PAIRGAIN TECHNOLOGIES HIGAIN™ LINE UNIT
MODEL HLU-D41
List 1, PairGain #150-1260-01, CLEI Code: T1LID094AA

CONTENTS PAGE

CAUTION
This product incorporates static sensitive components. Proper electrostatic discharge procedures must be followed.

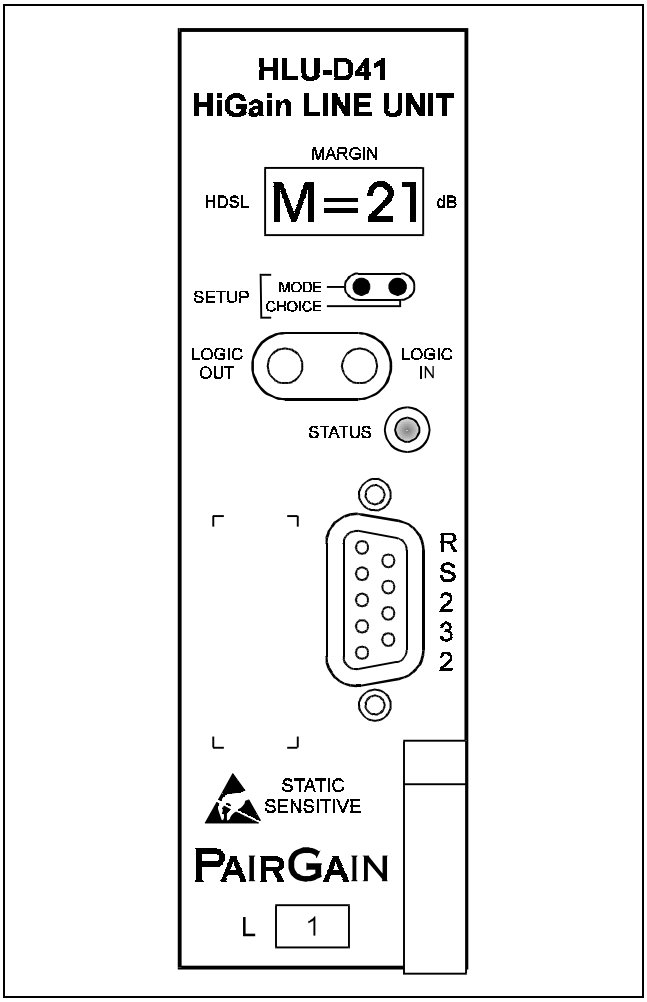

Figure 1. HLU-D41 Front Panel. The PairGain HLU-D41 is a Fractional T1 (FT1) local unit used in conjunction with the HRU-512 remote unit to provide a complete HiGain HDSL system.

A. PRODUCT OVERVIEW

1. DESCRIPTION AND FEATURES

1.01 This Technical Practice describes the PairGain Technologies Fractional T1 (FT1) HiGain Line Unit, Model HLU-D41 (see Figure 1). The HLU-D41, in conjunction with the HRU-512, provides for fractional T1 service over a single, unconditioned copper loop. The HLU-D41, can be plugged into the channel unit slot of an AT&T type D4 channel bank or a SLC-96 channel bank. The HLU-D41 delivers line power and data at rates of 64 kbps through 768 kbps (1 to 12 DS0s) on a single copper pair over the full Carrier Serving Area range to a High bit-rate Digital Subscriber Line (HDSL) HRU-512 FT1 Remote Unit. The HLU-D41 range is 12,000 ft. over a 24 AWG twisted wire pair, or 9,000 ft. over a 26 AWG twisted wire pair, including all bridge taps.

1.02 The HLU-D41 can be provisioned to use 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, or 12 DS0 channels, depending on the data rate desired (see Table 1).

TABLE 1. DATA RATES VS. DS0 TIME SLOTS

Data Rate, kbps	*Number of DS0 Time Slots*
64	1
128	2
142	3
256	4
320	5
384	6
448	7
512	8
576	9
640	10
704	11
768	12

1.03 Revision History of this practice.

Revision 02—June 5, 1997

a) official 02 release, replaces 02P dated 10/23/95

1.04 The HLU-D41, List 1 has the following features:

- 784 kbps full duplex, two-bits, one-quaternary (2B1Q) HDSL transmission on one wire pair
- Front panel light emitting diode (LED) display to indicate unit status
- Front panel four-digit LED display of HDSL margin (in dB), configuration parameters, alarms, etc.
- Operator setup via front panel is stored in non-volatile random access memory (NVRAM)
- Responds to both Digital Data Service (DDS) NEI and OCU loopback codes
- RS-232 maintenance port
- Front panel DDS test access
- Provisionable idle code, “7F” or “FF”
- Payload bandwidth selectable from 64 kbps (1 channel) to 768 kbps (12 channels), in increments of 64 kbps
- Provisionable Robbed Bit Signaling (RBS) or Clear Channel Signaling (CLR) for each DS0 channel
- Lightning and power cross protection on HDSL interface
- DS1 remote loss-of-signal (LOS) detector, which activates after receiving 125 consecutive zeros from customer at Remote Unit
- HDSL margin alarm
- Easy return to factory default settings
- Circuit identification number (ID) capability
- Remote unit can be either line powered or locally powered
- SLC-9C channel band compatibility for CLR channel applications.

2. APPLICATIONS

2.01 The HLU-D41 provides a cost-effective, easy-to-deploy method for delivering fiber-quality fractional T1 Digital Service over one metallic pair. Conventional span repeaters, cable pair conditioning and bridged tap removal are not required.

2.02 The general guidelines require that each loop have less than 35 dB of loss at 196 kHz and 135 ohms driving and terminating impedances. Table 2 provides a guide for the loss of various cable gauges at 196 kHz and 135 ohms, and should be used to calculate the loss between the local and the remote unit. Add 3 dB for each bridged tap and 1 dB for each cable gauge change.

2.03 The system operates with any number of other T1, POTS, Digital Data Service (DDS) or other HDSL systems sharing the same cable binder group. The HiGain systems can be used with customers requiring FT1 service on a temporary or permanent basis. The system also provides a means of quickly deploying service in advance of fiber-optic transmission systems. By using the HiGain FT1 system, service can be connected within a day or even a few hours.

