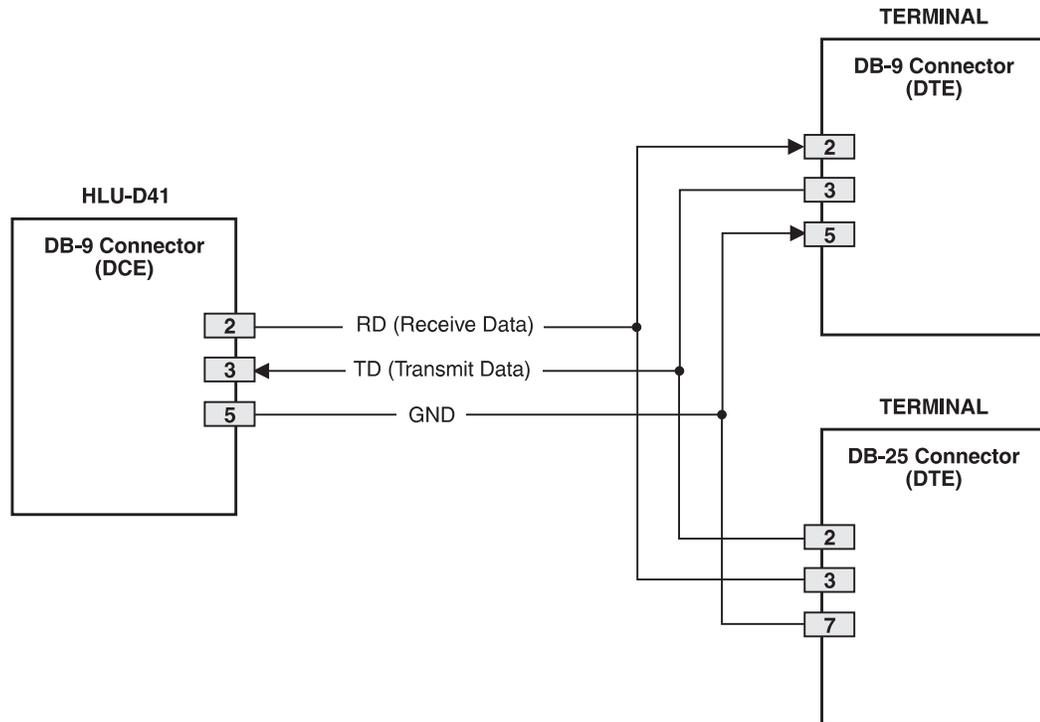
**Figure 5.** *Installing an HLU-D41 in a Channel Bank*

To install the HLU-D41 into a channel bank:

- 1 Slide the HLU-D41 into the card guides for the desired slot, then push the unit in until it touches the channel-bank backplane card-edge connector.
- 2 Push the unit in until it is entirely within the card guide and the retaining latch locks into place indicating that the unit is properly seated.

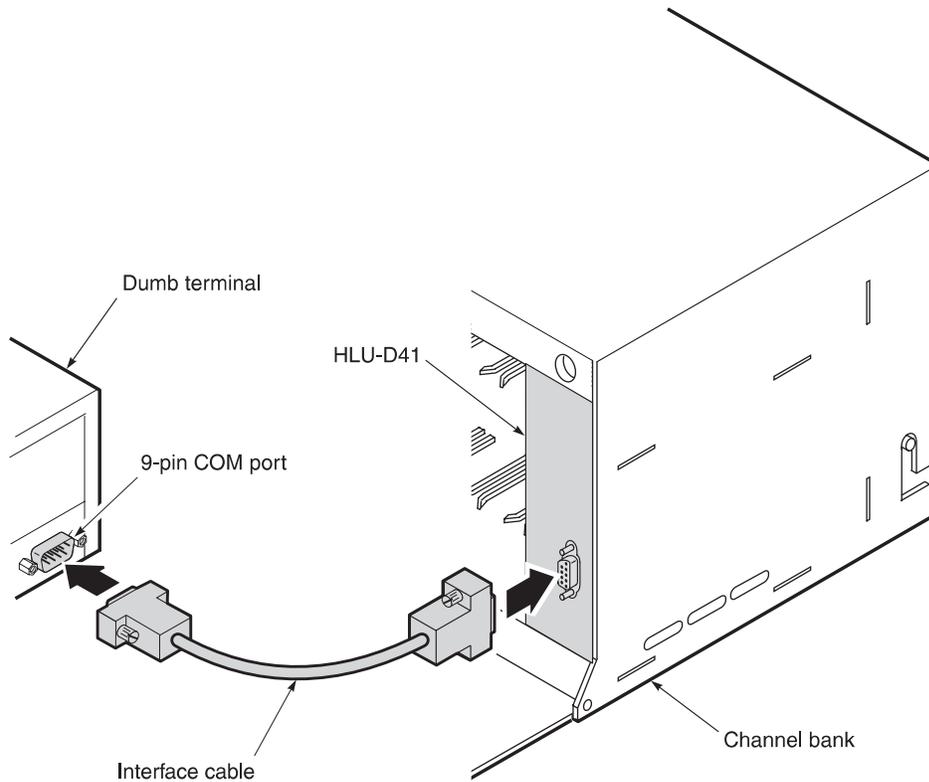
## 10. Connecting to a Dumb Terminal

- 10.1** The 9-pin RS-232 connector on the front of the HLU-D41 allows you to connect your system to a dumb terminal or PC running a terminal emulation program with a standard RS-232 cable. Once connected to a dumb terminal, you can access the maintenance, provisioning, and performance screens. Figure 6 shows the HLU-D41 DB-9 RS-232 I/O.



*Figure 6. DB-9 RS-232 I/O*

- 10.2** The dumb terminal is configured as DCE. To connect the HLU-D41 to a dumb terminal, connect the RS-232 COM port of the dumb terminal to the HLU-D41 front panel RS-232 connector using a serial cable (Figure 7):



*Figure 7. Connecting the HLU-D41 to a Dumb Terminal*

## 11. Initialization

- 11.1 Power-up Sequence.** When an HLU-D41 is first inserted into a channel bank, its bandwidth and slot settings may exceed the intended setting for the new application. This could disrupt service in an existing channel bank for the active channel timeslots if the HLU-D41 slot configuration conflicts with another channel card's DS0 data. A special power-up sequence is built into the HLU-D41 to preclude this interference with another channel card's DS0 data during the power-up initialization mode.
- 11.2 Time Slot Assignments for Remote Units and Line Units.** When installing the fractional T1 circuit, remember that the data at the remote unit (customer) side always begins at time slot 1 and continues through the number of time slots provisioned. Data at the line unit begins at the time slot assigned to the line unit's physical slot position. For example, if the line unit is installed in the D4 channel bank in position 13 and the circuit is provisioned for four contiguous time slots of bandwidth, then the data will be in time slots 13, 14, 15, and 16 at the line unit, but in time slots 1, 2, 3, and 4 at the remote unit.

## C. SETTING OPTIONS FROM THE FRONT PANEL

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### 12. Using the Mode and Choice Setup Buttons

- 12.1 Option Settings.** The Mode and Choice Setup buttons are used to set the system options from the front panel. Table 9 lists the system options and defines each of the modes and settings. Options are listed in the sequence in which they appear in the front panel LCD. Table 10 lists the four-digit LCD messages. The front panel LCD has a maximum display of four digits, thus the first part of a two-part message blinks for one second followed by the second part of the message.



**The following three user options cannot be set using front panel Mode and Choice Setup buttons, but must be set using the Maintenance Terminal menus: Circuit ID, Margin Alarm Threshold, and Signaling.**

**Table 9. System Options**

<b>Mode</b>	<b>Choice</b>	<b>Description</b>
IDLE	FF*	Blocked channels are filled with Hex transmit code FF.
	7F	Blocked channels are filled with Hex transmit code 7F.
LPBK	DIS*	Disables the activation of NREM by NEI DDS code.
	ENA	Enables the activation of NREM by NEI DDS code.
PWRF	DIS	Prevents line powering over the HDSL pair.
	ENA*	Allows line powering over the HDSL pair.
ESAL	17	Causes a minor alarm display (flashing red Status LED) when 17 Errored Seconds (ES) occur within a 24-hour period.
	170	Causes a minor alarm display (flashing red Status LED) when 170 ES occur within a 24-hour period.
	NONE*	Prevents generation of a minor alarm due to excessive ES.
LBTO	NONE	Disables automatic time-out cancellation of all loopbacks.
	20	Sets automatic time-out to 20 minutes.
	60*	Sets automatic time-out to 60 minutes.
	120	Sets automatic time-out to 120 minutes.
DS1	AUTO	The HRU independently monitors its incoming DS1 bit stream for the Binary Eight Zero Substitution (B8ZS) pattern. If the HRU detects this pattern, it enters its B8ZS mode. It reverts back to its Alternate Mark Inversion (AMI) mode if no B8ZS patterns are received for five seconds.
	B8ZS	Places the HRU into its B8ZS mode.
	AMI*	Places the HRU into its AMI mode.
SLOT	ALT	Customer data is transported in Alternating DS0 time slots (1, 3, 5...23). Time slots 2, 4, 6, ... 24 are not used.
	CONT*	Customer data is transported in Contiguous DS0 time slots (1, 2, 3...12). Time slots 13 through 24 are not used.
HAIS	ENA*	Enables the HRU to transmit the AIS signal toward the CPE when the HDSL loop is not in sync (LOSW) or when a margin alarm occurs.
	DIS	Prevents the HRU from transmitting the AIS signal toward the CPE when a margin alarm occurs. AIS is still transmitted when the HDSL loop is not in sync.
NAIS	ENA*	Enables the HRU to transmit the AIS signal toward the CPE when in NREM loopback.
	DIS	Enables the HRU to transmit an LOS condition (instead of the AIS signal) toward the CPE when in NREM loopback.
BAND	01-12	Sets the bandwidth in 64K increments. For each press of the button, the display adds 64K, as well as an additional channel to the system setting. One channel is 64K, 12 channels is 768K.
MARG	Range: 0 to 15 dB Default: 4* dB	The MARG (Margin Alarm Threshold) can only be set using the Maintenance Terminal menus. This setting determines the minimum allowable margin below which a minor alarm can occur. A 0 dB setting disables this option.
SGNL	RBS	All DS0 channels in Robbed Bit Signaling (RBS) mode.
	CLR*	All DS0 channels in Clear Channel mode.
	MIX	Mix of RBS and Clear Channel modes.
CONF	YES	Confirms that all operating parameters (except Margin) are to be updated to the new selections.
	NO*	Prevents newly selected operating parameters from being updated. These options remain as they were before the setting options procedure was started.