2.04 See Figure 2 for typical applications with the HLU-D41 functional T1 card.

TABLE 2. CABLE LOSS

Cable Gauge (AWG/mm)	*Loss in dB at 196 kHz*	*Ohms per kft*	*Max kft*
26/0.40	3.88	83	9
24/0.51	2.84	52	12
22/0.61	2.18	32	16
19/0.91	1.54	16	22

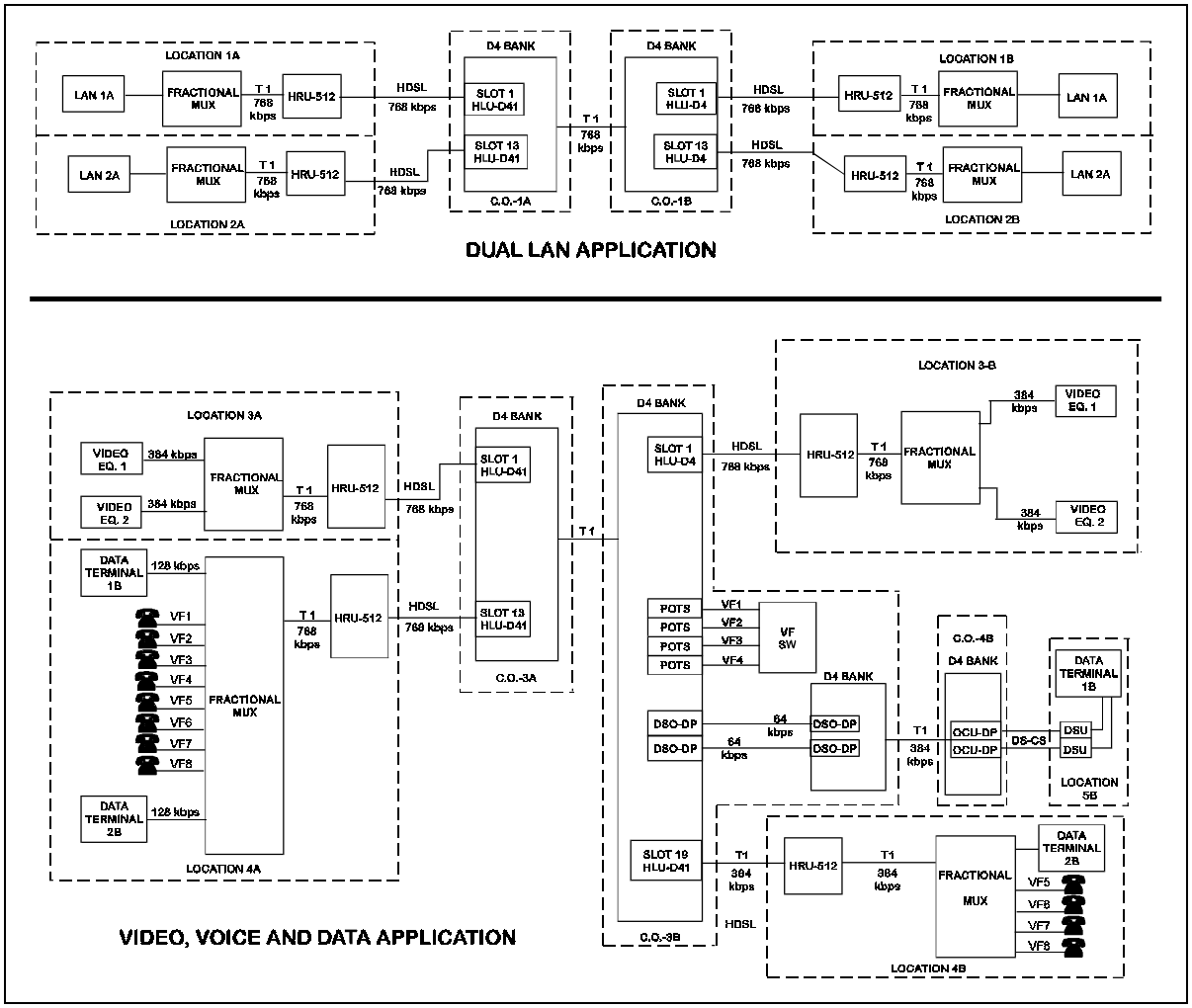

Figure 2. Typical applications of the HLU-D41 fractional T1 card.

3. SPECIFICATIONS

POWER REQUIREMENTS:

Central Office D4 Channel Bank Shelf Input:

-42.5 to -56 VDC battery

System Power:

Consumes 12 Watts maximum (for line powered HRU)

Heat Dissipation:

6 Watts maximum

LOOP REQUIREMENTS:

Loop Types:

Single non-loaded pair, single or mixed gauges, with or without bridged taps

Maximum Loop Loss:

35 dB at 196 kHz, 135-ohm termination

HDSL TRANSMISSION:

Format:

One 784 kbps full duplex pair, 2B1Q line code

Signal Level:

+13.5 dBm

Impedance:

135 ohms

Return Loss:

>20 dB, 40 kHz to 200 kHz

MECHANICAL:

Fits a single channel unit slot in an AT&T D4 channel bank, SLC 96 channel bank or equivalent

ENVIRONMENTAL:

Storage Temperature:

-40° to +85° C

Operating Temperature:

-40° to +65° C

Humidity:

5% to 95%, non-condensing

Clocking:

Internal Stratum-4 clock which tracks the signal rate.

4. CERTIFICATION

4.01 FCC compliance: The HLU-D41 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 electrical interference to radio communications. Operation of this equipment in a residential area may cause electrical interference, in which case the user will be required to correct the interference at his own expense.

5. WARRANTY

5.01 PairGain Technologies warrants this product to be free of defects and to be fully functional for a period of 36 months from the date of original shipment, given proper installation. During this warranty period, PairGain will repair or replace any unit, without cost, if the unit is found to be defective for any reason other than abuse, improper use or installation.

5.02 This module should not be field repaired. 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.

5.03 If a unit needs repair, call PairGain for a Return Material Authorization (RMA) number and return the defective unit, freight prepaid, along with a brief description of the problem, to:

PairGain Technologies, Inc.
14402 Franklin Avenue
Tustin, CA 92680
ATTN: Repair and Return Dept.
(714) 832-9922
(800) 638-0031

6. TECHNICAL ASSISTANCE

6.01 PairGain Technical Assistance is available 24-hours-a-day, 7-days-a-week by contacting PairGain's Customer Service Engineering group at one of the following numbers:

Telephone: **(800) 638-0031**
(714) 832-9922

Fax: **(714) 832-9924**

During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday through Friday, excluding holidays), technical assistance calls are 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 results in a callback within 30 minutes of initiating the request. In addition, PairGain maintains a computer bulletin board system for obtaining current information on PairGain products, product trouble-shooting 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.

B. FUNCTIONAL DESCRIPTION

7. OPERATIONAL CAPABILITIES

7.01 The HLU-D41 uses one PairGain Technologies 2B1Q HDSL transceiver to establish a full duplex 784 kbps data link to the Remote Unit. The HLU-D41 block diagram is shown in Figure 3.

7.02 Multiplexed DS0 channels are extracted from the channel bank backplane. The number of channels extracted is determined when the HLU-D41 is provisioned either through the front panel push-button interface, or through the front panel RS-232 port. Next, the DS0 channels optioned for A/B robbed bit signaling are properly formatted. The DS0 channels are then passed to the DS1 formatter which builds a DS1 signal. 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. The half-DS1 signal is passed to the HDSL framer. The framer bit stuffs the half-DS1 signal into the HDSL payload envelope and adds the required HDSL overhead. The 784 kbps HDSL signal is encoded by the single pair transceiver into a 2B1Q signal. The 2B1Q signal is coupled to the twisted pair line by a transformer in the line interface. The line interface provides lightning and power cross protection.

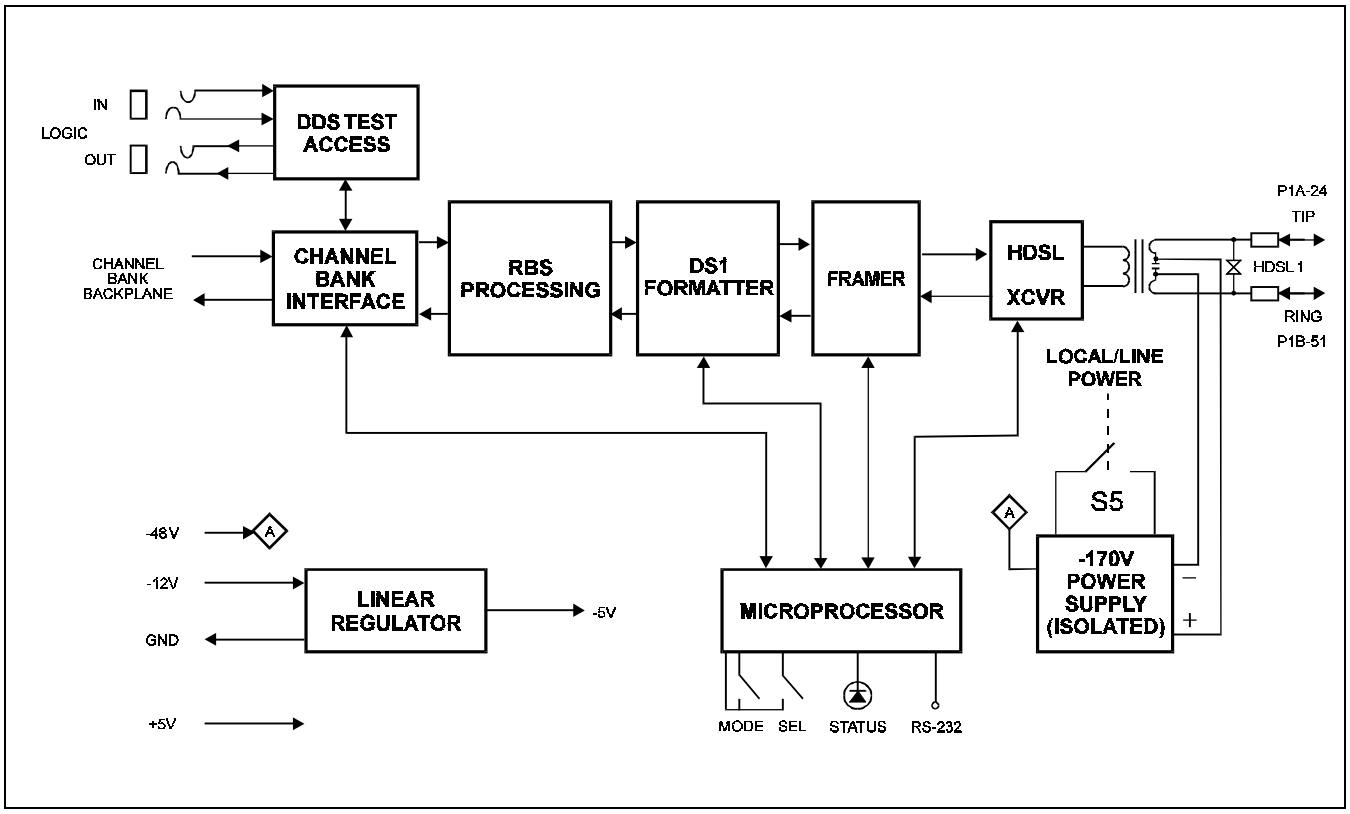

Figure 3. HLU-D41 Block Diagram. PairGain's HDSL technology provides full duplex services at standard FT1 rates over a single copper wire pair between an HLU and an HRU, which comprises one fractional HiGain system.

7.03 The 784 kbps signal from the remote HDSL transceiver appears at the HDSL line interface. The single pair transceiver does a 2-wire to 4-wire conversion of the signal using echo-canceling technology. The signal to be transmitted toward the channel bank is processed by the HDSL Framer which monitors its signal quality. 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.