\* Default setting.

**Table 10. Four-Digit LCD Messages**

Message	Full Name	Description
FERR	Framing Bit Error	Framing bit error occurred at HLU T1 input.
LBPV	Local Bipolar Violation	A bipolar violation has been received at the T1 input to the HLU-D41.
SIG	Signal	The HLU and HRU, or first doubler transceivers, are trying to establish contact with each other on Span 1.
S2	Signal 2	The first doubler and either HRU or second doubler transceivers are trying to establish contact with each other on Span 2.
S3	Signal 3	The second doubler and HRU transceivers are trying to establish contact with each other on Span 3.
ACQ	Acquisition	The HLU and HRU or first doubler multiplexers are trying to establish synchronization on Span 1.
A2	Acquisition 2	The first doubler and either HRU or second doubler multiplexers are trying to establish synchronization with each other on Span 2.
A3	Acquisition 3	The second doubler and HRU multiplexers are trying to establish synchronization with each other on Span 3.
HES	HDSL CRC Error	HLU HDSL Loop 1 CRC error.
SELF TEST	Self Test	The HLU is in a self test mode. This occurs every power On/Off cycle.
ALRM	Alarm Condition Exists	A minor alarm condition is in effect.
l=xx	HDSL Loop Margin	Indicates the power of the received HDSL signal on each loop relative to noise. Any value of 06 or greater is adequate for reliable system operation.
PWR FEED SHRT	Power Feed Short	Indicates a short on the HDSL span. This same message can occur with an HRU that is drawing the correct amount of power over good cable pairs but cannot communicate with the HLU.
PWR FEED OPEN	Power Feed Open	Indicates an open circuit on the HDSL span.
PWR FEED OFF	Power Feed Off	HDSL span power has been turned off by setting the PWFD option to <i>Disable</i> .
BAD RT?	No response from HRU	The HLU does not receive any response from the HRU. Thus, the HRU or span may be at fault.
VER	HLU Software Version #	Displayed during the System Settings review mode or by pressing the Mode Setup button for three seconds.
LIST 0xL	HLU's List #	Displayed during System Settings review mode defined above.
FRM	Frame:SF,ESF,UNFR,NONE	Defines the type of frame pattern being received from the DSX-1. Displayed during System Settings mode defined above.
LOSW	Loss of Sync Word	Indicates that the HDSL loop has lost sync.
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the T1 input to the HRU.
DS1	DS1 BPV errors	Indicates that the number of BPVs at the HLU or HRU DS1 inputs have exceeded the 24 hour ES threshold.
MAL	Margin Alarm	The margin on the HDSL loop has dropped below the user-defined threshold (1 to 15 dB) set by the user.

## 12.2 Setting System Options.

To initiate the Option Setting mode:

- 1 Press the Mode Setup button for two seconds and then release.

The message displayed on the front panel alternates between the first system parameter and its current setting.

- 2 Press and release the Choice Setup button to display all possible parameter settings (one at a time).

- 3 After the desired setting has been selected, press the Mode Setup button

This updates the current displayed mode to the selected setting, then scrolls to the next configurable parameter. After the last parameter has been selected, the display shows:

CONF NO

- 4 Do one of the following:

- If you do not want to change any of the parameters, press the Mode Setup button.
- If you want to accept the changed parameters, press the Choice Setup button.

A YES message displays and the selected changes are installed.

In either case the display returns to its normal mode.



**The display also returns to its normal mode, without installing any new changes, if neither button is pressed for 30 seconds.**

## 12.3 Setting Options to Factory Default Values.

Table 9 also shows the factory default values for the system options. To set the options to the factory default values:

- 1 Press the Choice Setup button for six seconds until the following message appears:

DFLT NO

- 2 Do one of the following:

- To set the default values press the Choice Setup button while the DFLT NO message is displayed. The following message then appears indicating that the factory default values are now in effect:

DFLT YES

- To terminate the DFLT mode without setting the factory default values, press the Mode Setup button or do nothing for 30 seconds. The latter returns the display to its normal state.

## 12.4 System Inventory.

To view a system inventory:

- 1 Press the Mode Setup button for three or more seconds.

This causes the display to scroll through the software version number, its List #, the received frame type, the received line code type, and all option settings. The line code parameter is the actual DS1 line code being received by the HLU-D41 if the DS1 code pattern is set to Auto. Otherwise the line code parameter mimics either of the other two line code settings, AMI or B8ZS.

- 2 Repeat this process until you have verified the system settings.

- 12.5 DS1 Mode.** The DS1 option configures the remote HRU-512 unit to either Auto, AMI or B8ZS. The Auto mode permits the HRU to set its DS1 input detect mode to the code (AMI or B8ZS) of its DS1 input. The AMI and B8ZS modes configure the HRU to detect AMI or B8ZS codes at its DS1 input to one or the other.

The HLU-D41 is not affected by this option since it does not have a T1 interface. The mode of the T1 interface to the channel bank is determined by the D4 or SLC bank's Line Interface Unit (LIU) card. If the bank is not configured for B8ZS, transmitting B8ZS coded T1 data at the HRU could cause a ones density problem.



**Some channel bank LIU cards have a B8ZS/AMI coded option switch. Make sure the HRU-512 and channel bank are configured for the same T1 line code mode.**

- 12.6** The HLU-D41 contains a non-volatile RAM (NVRAM) which stores the system option settings. No dip-switches or jumpers are required to configure the unit. The options are retained if shelf power is lost or if the unit is unplugged.

### 13. Mandatory System Options

- 13.1** During the initialization mode, data cannot be transmitted to the D4 channel bank (AIS is transmitted) until you either accept or change the desired bandwidth and timeslot configuration using the front panel Mode and Choice Setup buttons. If the current timeslot and bandwidth settings are not desired, you must change the settings before the power-up initialization mode terminates. The following two-part message appears on the front panel LCD at power-up:

SLOT CONT

This indicates that the timeslot setting is Contiguous.

- 13.2 Bandwidth Setting.** On power-up, after HDSL synchronization, the current bandwidth (BAND) setting blinks in the front panel LCD. This reminds you to either select a new value by pressing both the Mode and Choice Setup buttons or to accept the current setting by pressing just the Mode Setup button.

To change the bandwidth settings:

- 1** Press the Choice Setup button to select the desired bandwidth (in 64K increments through 768K).
- 2** After the desired bandwidth displays, press the Mode Setup button.

This updates the BAND setting to the selected bandwidth and causes the following two-part message to display:

CONF NO

- 13.3 Timeslot Setting.** After the bandwidth setting has been configured, the current timeslot setting blinks in the front panel LCD. At this point you may accept or change the setting. After the choice is made, the Choice Setup button must be pressed. If you do not press this button within 60 seconds after the bandwidth setting begins to blink, the original settings at power-up are used.

To change timeslot settings:

- 1 Press the Choice Setup button to toggle the setting between *ALT* (alternating) and *CONT* (contiguous) channel slots.
- 2 After the desired setting displays via the Choice Setup button, press the Mode Setup button.

This updates the *SLOT* parameter to the selected setting, and causes the following message to display:

BAND 64K

(or an increment from 64K to 768K).

- 13.4 Confirming Current Settings.** Pressing the Mode Setup button prevents installation of the changed parameters. However, pressing the Choice Setup button displays a YES message and confirms (installs) the selected changes. When this confirmation procedure is completed, the AIS signal is immediately replaced by the data in the provisioned bandwidth (DS0 time slots).

If the current Slot and Bandwidth settings are acceptable, do the following:

- 1 Press the Mode Setup button. The first press of the Mode Setup button causes the displayed SLOT message to change to BAND.
- 2 Press the Mode Setup button. The second press of the Mode Setup button changes the displayed BAND message to CONF (confirm).
- 3 Press the Mode Setup button. The third press of the Mode Setup button confirms the current settings, then exits the initialization mode.

When this procedure is completed, the AIS signal is immediately replaced by the data in the provisioned bandwidth (DS0 time slots).

- 13.5** If mandatory system setting procedures are completed before the HDSL loop has acquired sync, the SIG or ACQ messages appear on the front panel LCD. Within one minute (maximum), the status LED should be solid green, indicating that the unit is operating properly. The margin display should indicate a 6 dB margin or better on most cables. Once HDSL acquisition is achieved, the DS0 data at the remote HRU-512 is transmitted to the D4 channel bank for the provisioned bandwidth.
- 13.6** The HLU-D41 times out and completes the initialization mode after 60 seconds if you take no further action. The previously configured settings are then used and the normal operating display appears.
- 13.7** When the initialization mode is active, all other front panel push-button functions (setting options mode, system inventory mode, set factory defaults mode, and manual loopback mode) are disabled to ensure proper timeslot and bandwidth functioning.
- 13.8** The capability to access the various menu screens, change parameter settings, and initiate loopbacks using the Maintenance Terminal menus is not disabled during the initialization mode.
- 13.9 Retaining System Settings.** Since all of the HLU-D41 user options, including slot settings, reside in NVRAM, they are retained when the unit is unplugged or powered down.



**Do not initiate a loopback until the initialization mode is complete. Otherwise, the fractional system may operate in a mode not intended and may cause interference to other channel time slots.**

## D. SETTING OPTIONS FROM THE MAINTENANCE TERMINAL

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### 14. Using the Maintenance Terminal Menus

**14.1** After you have connected the HLU-D41 to a dumb terminal, you must configure the dumb terminal to the following communication settings.

- 1200 to 9600 baud (9600 baud is recommended)
- Parity: None
- 8 data bits
- 1 stop bit
- Hardware Flow Control set to None
- VT Terminal Emulation



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

**14.2** **Navigating the Maintenance Terminal menus.** Table 11 describes keys you can use on the dumb terminal's keyboard to navigate within the Maintenance Terminal menus.

*Table 11. Dumb Terminal Navigational Keys*

Key	Function
<U>	Updates a report
<C>	Clears a report
<S>	Selects the next Span Status screen
<P>	Selects the previous page of a report
<N>	Selects the next page of a report
<E>	Exits the current menu
<Esc>	Exits the current menu

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

- Press the key indicated to the left of the selection.
- Press the letter in parenthesis of the parameter to be changed.

## 15. Maintenance Terminal Main Menu

- 15.1** There are eight menus available for system administration from the Maintenance Terminal Main menu. Table 12 describes the function of each menu selection.

*Table 12. Maintenance Terminal Menus*

Menu	Function	See
View Span Status	Provides access to submenus that allow you to monitor the S-HDSL line between the HLU-D41 and the HRU-512.	Section 16
Set Clock	Allows you to set both the time and the date parameters at the HLU-D41, and to update the same settings at the HRU-512.	Section 17
System Settings	Allows you to set all user options.	Section 18
Loopback Mode	Provides access to submenus that allow you to issue and disable loopbacks from both the network and customer side.	Section 19
View Performance Data	Provides access to submenus that allow you to view the Errored Seconds (ES) and Unavailable Seconds (UAS) between the HLU-D41 and the HRU-512 in 15-minute intervals over a four-hour time period.	Section 20
View Performance History	Provides access to submenus that allow you to view the ES and UAS between the HLU-D41 and the HRU-512 in 15-minute intervals over a seven-day period.	Section 21
View Alarm History	Provides access to submenus that allow you to view alarm conditions between the HLU-D41 and the HRU-512.	Section 22
Enter Circuit ID #	Allows you to enter a unique circuit ID (up to 24 characters)	Section 23

- 15.2** To display the Maintenance Terminal Main menu:

- 1 Press the <spacebar> several times to initiate the RS-232 connection.

The Maintenance Terminal Main menu appears:

```

HI-GAIN FT1 LU  MAINTENANCE TERMINAL MAIN MENU  (ver V2.3L-002D)
                CIRCUIT ID#:

                A. VIEW SPAN STATUS
                B. SET CLOCK
                C. SYSTEM SETTINGS
                D. LOOPBACK MODE: NONE
                E. VIEW PERFORMANCE DATA
                F. VIEW PERFORMANCE HISTORY
                G. VIEW ALARM HISTORY
                H. ENTER CIRCUIT ID #
  
```

## 16. View Span Status

- 16.1** Press <A> from the Maintenance Terminal Main menu to open the View Span Status screen.  
The following screen displays:

```

                                SPAN 1 STATUS
                                (HLU/ver2.3-002D:HDU1/ver1.3-0001)
TIME: 00:17:46
DATE: 05/06/97
CIRCUIT ID#: PairGain 506

ALARMS:  NONE
LOOPBACK: OFF

                                HLU  HDSL          HDU1  HDSL
                                cur/min/max      cur/min/max
MARGIN:                        20/17/21          22/00/22 dB
PULSE ATTN:                     00                00
PPM OFFSET:                       00                01 ppm
24 HOUR ES:                       00008            00002 seconds
24 HOUR UAS:                       00062            00036 seconds

                                DS1 STATUS
                                HLU          HRU
24 HOUR BPV Seconds:             -----          00020
24 HOUR UAS Count:               00000            00012
Frame type:                       SF          SF
Code type:                         AMI         AMI

                                (E)xit (C)lear (U)pdate (S)pan

```

You can do the following:

- Press <C> to clear the *cur* (current), *min* (minimum) and *max* (maximum) numeric counts.
- Press <U> to update *cur* (current) values.
- Press <S> to view each of the available span screens.
- Press <E> to return to the previous menu.

- 16.2** Table 13 shows the Span Status fields and descriptions. Table 14 lists the "Alarm" field messages and descriptions and Table 15 lists the "Loopback" field messages and descriptions.

**Table 13. Span Status Fields and Descriptions**

<b>Field</b>	<b>Description</b>
Time	Time of day when Span Status was checked
Date	Date when Span Status was checked
Circuit ID	Shows the user-defined circuit ID
Alarms	Presence or absence of alarm conditions. See Table 14.
Loopback	Indicates Off condition or identifies specific active loopback. See Table 15.
Margins	Indicates the excess signal to noise ratio, at either the HLU or HRU, relative to a $10^7$ Bit Error Rate. First value is current margin, second value is minimum margin since last cleared, and third value is maximum value since last cleared. NA means "Not Available."
Pulse Attenuation	Indicates the attenuation of the 2B1Q pulse from the distant end. HiGain operates with pulse attenuations in excess of 30 dB. This value is related to the cable pair's 196 kHz loss. The pulse attenuation is a more direct indication of the loop attenuation to the 2B1Q signal than the 196 kHz loss.
PPM Offset	Indicates the relative offset of the crystal oscillator in the HLU from the HDU crystal oscillator. Any value between -100 and +100 is adequate.
24 Hour ES	The number of one second intervals that contained at least one CRC error. This value is a running total of the last 24 Hours.
24 Hour UAS	The number of seconds the HDSL loop was out of sync.
24 Hour BPV Seconds	The number of seconds in which at least one bipolar violation was detected on the DS1 input over a 24-hour period.
24 Hour UAS Count	The number of seconds during which the DS1 input signal was absent (125 or more consecutive 0s) over a 24-hour period.
Frame type	Type of DS1 framing used on the input stream (SF or ESF)
Code type	Type of DS1 line coding used (AMI, B8ZS, AMI : ZBTSI or B8ZS : ZBTSI). The latter two conditions indicate the code type that is being received when HiGain is set to its ZBTS mode. In either the AMI or B8ZS DS1 code mode, it displays the selected code as opposed to the code type that is actually being received.
HLU/Ver w.x-y	"w.x" = the software version number of the HLU. "y" = List # of the HLU.
HRU or HDU/w.x-y	"w.x" = the software version number of the HRU or HDU. "y" = List # of the HRU or HDU.

**Table 14. HLU-D41 Alarm Field Messages and Descriptions**

Message	Full Name	Description
NONE	No Alarms	No alarms to report.
RLOS	Remote Loss of Signal	No signal at the HRU-512 input port.
ALRM	Minor Alarm	A minor alarm condition is in effect.
LOSW	Loss of Sync Word	The HDSL loop has lost sync.
HES	HDSL Errored Second	The HDSL CRCs have exceeded the ES threshold
MOOS	Multiplexer Out of Sync	The D4 channel bank is generating a MOOS condition.
LAIS	Local Alarm Indicating Signal	Indicates an AIS (all 1s) pattern is being transmitted from the local HLU-D41 onto a D4 channel bank data bus (towards the network) for the DS0 time slots (bandwidth).
DS1	DS1 BPV errors	Indicates that the number of BPV seconds, in which at least one BPV has occurred at the HRU DS1 input, has exceeded the 24-hour ES threshold.
RAIS	Remote Alarm Indicating Signal	Indicates an AIS (all 1s) pattern is being transmitted from the HRU-512 DS1 output toward the CPE.
MAL	Margin Alarm	The margin on the HDSL loop has dropped below the threshold (1 to 15 dB) set by the user.
----	Not Applicable	Data for the indicated terminal parameter is not applicable on the fractional T1 system.