7.04 An 8-bit microprocessor is used to monitor and control the HLU-D41. Provisioning status information is provided through the RS-232 interface, or the front panel, to the microprocessor. The micro-processor communicates with the HDSL Framer for signal status. It configures the circuit bandwidth at the DS0 channel interface.

7.05 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 -170 VDC feed to power the Remote Unit. The LOCAL/LINE power switch (shown in Figure 3) is located at the rear of the D41 (shown in Figure 4). The switch gives the user the choice between powering the HRU-512 over the HDSL cable pair (LINE) or allowing the HRU-512 to be locally powered (LOCAL). The line power supply can also be turned on or off by the microprocessor and is automatically shut down in the presence of line short circuits or a microprocessor failure.

7.06 The maximum power consumption and maximum power dissipation for the HLU-D41 on a per-slot basis are as follows:

Maximum Power Consumption:

- Per Slot = 12 Watts (line powered HRU)
- Per Slot = 8 Watts (locally powered HRU)

Maximum Power Dissipation:

- Per Slot = 6 Watts (line powered HRU)
- Per Slot = 3 Watts (locally powered HRU

Note: These worst case conditions assume a 9,000 ft., 26 AWG loop.

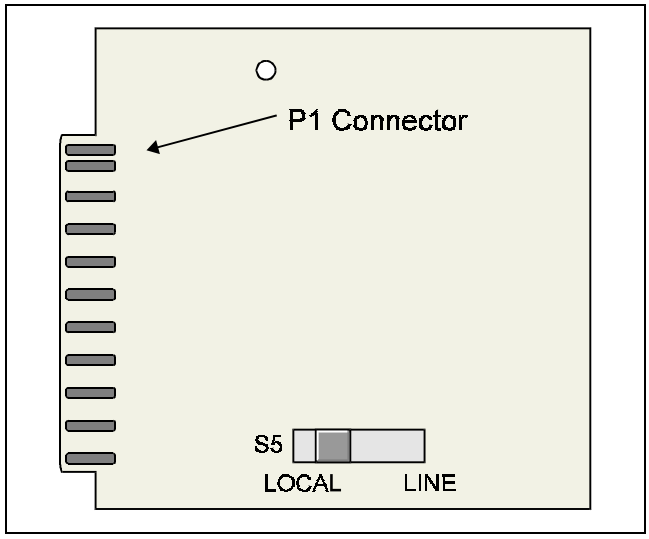

Figure 4. HLU-D41 Rear Card Edge with Local/Line Switch. Switch allows user choice for HRU-512 local or line powering.

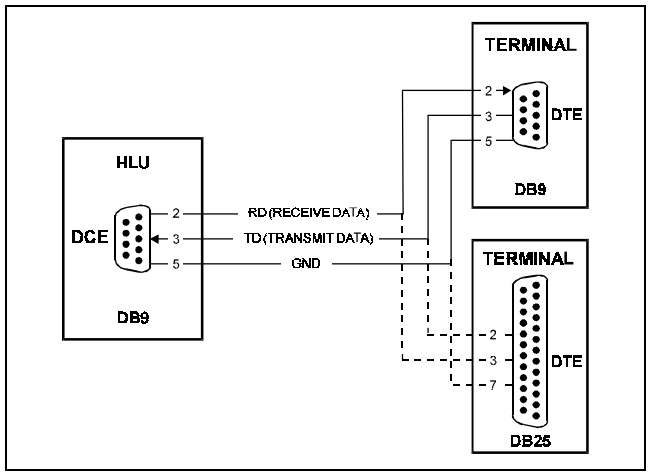

Figure 5. DB-9 Connector. A standard RS-232 (DB-9) female connector on the front panel provides access to the maintenance interface features via an ASCII terminal.

7.07 The maximum number of channel bank slots that can be occupied by the HLU-D41 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 295 mA of +5V power when the HRU is locally powered and 325 mA when the HRU is line powered.** The worst case +5V current drain for D4 common equipment is 1.2 A. The 325 A D4 bank power converter supplies 3 A at +5V. That leaves 1.8 A for the 48 channel slots or 37 mA per slot. This translates to 1.8/.325 or a maximum of 5.5 HLU-D41 units per D4 channel bank (2 to 3 units per digroup).

7.08 The worst case +5V current drain for SLC96 common equipment is also 1.2 A, PCU SLC96

power converter supplies 3.2 A at +5V. This leaves 2 A for the 48 dual channel slots. This translates to 2/.325 or a maximum of 6 HLU-D41 units per SLC96 bank. If the enhanced PCU 325 A converter, which supplies 5 A, is used, a maximum of 12 HLU-D41 units per SLC96 bank can be used. Apply these same rules to calculate the maximum number of HLU plugs per bank for channel bank power supplies with different capacities.

7.09 A female 9-pin (RS-232) DB-9 connector is provided on the front panel (see Figure 5). This connector provides access to the HiGain system maintenance, provisioning and performance monitoring interface via a standard RS-232 interface. Figures 8 through 15 show the menu selections that are available from the terminal. Tables 4, 8 and 9 define the various terms used in the screen displays. The RS-232 craft port is configured as DCE with 8 data bits, 1 stop bit and no parity. Striking the SPACE bar several times invokes the autobaud function for a range of 1200 to 9600 bps

7.10 The HLU-D41 generates an alarm message on its front panel display for any of the operating conditions listed below. The front panel message which accompanies each alarm condition is listed in bold letters. Since more than one alarm condition can exist at any time, but only one message can be displayed, the alarms are listed in their order of priorities. Only the highest priority alarm is displayed if more than one alarm condition exists. The alarm conditions are:

(1) **ALRM LOSW:** The HDSL loop lost synchronization.

(2) **ALRM MOOS:** Mux Out Of Sync. The D4 channel bank is in an alarm state.

(3) **ALRM RLOS:** Loss of HRU DS1 input signal.

(4) **ALRM HES:** The HDSL Loop has exceeded the 24-hour user-selected Errored Seconds (ES) threshold (17, 170 or None).

(5) **ALRM DS1:** The total number of ES at the remote unit HRU DS1 input have exceeded the 24-hour user-selected threshold (17, 170 or None).