**Table 15. HLU-D41 Loopback Field Messages and Descriptions**

Message	Full Name	Description
NREM	Network Remote Loopback	Loopback at HRU (remote) towards network initiated from C.O. (network) by intelligent line repeater #1 code, HRU Mode and Choice Setup buttons or Maintenance Terminal menu.
NLOC	Network Local Loopback	Loopback at HLU (local) towards network initiated from CO (network) by intelligent office repeater code or by depressing both the HLU Mode and Choice Setup buttons.
CLOC	Customer Local Loopback	Loopback at HRU (local) towards Customer Interface (CI) initiated from Customer Premises Equipment (CPE) by intelligent line repeater #1 code.
CREM	Customer Remote Loopback	Loopback at HLU (remote) towards customer initiated from CPE (customer) by intelligent office repeater code.

**16.3** The Span 1 screen contains data on the HDSL loop between the HLU-D41 and the first doubler. The Span 2 Screen refers to the loops between the first doubler and the HRU-512 for single-doubler circuits or between the first and second doublers for two-doubler circuits. The Span 3 screen refers to the loops between the second doubler and the HRU-512 for two-doubler circuits. All status screens contain the same DS1 interface information.

## 17. Set Clock

**17.1** Press <B> from the Maintenance Terminal Main menu to open the Set Clock screen.

The following screen displays:

```

SET CLOCK

TIME: 00:13:40
DATE: 04/04/97
CIRCUIT ID#:

Format: HH:MM
        MM/DD/YY

NEW TIME: 01:22
NEW DATE: 05/06/97

(U) PDATE REMOTE?
  
```

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

The "New Date" field displays.



**If you input an invalid entry, the following messages appears followed by the name of field where the invalid entry occurred:**

> error

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

The "Update Remote" field displays.

**17.4 Update Remote.** The remote unit date and time is set using this option. List 1 HRU-512 units having software versions 6.4 and above, and all List 6, and List 7 HRU-512 units can be set to the same time and date as the HLU-D41. To update the remote, do one of the following:

- Press <U> and the remote unit is updated to the same date and time set for the HLU-D41. All time information is lost when power is removed. The last date, however, is retained in NVRAM and reappears when power is restored.
- Press <Enter> and the remote unit is not updated.

## 18. System Settings

- 18.1** The options set from this menu are the same as the options set at the HLU-D41 Front Panel interface (except for Margin Alarm Threshold and Signaling which can only be set at this menu). Refer to Table 9 for a listing of system setting options.

Press <C> from the Maintenance Terminal Main menu to open the System Settings screen.

The following screen appears:

```

                                SYSTEM SETTINGS

TIME: 01:24:50
DATE: 05/06/97
CIRCUIT ID#:

(I)DLE CODE:          FF
NETWORK (L)OOPBACK:  DISABLE
(P)OWER:              ENABLE
ES ALARM TH(R)ES:    NONE
LOOPBACK (T)IMEOUT:  60
HRU (D)SI CODE:      AMI
DS0 (C)HAN SLOTS:    CONT
AIS ON (H)DSL ALRM:  DISABLE
AIS ON NRE(M):       ENABLE
MAR(G)IN ALM THRES:  4
DS0 (B)ANDWIDTH:     64K
SIG(N)ALING: rb - Robbed Bits:    01

                                (E)xit
Enter the letter in parenthesis (X) to change any setting
enter channel number(s): 01

```

- 18.2** The following paragraphs explain how to change system settings in the order in which they are presented in System Settings screen. To change any option, enter its character key which is shown inside the parenthesis within each parameter description. This causes the screen to refresh with the new settings. After all parameters have been selected, press <E> to exit, then <C> to confirm. The newly selected parameters are now activated.

- 18.3** **Idle Code.** The *Idle Code* option can be set to *FF* or *7F*. The Idle Code setting determines the bit pattern carried in blocked DS0 channels. The default is *FF*.

- 1 Press <I> in the System Settings menu.

The *Idle Code* option changes to the next available setting.

- 2 Repeat this process until the desired setting appears next to the *Idle Code* option name in the menu.

- 18.4** **Network Loopback.** The *Network Loopback* option can be set to *Disable* or *Enable*. The Network Loopback setting allows you to disable or enable the activation of Network Remote (NREM) by NEI DDS code. The default is *DISABLE*.

- 1 Press <L> in the System Settings menu.

The *Network Loopback* option changes to the next available setting.

- 2 Repeat this process until the desired setting appears next to the *Network Loopback* option name in the menu.

- 18.5 Power.** You can set the *Power* option to *Disable* or *Enable*. The *Power* setting allows you to disable or enable line powering of the remote unit over the HDSL pair. The default is *Enable*.
- 1 Press <P> in the System Settings menu.  
The *Power* option changes to the next available setting.
  - 2 Repeat this process until the desired setting appears next to the *Power* option name in the menu.
- 18.6 ES Alarm Thres.** You can set the *ES Alarm Thres* (threshold) to a count of *17* or *170* seconds. This setting causes the Status LED to flash red when the alarm threshold count has been exceeded. You can also set the alarm threshold count to *None*. The default is *None*.
- 1 Press <R> in the System Settings menu.  
The *ES Alarm Thres* option changes to the next available setting.
  - 2 Repeat this process until the desired setting appears next to the *ES Alarm Thres* option name in the menu.
- 18.7 Loopback Timeout (LBTO).** The *Loopback Timeout* can be set to a count *20*, *60* or *120* minutes. You can also set the loopback timeout to *NONE*, which disables the automatic time-out cancellation of all loopbacks. The default is *60*.
- 1 Press <T> in the System Settings menu.  
The *Loopback Timeout* option changes to the next available setting.
  - 2 Repeat this process until the desired setting appears next to the *Loopback Timeout* option name in the menu.
- 18.8 HRU DS1 Code.** The *HRU DS1 Code* can be set to *Auto*, *B8ZS* or *AMI*. The default is *AMI*.
- 1 Press <D> in the System Settings menu.  
The *HRU DS1 Code* option changes to the next available setting.
  - 2 Repeat this process until the desired setting appears next to the *HRU DS1 Code* option name in the menu.
- 18.9 DS0 Chan Slots.** The *DS0 Chan* (channel) *Slots* option can be set to *ALT* (alternating) or *CONT* (contiguous). If the *DS0 Chan Slots* setting is *ALT*, customer data is transported on alternating sequential timeslots 1, 3, 5...23 (timeslots 2, 4, 6...24 are not used). If the *DS0 Chan Slots* setting is *CONT*, customer data is transported on contiguous sequential timeslots 1,2,3...12 (timeslots 13 through 24 are not used). The default is *CONT*.
- 1 Press <C> in the System Settings menu.  
The *DS0 Chan Slots* option changes to the next available setting.
  - 2 Repeat this process until the desired setting appears next to the *DS0 Chan Slots* option name in the menu.
- 18.9.1 Data Applications.** *ALT* is the recommended setting for data applications. This setting prevents ones density violations from occurring when installed in D4 channel banks configured for *AMI*. Use of *CONT* may allow ones density violations to occur, resulting in possible interference to all 24 DS0 time slots and possible loss of frame sync. This also initiates a Multiplexer Out of Sync (MOOS) condition with loss of customer data in all 24 DS0 time slots, until frame sync is re-acquired.
- 18.9.2 Voice Applications.** *CONT* is the recommended setting for voice channels or with D4 channel banks configured for *B8ZS*.

- 18.10 AIS on HDSL ALRM.** The *AIS on HDSL Alrm* (alarm) option allows you to *Enable* or *Disable* the AIS signal toward the CPE when the HDSL loop is not in sync or when a margin alarm occurs. The default is *Enable*.
- 1 Press <H> in the System Settings menu.  
The *AIS on HDSL Alrm* changes to the next available setting.
  - 2 Repeat this process until the desired setting appears next to the *AIS on HDSL Alrm* option name in the menu.
- 18.10.1 Enabling AIS on HDSL ALRM.** The *Enable* choice causes the AIS pattern to be transmitted to the CPE when the HDSL loop experiences an out of sync (LOSW) condition or when a margin alarm occurs. This choice causes all channels on the loop to be lost as they are replaced by the AIS pattern. However, it does allow the downstream equipment to be made aware of the loss of the HDSL loop or a low margin condition on the loop, which in turn alerts the maintenance personnel to the problem.
- 18.10.2 Disabling AIS on HDSL ALRM.** The *Disable* choice causes the AIS signal to be transmitted only if the HDSL Loop is out of sync (LOSW). Margin alarms have no effect when the *Disable* mode is selected. The *Disable* mode is the recommended setting to allow the system to operate, even with low margin conditions, and yet continue to transmit customer data.
- 18.11 AIS on NREM.** The *AIS on NREM* option allows you to *Enable* the AIS signal toward the CPE when in the NREM loopback mode, or to select *Disable*, which transmits an LOS signal toward the CPE when in the NREM loopback mode. The default is *Enable*.
- 1 Press <M> in the System Settings menu.  
The *AIS on NREM* changes to the next available setting.
  - 2 Repeat this process until the desired setting appears next to the *AIS on NREM* option name in the menu.
- 18.12 Margin Alm Thres.** The *Margin Alarm Thres* (threshold) option allows you to set the margin threshold from 0 to 15. The margin threshold, in dB, is the excess SNR relative to the SNR. A 0 dB setting disables the option. The default is 4.
- 1 Press <G> in the System Settings menu.  
The following prompt appears:  
  
ENTER MINIMUM ACCEPTABLE HDSL MARGIN (0 TO 15 dB)
  - 2 Enter the desired HDSL margin and press <Enter>.
- 18.13 DS0 Bandwidth.** The *DS0 Bandwidth* option selects the FT1 bandwidth. In the D4 or SLC-96 channel bank, the first channel of the selected bandwidth is determined by the slot occupied by the HLU-D41. In the HRU-512, the first channel of the selected bandwidth is always channel 1.
- 1 Press <B> in the System Settings menu.  
The *DS0 Bandwidth* changes to the next increment.
  - 2 Continue to press <B> to increase the indicated bandwidth in 64 kbps increments.  
The "Signaling" field adds channels each time you press *B*, such that 01 equates to *DS0 Bandwidth 64K*, 02 equates to *DS0 Bandwidth 128K*, etc. The maximum bandwidth setting for the FT1 circuit is 768K (or 768 kbps).

**18.14 Signaling.** The *Signaling* option can be set to *RBS*, *CLR*, or *MIX*. The default setting for all channels is *CLR*.

- 1 Press <N> in the System Settings menu.

The following prompt appears:

```
ENTER CHANNEL NUMBERS
```

- 2 To change channels from *CLR* to *RBS*, enter the channel's number (ranging from 01 through 12).

You can only enter channel numbers ranging from 0 through 12 for which you have entered the correct bandwidth increment using the *DSO BANDWIDTH* option in Section 18.13.

**18.14.1 Configuring Channels.** The number of channels used by the selected bandwidth are displayed in sequence, as 01, 02, 03, 04, 05..., on the Maintenance Terminal menu. The selected signaling mode is indicated beneath each channel. Whenever the bandwidth is increased in size, the newly activated channels are initialized to *CLR*.

**18.14.2** Multiple channels may be changed by inserting a space between each channel entry. Channels configured as *RBS* are marked with *rb* whereas channels configured as *CLR* are not marked. To change a channel back to *CLR*, select the *N* option and enter the channel number(s) again. The *rb* mark disappears from the selected channels indicating a *CLR* status.



**Some D4 channel banks require their option *H* to be enabled to support the HLU-D41's RBS signaling mode.**

## 19. Loopback Mode

**19.1** Press <D> from the Maintenance Terminal Main menu to open the Loopback Menu screen (see Section 24 for a diagram of the HiGain FT1 loopback configuration).

The following screen appears:

```

                                LOOPBACK MENU

TIME: 01:49:28
DATE: 05/06/97
CIRCUIT ID#:

A. DISABLE LOOPBACKS
B. NETWORK LOOP HLU           (NLOC)
C. NETWORK LOOP HRU           (NREM)
D. NETWORK LOOP DOUBLER 1     (NDU1)
G. CUSTOMER LOOP HLU          (CREM)
H. CUSTOMER LOOP HRU          (CLOC)
I. CUSTOMER LOOP DOUBLER 1    (CDU1)

                                (E)XIT

```

**19.2** This screen shows loopback selections for a single doubler system. Each of the modules in the configuration can be looped back towards the network or the customer from this screen. NDU1 and CDU1 are available for single doubler applications. NDU2 and CDU2 are available for two doubler

applications and NLOC, NREM, CLOC and CREM are available for non-doubler applications. These available loopback options display in the Loopback Menu based upon the installed configuration.

See Section 24 for instructions on how to use the HLU-D41 Mode and Choice Setup buttons to initiate loopbacks and Table 18 for a comprehensive listing of all HiGain loopbacks. The following procedures are shown in the sequence in which they appear in the Loopback menu.

- 19.3 Disable Loopbacks.** The *Disable Loopbacks* option allows you to disable (cancel) any of the loopbacks listed in the menu. To disable loopbacks, press <A> in the Loopback menu.

The following prompt appears:

PLEASE WAIT.....

A series of dots moves from left to right indicating that the command has been issued. When this process completes, the system returns to the Main menu.

- 19.4 Network Loop HLU (NLOC).** The *Network Loop HLU (NLOC)* option allows you to send a Network Local (NLOC) loopback from the line unit towards the network. To send an NLOC loopback, press <B> in the Loopback menu

The following prompt appears:

PLEASE WAIT.....

A series of dots moves from left to right indicating that the command has been issued. When this process completes, the system returns to the Main menu. *NLOC* now appears next to the Loopback Mode in the Main menu. The loopback continues to cycle in the system depending upon your *Loopback Timeout* setting. You can always go back to the Loopback menu and press *A* to disable the NLOC loopback.

- 19.5 Network Loop HRU (NREM).** The *Network Loop HRU (NREM)* option allows you to send a Network Remote (NREM) loopback from the remote unit towards the network. To send an NREM loopback, press <C> in the Loopback menu.

The following prompt appears:

PLEASE WAIT.....

A series of dots moves from left to right indicating that the command has been issued. When this process completes, the system returns to the Main menu. *NREM* now appears next to the Loopback Mode in the Main menu. The loopback continues to cycle in the system depending upon your *Loopback Timeout* setting. You can always go back to the Loopback menu and press *A* to disable the NREM loopback.

- 19.6 Network Loop Doubler 1.** The *Network Loop Doubler 1 (NDU1)* option allows you to send an NDU1 loopback at the first doubler towards the network. To send an NDU1 loopback, press <D> in the Loopback menu.

The following prompt appears:

PLEASE WAIT.....

A series of dots moves from left to right indicating that the command has been issued. When this process completes, the system returns to the Main menu. *NDU1* now appears next to the Loopback Mode in the Main menu. The loopback continues to cycle in the system depending upon your *Loopback Timeout* setting. You can always go back to the Loopback menu and press *A* to disable the NDU1 loopback.

- 19.7 Customer Loop HLU (CREM).** The *Customer Loop HLU (CREM)* option allows you to send a Customer Remote (CREM) loopback from the line unit (remote) towards the customer interface. To send a CREM loopback, press <G> in the Loopback menu.

The following prompt appears:

PLEASE WAIT.....

A series of dots moves from left to right indicating that the command has been issued. When this process completes, the system returns to the Main menu. *CREM* now appears next to the Loopback Mode in the Main menu. The loopback continues to cycle in the system depending upon your *Loopback Timeout* setting. You can always go back to the Loopback menu and press *A* to disable the CREM loopback.

- 19.8 Customer Loop HRU (CLOC).** The *Customer Loop HRU (CLOC)* option allows you to send a Customer Local (CLOC) loopback from the remote unit (local) towards the customer interface. To send a CLOC loopback, press <H> in the Loopback menu.

The following prompt appears:

PLEASE WAIT.....

A series of dots moves from left to right indicating that the command has been issued. When this process completes, the system returns to the Main menu. *CLOC* now appears next to the Loopback Mode in the Main menu. The loopback continues to cycle in the system depending upon your *Loopback Timeout* setting. You can always go back to the Loopback menu and press *A* to disable the CLOC loopback.

- 19.9 Customer Loop Doubler 1.** The *Customer Loop Doubler 1 (CDU1)* option allows you to send a CDU1 loopback at the first doubler towards the CI. To send a CDU1 loopback, press <I> in the Loopback menu.

The following prompt appears:

PLEASE WAIT.....

A series of dots moves from left to right indicating that the command has been issued. When this process completes, the system returns to the Main menu. *CDU1* now appears next to the Loopback Mode in the Main menu. The loopback continues to cycle in the system depending upon your *Loopback Timeout* setting. You can always go back to the Loopback menu and press *A* to disable the CDU1 loopback.

## 20. View Performance Data

**20.1** Press <E> from the Maintenance Terminal Main Menu to open the View Performance Data screen.

The following screen displays:

```

Date: 05/06/97          SPAN 1 PERFORMANCE DATA
CIRCUIT ID#:
                ERRORED SECONDS/UNAVAILABLE SECONDS

                DS1
                HLU    HRU    HDSL
                HLU    HDU1
20:30  ---/000  000/000  000/000  000/000
20:45  ---/000  000/000  000/000  000/000
21:00  ---/000  000/000  000/000  000/000
21:15  ---/000  000/000  000/000  000/000
21:30  ---/000  000/000  000/000  000/000
21:45  ---/000  000/000  000/000  000/000
22:00  ---/000  000/000  000/000  000/000
22:15  ---/000  000/000  000/000  000/000
22:30  ---/000  000/000  000/000  000/000
22:45  ---/000  000/000  000/000  000/000
23:00  ---/000  000/000  000/000  000/000
23:15  ---/000  000/000  000/000  000/000
23:30  ---/000  000/000  000/000  000/000
23:45  ---/000  000/000  000/000  000/000
00:00  ---/000  000/000  000/000  000/000
00:15  ---/000  000/000  000/000  000/000

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

```

**20.2** This screen shows performance data for doubler applications. Both the ES and UAS for both HDSL loops and each T1 input are listed at 15-minute intervals over a four hour time interval.

**20.2.1 Span 1.** The Span 1 screen contains data on the two HDSL loops between the HLU-D41 and the first doubler (HDU1).

**20.2.2 Span 2.** The Span 2 screen refers to the loops between the first doubler (HDU1) and the HRU-512 for one doubler circuits or between the first and second doublers (HDU1 and HDU2) for two-doubler circuits.

**20.2.3 Span 3.** The Span 3 screen refers to the loops between the second doubler and the HRU-512 for two-doubler circuits. All status screens contain the same DS1 interface errors.