(6) **ALRM MAL:** The margin on the HDSL loop has dropped below the minimum threshold value set by the terminal MARGIN ALARM THRES as described in Paragraph 9.07.

7.11 The alarm message remains for the duration of the alarm condition. The HLU-D41 STATUS LED flashes RED for the duration of the alarm condition. The various ALRM messages are only displayed when the front panel display is in its active ON state.

7.12 The HLU-D41's front panel tri-color STATUS LED has the following states:

- GREEN - Normal Operation
- FLASHING GREEN - HDSL Acquisition
- FLASHING RED - Minor Alarm (For conditions see Table 4.)
- RED - FUSEALRM
- YELLOW - Self-test in process or an HLU loopback in effect (CREM or NLOC).

7.13 To accommodate a mix of voice and data applications, each DS0 channel within the payload must be provisioned to use A/B Robbed Bit Signaling (RBS), or Clear Channel (CLR) operation. The HLU-D41 allows the user to select either option for each DS0 channel via the terminal interface (see Paragraph 9.08).

8. LOOPBACK OPERATION

8.01 The HLU-D41 system has four types of user initiated loopbacks—two toward the Customer (CLOC and CREM) and two toward the Network (NLOC and NREM). These loopbacks are described in detail in the following paragraphs (refer to Figure 7 and Tables 8 and 9 for additional loopback information):

8.02 Pressing both the **MODE** and **CHOICE** buttons on the front panel, for at least three seconds, initiates a MANUAL loopback session. This session allows the user to select one of four HiGain loopbacks. The message, "MAN LPBK," appears on the front panel display followed by the message "NLO?" If the **CHOICE** button is now pressed, an NLOC loopback is executed and the message changes from "NLO?" to "NLOC." If the **MODE** button is pressed instead of the **CHOICE** button, "NLO?" is replaced by "NRE?" This allows an NREM loopback to be executed with the **CHOICE** button. Pressing the **MODE** button two more times yields the "CRE?" (CREM) and "CLO?" (CLOC) loopback options in the sequence listed. This interactive button procedure permits any of the four HiGain loopbacks to be executed. Once a loopback is executed/activated, the next loopback option can be presented by pressing the **MODE** button. However, the previously executed loopback will remain active until the **CHOICE** button is pressed, thus selecting a different loopback to activate. If neither button is pressed within 30 seconds and no loopback is in effect, the MANUAL loopback session terminates and the normal margin display reappears. If any loopback is in effect, the 30-second time-out is inhibited. The active loopback will continue until the loopback times out in accordance with the user-selected LBTO setting. Also, pressing both

buttons, again for three seconds, terminates any active loopback, ends the MANUAL loopback session and returns the display to normal. Loopbacks can also be initiated from the RS-232 maintenance port by selecting the LOOPBACK MODE option "D" from the MAIN MENU. This displays the Loopback Menu, shown in Figure 15, from which any of the four loopbacks can be initiated.

8.03 When a CLOC loopback is performed, the Customer Interface (CI) signal that is sent to the HRU-512 is looped back to the Customer Premise Equipment (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 transmits FF toward the bank. Time slots not configured by the HLU-D41 are unaffected by it.

8.04 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 line unit (HLU-D41). For the HiGain fractional T1 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 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 by it.

8.05 When an NLOC loopback is performed, the bank signal is looped back to the bank at the HLU-D41 and the AIS signal is transmitted toward the CPE. This 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.

8.06 An NREM loopback operates similarly to an NLOC loopback except that in an NREM loopback, the 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.

8.07 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).

CAUTION

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

9. SYSTEM OPTION SETTINGS

9.01 The HLU-D41 contains a non-volatile RAM which stores the system option settings. No DIP switches or jumpers are required to set the HLU-D41 configurations. The system options are set by:

(a) pressing the SETUP (**MODE** and **CHOICE**) momentary push-buttons on the front panel.

or

(b) using an ASCII terminal (or a personal computer with an asynchronous communication program emulating an ASCII terminal) through the RS-232 interface.

Table 3 lists the HLU-D41 system option settings. Figure 10 illustrates the same options on the HLU-D41 SYSTEM SETTINGS Screen. The settings shown represent the factory default settings.

9.02 To enter the "change options" mode, press the **MODE** button for at least one second, but less than three seconds, and then release. The four-character message, displayed on the front panel, alternates between the system parameter and its current setting (see Table 4). Pressing the **CHOICE** button scrolls the display through each individual setting of the **MODE** (parameter) being displayed. After the setting has been selected, via the **CHOICE** button, press **MODE**. This updates the displayed mode to the selected setting. It then selects the next configurable parameter. After the last parameter is selected, the display shows "CONF NO"—pressing the **MODE** button will prevent installation of the changed parameters, however, pressing the **CHOICE** button will display a "YES" message and install the selected changes. The display will also return to its normal mode, without installing any new changes, if, after 30 seconds, neither button is pressed. Review Table 3 for a description of the options.

9.03 All provisionable HiGain system user options can be set to their default values by pressing the **CHOICE** button for at least six seconds until the message: "DFLT NO" appears. To install the default values, press the **CHOICE** button again. The "YES" message will follow, indicating that the default values are

now in effect. To terminate this DFLT mode without reverting the options to their default values, press **MODE** or do nothing for 30 seconds. The latter returns the display to its normal state.

9.04 Pressing the **MODE** button for three or more seconds causes the display to scroll through the HLU software version number, its list number, received frame type, received code type, and all provisionable option settings (see Table 3).

9.05 The following user options can only be set via the ASCII terminal: CIRCUIT ID, MARGIN ALARM THRESHOLD, and SIGNALING.

9.06 The CIRCUIT ID option is set by selecting the "H" option from the terminal MAIN MENU screen shown in Figure 8. The message "enter circuit ID# (24 characters max:)" follows the "H" selection. Press "Enter" after entering the selected set of alpha-numeric ID characters. Press "C" to confirm. If more than 24 characters are entered, a "BEEP" is emitted. A maximum of 24 characters may be entered as a circuit ID. The ID appears in all HLU screens as shown in Figures 8 through 15. Note that the Circuit ID is not set to its default (all blanks) setting when the "DFLT" setting option is utilized (see Paragraph 9.03).