**20.3** Earlier and later data, in four-hour increments on six different screens per span can be accessed. You can do the following:

- Press <P> to return to the previous screen.
- Press <N> to go to the next screen.
- Press <S> to go to the next available span screen.
- Press <E> to exit the menu.



**All of the counters can be set to 0 by pressing <C> (Clear) from the HLU-D41 Span Status screen. Note that since the HLU-D41 is considered to be the master module, this clears all performance data screens at both the HLU-D41 and the HRU-512. The menus at the HRU-512 do not allow the counters to be cleared.**

## 21. View Performance History

**21.1** Press <F> from the Maintenance Terminal Main Menu to open the View Performance History screen.

The following screen appears:

```

Time: 00:22:54              7 DAY HISTORY
CIRCUIT ID#:

                                SPAN 1
                                ERRORED SECONDS/UNAVAILABLE SECONDS

                                DS1              HDSL
                                HLU              HRU              HLU              HDU1
04/29 -----/00000 00000/00000 00000/00000 00000/00000
04/30 -----/00000 00000/00000 00000/00000 00000/00000
05/01 -----/00000 00000/00000 00000/00000 00000/00000
05/02 -----/00000 00000/00000 00000/00000 00000/00000
05/03 -----/00000 00000/00000 00000/00000 00000/00000
05/04 -----/00000 00000/00000 00000/00000 00000/00000
05/05 -----/00000 00000/00000 00000/00000 00000/00000
current -----/00000 00000/00000 00000/00000 00000/00000

                                (E)xit (S)pan

```

**21.2** This screen shows 7-Day Performance History screens for doubler applications. The ES and UAS for both HDSL loops and each of the two DS1 inputs are listed for the current and previous seven days.

**21.2.1 Span 1.** The Span 1 Screen contains data on the two HDSL loops between the HLU-D41 and the first doubler (HDU1).

**21.2.2 Span 2.** The Span 2 Screen refers to the loops between the first doubler (HDU1) and the HRU-512 for one-doubler circuits or between the first and second doublers (HDU1 and HDU2) for two-doubler circuits.

**21.2.3 Span 3.** The Span 3 Screen refers to the loops between the second doubler and the HRU-512 for two-doubler circuits. All status screens contain the same DS-1 interface errors.

**21.3** You can do the following:

- Press <S> to go to the next available span screen.
- Press <E> to exit the menu.

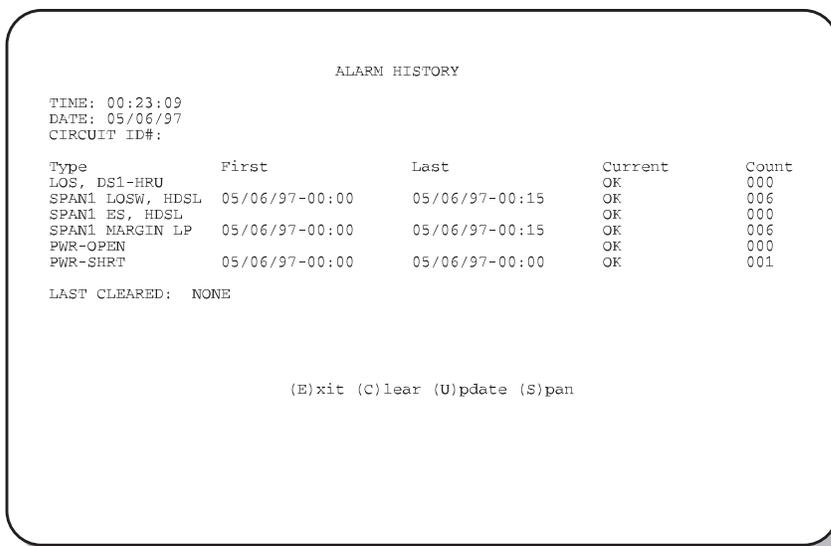


**All of the counters can be set to 0 by pressing <C> (Clear) from the HLU-D41 Span Status screen. Note that since the HLU-D41 is considered to be the master module, this clears all performance history screens at both the HLU-D41 and the HRU-512. The menus at the HRU-512 do not allow the counters to be cleared.**

## 22. Alarm History

**22.1** Press <G> from the Maintenance Terminal Main Menu to open the Alarm History screen.

The following screen appears:



**22.2** The Alarm History screen shows the history of all HiGain system alarms for doubler and non-doubler configurations. Table 16 lists the Alarm History fields and descriptions.

*Table 16. Alarm History Fields and Descriptions*

Field	Description
Type	Identifies the type of alarm
LOS, DS1-HRU	First and last instance of LOS at the HRU; Current condition, number of alarms
Span 1 LOSW, HDLSL1	First and last instance of LOSW on HDLSL1; Current condition, number of alarms
Span-1 ES, HDLSL1	First and last instance of ES on HDLSL1; Current condition, number of alarms
Span 1 Margin L1	First and last instance of exceeded margin on Loop 1; Current condition, number of alarms
PWR Open	Power condition: Open or Closed
PWR SHRT	Power short condition
Last Cleared: None	Last time Alarm History cleared

**22.3** The LOS and PWR system alarms are common to all spans. Only the LOSW, ES and MARGIN are span-specific alarms. The PWR-OPEN and PWR-SHRT alarms indicate alarm conditions on the HLU-D41. Neither PWR alarm is available on the other spans. The First and Last columns contain the time and date stamp of the first and last occurrence of each alarm. The Current column shows the status of each alarm. The Count column lists the number of times each alarm occurred. The maximum non-overflowing count is 999.

**22.3.1** **Span 1.** The Span 1 Screen concerns alarms that occurred on the HDLSL loops between the HLU-D41 and the first doubler (HDU1).

**22.3.2 Span 2.** The Span 2 Screen refers to the loop between the first doubler (HDU1) and the HRU-512 for one-doubler circuits or between the first and second doublers (HDU1 and HDU2) for two-doubler circuits.

**22.3.3 Span 3.** The Span 3 Screen refers to the loop between the second doubler and the HRU-512 for two-doubler circuits.

**22.3** You can do the following:

- Press <C> to clear all of the alarms listed in the screen.
- Press <U> to update the report.
- Press <S> to go to the next available span screen.
- Press <E> to exit the menu.

## 23. Enter Circuit ID

**23.1** To enter a circuit ID:

- 1 Press <H> from the Maintenance Terminal Main Menu to view the Enter Circuit ID screen.

The following message displays:

```
enter circuit ID# (24 characters max):
```

- 2 Enter a unique circuit ID (either alpha or numerical) of no more than 24 characters, then press <Enter>.
- 3 Press <C> to confirm.



**If more than 24 characters are entered, a beep is emitted and only the first 24 characters are accepted.**

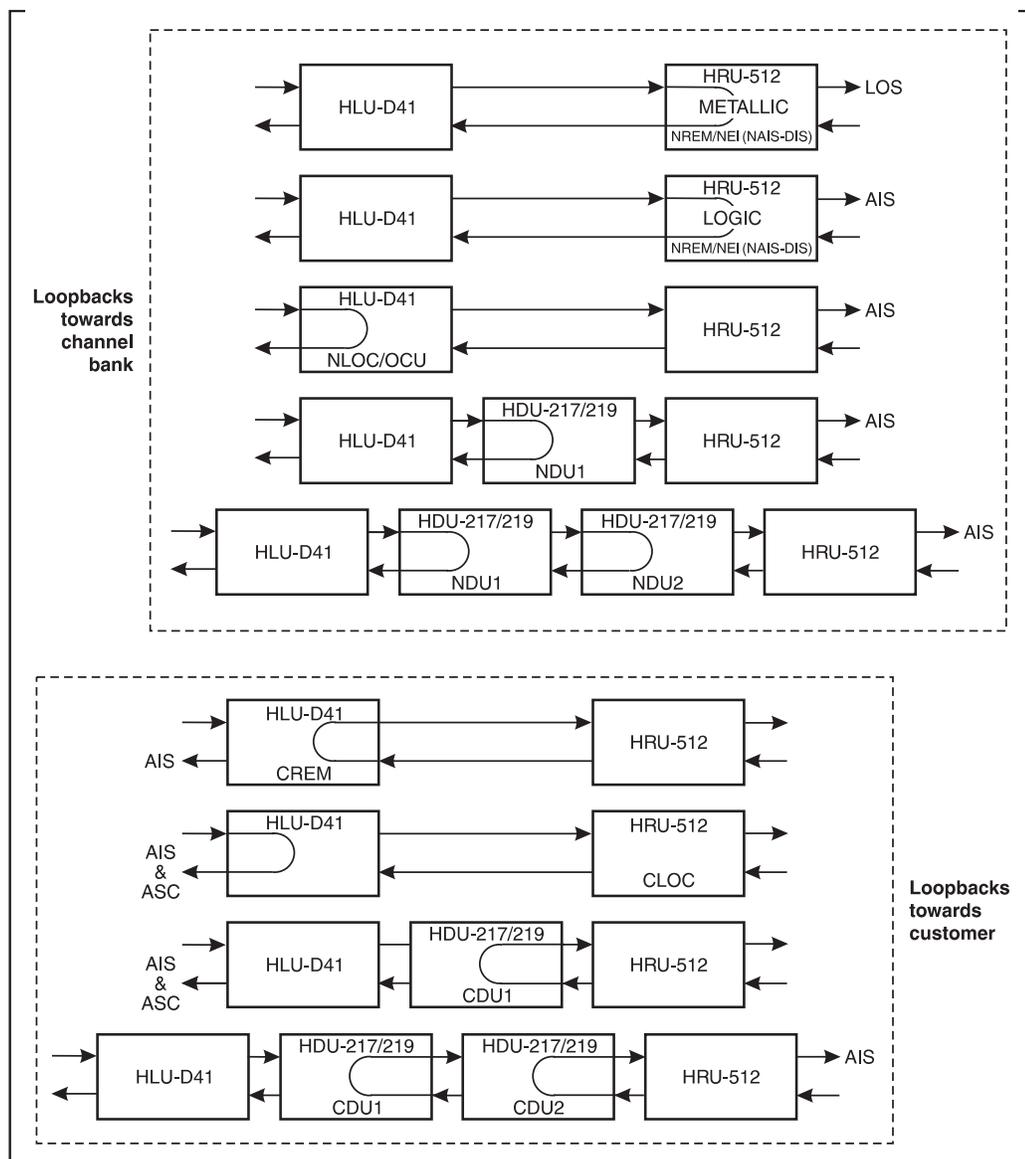
**23.2** The Circuit ID appears in all HLU-D41 screens. Note that the Circuit ID is not set to its default (all blanks) setting when the DFLT setting option is utilized. The Circuit ID # is not available at the HRU-512 Maintenance Port.

**23.3** The Circuit ID is stored in NVRAM and thus remains if power is lost.

## E. TROUBLESHOOTING

### 24. Loopbacks Issued from the Front Panel

**24.1** Loopbacks permit you to perform isolated diagnostic tests on specific areas of the circuit. The transmitted signal is returned (looped back) to the sending device after passing through a data communications link or network. This allows you to compare the returned signal with the transmitted signal and to determine if there is a problem with the circuit. This section addresses loopbacks issued from the front panel (see Section 19 for loopbacks issued from the Maintenance Terminal menu). The HLU-D41 FT1 loopback configuration for a two-doubler system is shown in Figure 8. When two doublers are installed in the system, the HLU-D41 system has eight types of user initiated loopbacks. Table 17 lists the HiGain loopbacks which are available for any system configuration. Table 18 shows a comprehensive listing of all HiGain loopbacks.



**Figure 8.** HiGain FT1 Loopback Configuration

**Table 17. HiGain Front Panel Loopbacks**

<b>Loopback type</b>	<b>Non-doubler system</b>	<b>One-doubler system</b>	<b>Two-doubler system</b>
NLOC	•	•	•
NREM	•	•	•
CLOC	•	•	•
CREM	•	•	•
NDU1		•	•
CDU1		•	•
NDU2			•
CDU2			•

The DDS type loopbacks Office Channel Unit (OCU) and Network Element Interface (NEI) are also supported (see Section 25).

**Table 18. Comprehensive Listing of all HiGain Loopbacks**

<b>Message</b>	<b>Full Name</b>	<b>Description</b>
NLOC	Network Local Loopback	Loopback at HLU-D41 (local) towards network initiated from DDS NEI loopback code, Mode and Choice Setup buttons or Maintenance Terminal menu.
NREM	Network Remote Loopback	Loopback at HRU-512 (remote) towards network initiated from HLU-D41 Mode and Choice Setup buttons, HRU-512 loopback button or Maintenance Terminal menus.
CLOC	Customer Local Loopback	Loopback at HRU-512 (local) towards CI initiated from HLU-D41 Mode and Choice Setup buttons or Maintenance Terminal menus.
CREM	Customer Remote Loopback	Loopback at HLU-D41 (remote) towards customer initiated by DDS OCU loopback code, Mode and Choice Setup buttons or Maintenance Terminal menus.
NDU1	Network Doubler 1 Loopback	Loopback at first doubler towards network initiated by HLU-D41 Mode and Choice Setup buttons or Maintenance Terminal menu.
CDU 1	Customer Doubler 1 Loopback	Loopback at first doubler towards CI initiated by HLU-D41 Mode and Choice Setup buttons or Maintenance Terminal menus.
NDU2	Network Doubler 2 Loopback	Loopback at second doubler towards network initiated by HLU-D41 Mode and Choice Setup buttons or Maintenance Terminal menus.
CDU 2	Customer Doubler 2 Loopback	Loopback at second doubler towards CI initiated by HLU-D41 Mode and Choice Setup buttons or Maintenance Terminal menus.

## 24.2 Loopback Types (non-doubler applications)

**24.2.1 NLOC Loopback.** When NLOC loopback is performed, the channel bank signal is looped back to the bank at the HLU-D41 and the AIS signal is transmitted toward the CPE. This channel bank signal is only looped back for the configured bandwidth (time slots). Time slots not configured are unaffected. The AIS signal is transmitted from the remote unit to the CPE for all 24 time slots.

**24.2.2 NREM Loopback.** NREM loopback operates similarly to NLOC loopback except that in NREM loopback the channel bank signal is looped back to the bank at the remote unit and not at the line unit. The NI signal is only looped back for the configured bandwidth (time slots). Time slots not configured are unaffected.

During NREM, the signal transmitted to the CPE from the remote unit depends on the NAIS option setting. If the NAIS option is enabled, the AIS signal is transmitted from the remote toward the CPE for all 24 time slots (full T1 bandwidth). If the NAIS option is disabled, the LOS signal is transmitted from the remote unit toward the CPE for all 24 time slots (full T1 bandwidth).

**24.2.3 CLOC Loopback.** When a CLOC loopback is performed, the CI signal that is sent to the HRU-512 is looped back to the CPE at the remote unit (HRU-512). The CI signal is looped back in all 24 time slots (full T1 signal). At the HLU-D41, the first provisioned (occupied) slot transmits the Abnormal Station Code ASB (00011110) toward the bank. The second slot transmits 7F and the rest of the provisioned slots transmit FF toward the bank. Time slots not configured by the HLU-D41 are unaffected.

**24.2.4 CREM Loopback.** A CREM loopback operates similarly to a CLOC loopback except that in a CREM loopback, the CI signal is looped back to the CPE at the HLU-D41. For the HiGain FT1 system, the CI signal is looped back only on 12 of the 24 time slots (768K maximum bandwidth capability). The other 12 time slots contain the IDLE code configured via the HLU-D41 IDLE code option setting (7F or FF). At the HLU-D41, the AIS signal is transmitted toward the channel bank, but only for the bandwidth (time slots) configured by the HLU-D41 option setting. Time slots not configured by the HLU-D41 are unaffected.

**24.3 Loopback Types (doubler applications).** The doubler loopbacks towards the network (NDU1 and NDU2) operate similarly to NREM except that the loopback location is at the doubler. The doubler loopbacks towards the customer (CDU1 and CDU2) operate similarly to CREM except that the loopback location is at the doubler.

**24.4 Initiating Manual Loopbacks.** A manual loopback session permits you to choose one of the available HiGain system loopbacks. The Mode Setup button permits you to advance to the next available loopback and the Choice Setup button permits you to select the listed loopback.



**Only one loopback can exist at any given time. If neither push-button is pressed for a period of 30 seconds and no loopback is in effect, the manual loopback session terminates and the normal margin displays reappear. If a loopback is in effect, the 30-second time-out is delayed. The active loopback and the manual loopback session continue until the loopback times out in accordance with the user selected LBTO setting.**

To initiate a manual loopback:

- 1 Press both the Mode Setup button and the Choice Setup button simultaneously for at least three seconds.

The following message blinks in one-second intervals:

MAN LPBK

Followed by:

NLO?

2 Do one of following:

- Press the Choice Setup button to initiate an NLOC loopback.
- Press the Mode Setup button advance to the next available loopback.

Follow this sequence to initiate the entire battery of available loopbacks. See Table 17 to identify the loopbacks available for your system. Previously executed loopbacks remain active until the Choice Setup button is pressed and a different loopback is activated.

**24.5 Terminating Loopbacks.** Pressing both the Mode and Choice Setup buttons simultaneously for three seconds terminates any active loopback, ends the Manual loopback session, and returns the display to normal mode.



**At the initial activation of any of the HiGain loopbacks, the HLU-D41 can momentarily transmit excessive 0s to the D4 bank. This can cause a 1s violation, which may cause some banks to momentarily lose sync.**

## 25. Digital Data Service (DDS) NEI Test Access and Control

**25.1** The front panel DDS test access jacks, identified as Logic In and Logic Out, provide for high speed DDS test access. Figure 8 shows the metallic and logic Network Element Interface (NEI) and Office Channel Unit (OCU) loopback codes as they relate to the HiGain FT1 loopback configuration. NEI is a DDS in-band loopback. The interface is compatible with a TPI 108/109 RT II or Phoenix test set, which fractionally provides 64/56 kbps splitting access to the first time slot of the physical slot where the HLU-D41 is plugged in. Circuit signals are provided at the Logic In and Logic Out jacks, while clock is provided to the test set by the Office Interface Unit (OIU) in the D4 channel bank. Near and far access is also provided.

**25.2** The HLU-D41 generates DDS control codes in the first DS0 channel of the FT1 circuit when abnormal conditions occur. For any of the alarm conditions except for LOSW, the HLU-D41 sends the Mux Out of Sync (0001 1010) code toward the channel bank and sends AIS to the Customer Interface. When an LOSW occurs, the HLU-D41 is unable to communicate with the FT1 remote unit and the HLU-D41 sends the Abnormal Station Code (0001 1110) toward the channel bank.