9.07 To set the MARGIN ALARM THRESHOLD, press "G" as prompted by the SYSTEM SETTINGS menu. Enter the desired minimum acceptable alarm threshold from the 0 to 15 dB range. This causes a minor alarm to occur if the margin on the HDSL loop (MAL) drops **below** the selected threshold value (see Paragraph 7.10). Since the margin can never drop below 0, selecting "0" for the margin threshold will turn the margin alarm off.

9.08 To set the signaling options, press "N" as prompted by the SYSTEM SETTING menu. Each channel (DS0 time slot) of the selected bandwidth may be independently set to either Robbed Bit Signaling (RBS) or Clear Channel Signaling (CLR). The number of channels used by the selected bandwidth are displayed in sequence, as 01, 02, 03, 04, 05..., on the terminal screen. The selected signaling mode is indicated beneath each channel. The default setting for all channels is CLR. Whenever the bandwidth is increased in size, the newly activated channels are initialized to CLR. To change channels from CLR to RBS, enter the channel's number. 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. Note that some D4 banks require their option H to be enabled to support the HLU-D41's RBS signaling mode.

9.09 The remaining system settings are set in a similar manner. Enter the letter shown in parentheses which represents the parameter to be changed. Each entry of that letter scrolls the parameter to its next value. After all selections have been made, press "E" for Exit. Press "C" to the resulting "Confirm?" message. This activates the new selections and returns control to the MAIN MENU.

9.10 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 configures 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 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 banks' 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.

TABLE 3. HLU-D41 SYSTEM OPTIONS

Note: An asterisk (*) indicates HLU-D41 factory (default) settings.

Mode	*Choice*	*Description*
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 and flashes the red STATUS LED when 17 Errored Seconds (ES) occur within a 24-hour period.
	170	Causes a minor alarm display 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 remote unit 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 (see Paragraph 9.10).
	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 AFS signal) toward the CPE when in NREM loopback.
MARG	Range: 0 to 15 dB Default: 4* dB	The Margin Alarm Threshold can only be set via the RS-232 maintenance port, and is **not** subject to confirmation (CONFirm prompt below). It determines the minimum allowable margin below which a minor alarm can occur. A "0" dB setting disables this option.

Table continued on next page

TABLE 3. HLU-D41 SYSTEM OPTIONS (CONTINUED)

Message	*Full Name*	*Description*
SGNL	RBS	All DS0 channels in 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 MARG) are to be updated to the new selections.
	NO*	Prevents newly selected operating parameters from being updated. They remain as they were before the system option settings procedure was entered.

TABLE 4. HLU-D41 FOUR-CHARACTER FRONT PANEL DISPLAY MESSAGES

Message	*Full Name*	*Description*
CREM	Customer Remote Loopback	Signal from customer is looped back to customer at HLU-D41.
NLOC	Network Local Loopback	Network signal is looped back to network at HLU-D41.
CLOC	Customer Local Loopback	Signal from customer is looped back to customer at HRU-512.
NREM	Network Remote Loopback	Network signal is looped back to network at HRU-512.
SIG	Signal	The HLU and HRU transceivers are trying to establish contact with each other.
ACQ	Acquisition	The HLU and HRU multiplexers are trying to establish synchronization over the loop.
HES	HDSL CRC Error	At least 1 CRC error has been detected on the HDSL Loop in the last second.
SELF-TEST	Self-test Mode	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.
ACO	Alarm CutOff	A minor alarm occurred and was retired to an ACO condition after pressing the **CHOICE** button on the HLU-D41 front panel.
M=xx	HDSL Loop Margin	Indicates the power of the received HDSL signal relative to noise. Any value of "06" or greater is adequate for reliable system operation.
PWR FEED GOOD	Power Feed Good	Indicates HDSL span power has been turned on by setting the PWRF option to ENA, and that the HLU is able to provide power to the HRU.
PWR FEED SHRT	Power Feed Short	Indicates a short between the HDSL Tip and Ring.

Table continued on next page

TABLE 4. HLU-D41 FOUR-CHARACTER FRONT PANEL DISPLAY MESSAGES (CONTINUED)

Message	*Full Name*	*Description*
POFF	Power Feed Off	Indicates HDSL span power has been turned off at the HLU-D41 by setting the PWRF option to DIS.
BAD RT?	No response from HRU	The HLU does not receive any response from the HRU. Thus the HRU integrity is questionable.
VER xxxx	HLU Software Version Number	This is displayed during the System Settings scroll mode, which is initiated by pressing the HLU-D41 **MODE** button for 3 seconds.
LIST xxxx	HLU List Number	Displayed during System Settings scroll mode defined above.
FRM	Frame: SF, ESF, UNFR	Indicates the framing pattern being received at the HRU DS1 input port. Displayed during System Settings scroll mode defined above.
CODE	Line Code: AMI, B8ZS	This is the line code that the HRU-512 is receiving at it's DS1 input port. Displayed during System Settings scroll mode defined above.
LOSW	Loss of Sync Word	Indicates that the HDSL loop has lost sync. Causes a minor alarm.
MOOS	Multiplexer (Mux) Out of Sync	Channel bank is generating a "MOOS" condition.
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the DS1 input port to the HRU. Causes a minor alarm.
DS1	DS1 Errored Seconds	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. Causes a minor alarm.
SLOT	Time Slot Configuration	Indicates the current configuration for transporting customer data. ALT indicates customer data is transported in ALTernating DS0 time slots (1, 3, 5...23). CONT indicates customer data is transported in CONTiguous DS0 time slots (1, 2, 3...12).
BAND	Bandwidth	Indicates the bandwidth (64K through 768K) currently selected by the user.
SGNL	Signaling Status	Indicates the signaling status for the selected bandwidth. RBS indicates all provisioned DS0 time slots are set to Robbed Bit Signaling mode. CLR indicates all provisioned DS0 time slots are set to Clear Channel Signaling mode. MIX indicates there is a mixture of RBS and CLR active DS0 time slot modes.
MAL	Margin Alarm	The margin on the HDSL loop has dropped below the threshold (1 to 15 dB) set by the user.
OCU	Office Channel Unit	An NLOC loopback that was initiated by an OCU latching loopback command sequence is in effect.
NEI	Network Element Interface	An NREM loopback that was initiated by an NEI latching loopback command sequence is in effect.

9.11 The SLOT option provides two choices for configuring how customer data is transported in the T1 frame. The "CONT" choice configures the HiGain FT1 system to transport customer data in contiguous sequential DS0 time slots (1, 2, 3, ... , 11, 12) for the user-selected bandwidth, whereas the "ALT" choice configures the HiGain FT1 system to transport customer data in alternating DS0 time slots (1, 3, 5, ..., 21, 23 or 2, 4, 6, ... , 22, 24) for the user-selected bandwidth. For data applications, the "ALT" choice is the recommended setting. It 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 MOOS condition with loss of customer data in all 24 DS0 time slots, until frame sync is re-acquired. Use of the "CONT" for voice channels, or, with D4 channel banks configured for "B8ZS," should not cause any loss of data.

9.12 The HAIS option provides two choices for the T1 transmit outputs at the HRU for HDSL loss of sync conditions. The "ENA" 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 of the problem. The "DIS" 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 HAIS DIS mode is selected. This DIS mode is the recommended setting to allow the system to operate, even with low margin conditions, and yet continue to transmit customer data.

9.13 The BAND option selects the fractional bandwidth as shown in Table 1. In the D4 or SLC-96 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.

10. D4 and SLC CHANNEL BANK OPERATION

10.01 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 6. More than one HLU-D41 may be installed in a channel bank (see Section 7 for deployment rules). The physical time slots are identical to the electrical (DS0) time slots in D4 banks. Physical slots 1, 2, 3... match the DS0 time slots 1, 2, 3... as shown in Table 7. 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 as follows:

TABLE 5. CHANNEL BANK SLOT POSITIONS

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

CAUTION
The last example is not recommended because its bandwidth exceeds the 24-slot single digroup limit. This would require the HLU 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" around feature.

10.02 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 can not be configured for RBS signaling and are restricted to the CLR signaling option.** In addition, Mode III has two channel counting sequences, such that the physical channel slots are not identical to the DS0 time slots. The two sequences, D1D and D4 are shown in Table 7. Table 6 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.

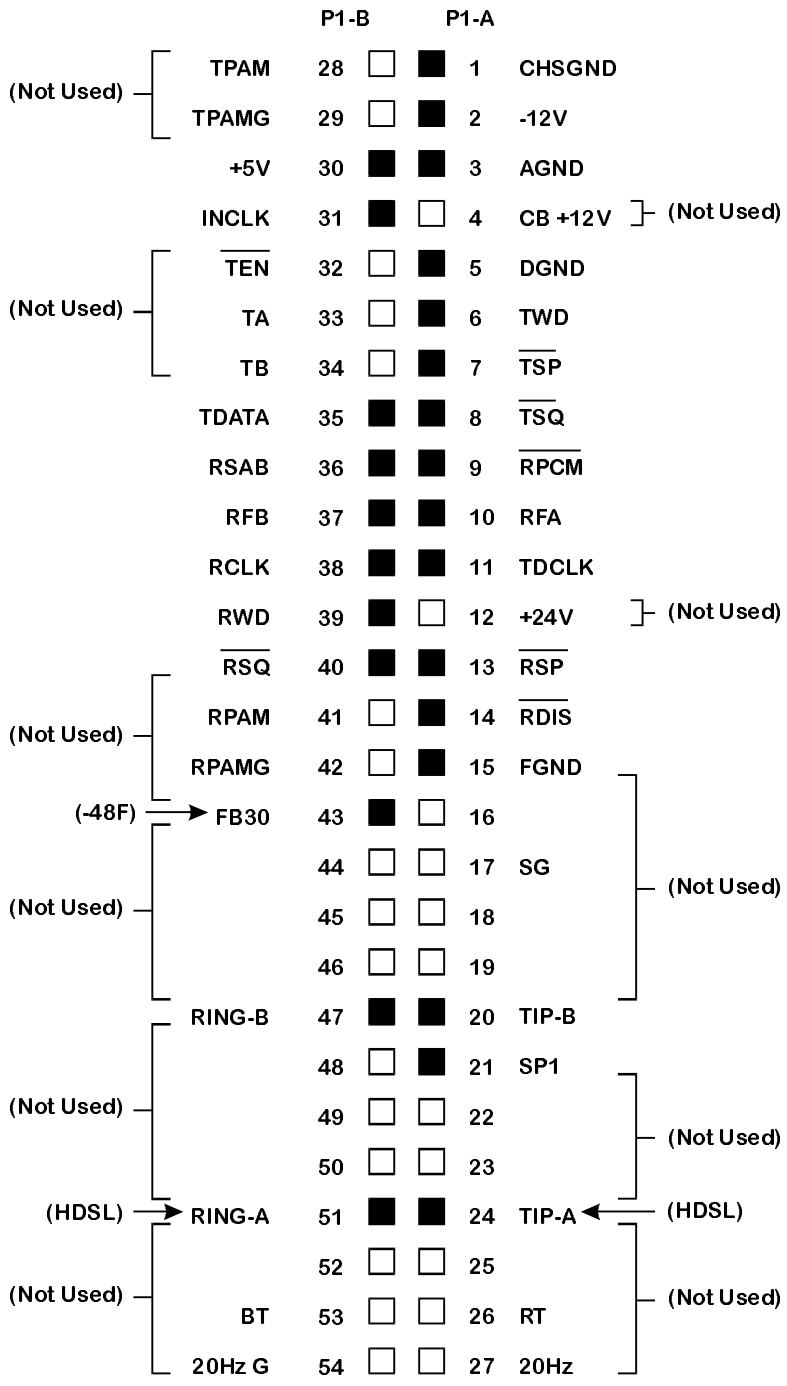

Figure 6. D4 Bank Card Edge Pin-out Diagram.