**25.3** The HLU-D41 detects the NEI latching loopback code and remotely commands the HRU-512 to activate its NREM loopback. The latching loopback code sequence can be applied to the HLU-D41 either through its front panel test access jacks or from a DDS test access unit located in the network. The NLOC loopback can be activated by the OCU latching code sequence.

**25.4 DDS Loopback Steps.** The HLU-D41 responds to DDS NEI and OCU latching loop up codes. Latching loop up codes must be in the following sequence: x = Don't Care Bit. Use the following settings to initiate DDS loopbacks:

- 1 A minimum of 35 Transition In Progress bytes (x0111010)
- 2 A minimum of 35 Loopback Select Code bytes (x1000001 for NEI, x1010101 for OCU)
- 3 A minimum of 100 Loopback Enable bytes (x1010110)
- 4 A minimum of 32 far end voice bytes (x1011010)



**The bytes in each group are adjacent.**

A 25-second timer is started after using setting 2 above. Loop up is aborted if setting 3 and 4 are not completed within this 25-second period. To loop down, setting 1 (above) must be transmitted.

## F. PRODUCT SUPPORT

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### 26. Technical Support

- 26.1** PairGain Technical Assistance is available 24-hours-a-day, 7-days-a-week by contacting PairGain Customer Service Engineering group at:
- Telephone:** (800) 638-0031 or (714) 832-9922
- Fax:** (714) 832-9924
- 26.2** During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday - Friday, excluding holidays), technical assistance calls are normally answered directly by a Customer Service Engineer. At other times, a request for technical assistance is handled by an on-duty Customer Service Engineer through a callback process. This process normally results in a callback within 30 minutes of initiating the request.
- 26.3** **Bulletin Board Services.** PairGain maintains a computer bulletin board system for obtaining current information on PairGain products, product troubleshooting tips and aids, accessing helpful utilities, and for posting requests or questions. This system is available 24-hours-a-day by calling (714) 730-3299. Transmission speeds up to 28.8 kbps are supported with a character format of 8-N-1.

### 27. PairGain Warranty

- 27.1** PairGain Technologies warrants this product to be free of defects and to be fully functional for a period of 60 months from the date of original shipment, given proper customer installation and regular maintenance. PairGain will repair or replace any unit without cost during this period if the unit is found to be defective for any reason other than abuse or improper use or installation.
- 27.2** Do not try to repair the unit. If it fails, replace it with another unit and return the faulty unit to PairGain for repair. Any modifications of the unit by anyone other than an authorized PairGain representative voids the warranty.
- 27.3** If a unit needs repair:
- 1 Call PairGain for a Return Material Authorization (RMA) number at (800) 638-0031.
  - 2 Return the defective unit, freight prepaid, along with a brief description of the problem, to:  
  
PairGain Technologies, Inc.  
ATTN: Repair and Return Dept.  
14402 Franklin Avenue  
Tustin, CA 92780  
USA
- 27.4** PairGain continues to repair faulty modules beyond the warranty program at a nominal charge. Contact your PairGain sales representative for details and pricing.

### 28. Certification

- 28.1** **FCC compliance.** The HLU-D41 has been tested and found to comply with the limits for Class A digital devices 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 their own expense.

- 28.2 UL Recognized.** The HLU-D41 is a UL Recognized component. Use normal caution when installing or modifying telephone lines. Dangerous voltages may be present. It is also considered imprudent to install telephone wiring during a lightning storm. Always disconnect all telephone lines and power connections from wall outlets before servicing or disassembling this equipment.
- 28.3 CSA Certification.** The HLU-D41 has been tested and found to comply with CSA Standard C22.2-950 with telecommunication features.

## G. ABBREVIATIONS AND GLOSSARY

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### 29. Abbreviations and Glossary

<b>2B1Q</b>	2-Bits-1-Quaternary
<b>ACO</b>	Alarm Cut Off
<b>AIS</b>	Alarm Indication Signal
<b>AMI</b>	Alternate Mark Inversion
<b>BER</b>	Bit Error Ratio
<b>BPV</b>	Bipolar Violation
<b>CI</b>	Customer Interface
<b>CO</b>	Central Office
<b>CLOC</b>	Customer Local Loopback
<b>CLR</b>	Clear Channel Signaling
<b>Code type</b>	Type of DS1 line coding used (AMI, B8ZS, AMI : ZBTSI or B8ZS : ZBTSI). The latter two conditions indicate the code type that is being received when the HiGain system is set to its ZBTS mode. In either the AMI or B8ZS DS1 code mode, the Code type displays the selected code as opposed to the code type that is actually being received, which is what is displayed when set to AUTO code mode.
<b>CPE</b>	Customer Premises Equipment
<b>CRC</b>	Cyclic Redundancy Check. A process used to check the integrity of a block of data.
<b>CREM</b>	Customer Remote Loopback
<b>CSA</b>	Carrier Service Area
<b>CSU</b>	Channel Service Unit. A device used to terminate a digital channel on a customer's premises.
<b>DCE</b>	Data Circuit-Terminating Equipment
<b>DDS</b>	Digital Data Service
<b>Digroup</b>	Two groups of 12 digital channels combined to form one single 24-channel T1 system.
<b>DS0</b>	Digital Signal, level 0. 24 DS0s (24x64 kbps) equal one DS1.
<b>DS1</b>	Digital Service, level 1. One DS1 is the same as one T1 (1.544 Mbps).

<b>DS1 BPV Seconds (ES)</b>	The number of seconds in which at least 1 BPV was detected on the DS1 input.
<b>DS1 UAS Count</b>	The number of seconds during which the DS1 input signal was absent (125 or more consecutive zeroes).
<b>DSX</b>	Digital System Cross-Connect frame. A bay or panel to which T-1 lines and DS-1 circuit packs are wired.
<b>ES</b>	Errored Seconds
<b>ESAL</b>	Errored Seconds Alarm
<b>ESF</b>	Extended Super Frame
<b>FT1</b>	Fractional T1
<b>Frame type</b>	Type of DS1 framing used on the input stream (SF or ESF).
<b>HDSL</b>	High-bit-rate Digital Subscriber Line
<b>HDSL 24 Hour ES (Errored Seconds)</b>	The number of 1 second intervals that contained at least 1 CRC error. This value is a running total of the last 24 Hours.
<b>HDSL 24 Hour UAS (Unavailable Seconds)</b>	The number of seconds the HDSL loop was out of sync.
<b>HDU</b>	HiGain Doubler Unit
<b>HLU</b>	HiGain Line Unit
<b>HRE</b>	HiGain Remote Enclosure
<b>HRU</b>	HiGain Remote Unit
<b>HLU/Ver w.x-y</b>	"w.x" = software version number of the HLU-D41. "y" = list # of HLU-D41.
<b>HRU/Ver a.b-c</b>	"a.b" = software version number of the HRU-512. "c" = list # of HRU-512.
<b>HDU1/Ver s.t-u</b>	"s.t." = the software version number of the HDU-217/219 #1. "u" = List number of the HDU-217/219 #1.
<b>HDU2/Ver f.g-h</b>	"f.g" = the software version number of the HDU-217/219 #2. "h" = List number of the HDU-217/219 #2.
<b>LCD</b>	Liquid Crystal Display
<b>LED</b>	Light Emitting Diode
<b>LIU</b>	Line Interface Unit
<b>LOSW</b>	Loss of Sync Word
<b>MARGINS</b>	Indicates the excess signal to noise ratio, at the HRU-512, HDU-217/219, or HLU-D41 HDSL ports, relative to a $10^{-7}$ BER. First value is current margin, second value is minimum margin since last cleared, and third value is maximum value since cleared. NA means Not Available (loop is not in sync). The normal range of a typical margin is from 22 to 6 dB.
<b>NEI</b>	Network Element Interface
<b>NI</b>	Network Interface
<b>NID</b>	Network Interface Device
<b>NIU</b>	Network Interface Unit
<b>NLOC</b>	Network Local Loopback
<b>NREM</b>	Network Remote Loopback
<b>NVRAM</b>	Non-Volatile RAM

<b>OCU</b>	Office Channel Unit
<b>POTS</b>	Plain Old Telephone Service
<b>PPM</b>	Indicates the relative offset of the crystal oscillator in the HRU-512 from the HLU-D41 crystal oscillator. Any value between -64 and +64 is adequate. Values outside this range indicate out of tolerance components or excessive temperature drift in critical components.
<b>Pulse Attenuation</b>	Indicates the attenuation of the 2B1Q pulse from the distant end. The HiGain system operates with pulse attenuations in excess of 30 dB. This value is related to the cable pair's 196 kHz loss. The pulse attenuation is a more direct indication of the loop attenuation to the 2B1Q signal than the 196 kHz loss. The normal range of pulse attenuation is from 1 to 32 dB.
<b>RBS</b>	Robbed Bit Signaling uses bits known as the A and B bits. These bits are sent by each side of the T1 termination and are buried in the voice data of each voice channel in the T1 circuit.
<b>RMA</b>	Return Material Authorization
<b>SF</b>	Super Frame
<b>SNR</b>	Signal-to-Noise Ratio
<b>UAS</b>	Unavailable Seconds
<b>ZBTSI</b>	Zero Byte Time Slot Interface



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