TABLE 6. RELATIONSHIP BETWEEN PHYSICAL SLOTS AND TIME SLOTS 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	256	ALT	16	13, 15, 17, 19	16, 4, 17, 5
D4	768	CONT	5	9, 10, 11...20	5, 17, 6, 18, 7, 19, 8, 20, 9, 21, 10, 22
D4	256	ALT	18	18, 20, 22, 24	21, 22, 23, 24

TABLE 7. CHANNEL COUNTING

D4 Channel Counting												
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
SLC-96 Mode III D1D Channel Counting												
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
SLC-96 Mode III D4 Channel Counting												
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

C. INSTALLATION AND TEST

11. INSTALLATION PROCEDURES

11.01 Upon receipt of the HLU-D41, visually inspect it for signs of damage. If it was damaged in transit, immediately report the damage to the transportation company or to PairGain Technologies.

11.02 When testing the fractional T1 circuit, remember that the data at the remote (customer) side always begins at time slot 1 and continues through the number of time slots provisioned. Data at the HLU begins at the time slot assigned to the HLU'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.

11.03 The four-character front panel display on the HLU-D41 has many useful system configuration and diagnostic messages which are listed in Tables 3 and 4. The four-character display is activated when power is initially applied to the line unit. In order to conserve power, the display remains active for only four minutes if neither the **MODE** nor **CHOICE** buttons are pressed. The use of either button re-activates the four-character display and restarts the 4-minute power saving timer.

11.04 Since all of the HLU-D41's user options, including SLOT settings, reside in NVRAM, they are retained when the unit is unplugged or powered down. 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 time slots if the HLU-D41 slot configuration is conflicting. A special power-up sequence is built into the HLU-D41 to preclude this interference with other channel card's DS0 data during the power-up "initialization mode." During the initialization mode, data is inhibited from being transmitted to the D4 channel bank (AIS is transmitted) until the user either accepts or changes the desired SLOT and BANDwidth configurations using the HLU-D41 front panel **MODE** and **CHOICE** buttons. On power-up, after HDSL synchronization, the current bandwidth setting blinks. This reminds the user to either select a new value by pressing both the **CHOICE** and **MODE** buttons or to accept the current setting by pressing just the **MODE** button. This is followed by the blinking of the SLOT setting, at which time the user may accept or change it. After the choice is made, the confirm YES button must be pressed. If the user does not press the button within 60 seconds after the bandwidth setting begins to blink, the original settings at power-up will be used. The procedure for using the **MODE** and **CHOICE** buttons is similar to that described in Paragraph 9.02.

11.05 If the current SLOT and BANDwidth settings are not desired, the user must change the settings before the Turn-on initialization mode terminates. The factory default setting, "SLOT CONT," is displayed on the HLU-D41 front panel four-character display at Turn-on. Press the **CHOICE** button to toggle the setting between "ALT" (alternating) and "CONT" (contiguous) channel slots. After the desired setting is selected, via the **CHOICE** button, press **MODE**. This updates the "SLOT" parameter to the selected mode, and causes the display to present the message "BAND 64K." Use the **CHOICE** button to select the desired bandwidth (64K through 768K). After the desired bandwidth is selected, via the **CHOICE** button, press **MODE**. This updates the BAND setting to the selected bandwidth and causes the display to present the message "CONF NO"—pressing the **MODE** button will prevent installation of the changed parameters, however, pressing the **CHOICE** button will display a "YES" message and install 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).

11.06 If the current SLOT and BANDwidth settings are acceptable, press the **MODE** button three times. The first press of the **MODE** button causes the displayed "SLOT" message to change to "BAND." The second press changes the displayed "BAND" message to "CONF" ("Confirm changes?"). The third press of the **MODE** button accepts the current settings, then exits the initialization mode. When this "accept current settings" procedure is completed, the AIS signal is immediately replaced by the date in the provisioned bandwidth (DS0 time slots).

11.07 If either of the above procedures are completed before the HDSL loop has acquired sync, the SIG or ACQ messages will be displayed on the front panel four-character display. 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.

11.08 The HLU-D41 will "time out" and complete the initialization mode after 60 seconds, if no action is taken by the user. The previously configured settings will then be used and the normal operating display will be observed.

11.09 When the initialization mode is active, all other front panel push-button functions ("change options mode," "scroll mode," "set factory defaults mode," and "manual loopback mode") are inhibited to insure proper SLOT and BANDwidth functioning.

11.10 The capability to access the various menu screens, change parameter settings, and initiate loopbacks with an ASCII terminal via the craft port is not inhibited during the initialization mode. The various menus may be accessed and parameters may be changed, via the ASCII terminal, at any time during the initialization mode.

CAUTION

The user is cautioned not to initiate any loopback until the initialization mode is completed. Doing so may cause the fractional system to operate in a mode not intended and may cause interference to other channel time slots.

12. LOCAL/LINE POWERED REMOTE UNIT

12.01 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 (locally powered). 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. However, if the HRU-512 is not remotely powered, the HLU-D41 applies power to the HRU-512 over the HDSL cable pair.

12.02 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. Jumper JP2, located on the HRU-512, and switch SW5, located on the HLU-D41, may be configured by the user to either enable or disable the metallic sealing current capability. To enable the sealing current capability when the HRU-512 is locally powered, the following two steps must be performed:

1. At the HLU-D41, set switch SW5 to the **LOCAL** position.
2. At the HRU-512, connect JP2 across **both** terminals.

12.03 To configure the system for HLU-D41 line powering:

1. At the HLU-D41, set switch SW5 to the **LINE** position.
2. At the HRU-512, connect JP2 across just **one** of the two terminals. These are the factory default settings for both units.

13. DDS NEI TEST ACCESS AND CONTROL

13.01 Bantam jacks are provided on the front panel of the HLU-D41 for high speed Digital Data Service (DDS) test access. The interface is compatible with a TPI 108/109 RT II 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 jacks labeled "IN" and "OUT" 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.

13.02 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 defined in Paragraph 7.10, 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.

13.03 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. The loopback locations are shown in Figure 7. Table 8 describes the different ways each loopback can be activated and released.

13.04 **DDS Loopback**. 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

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)

Note: The bytes in each group are adjacent.

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

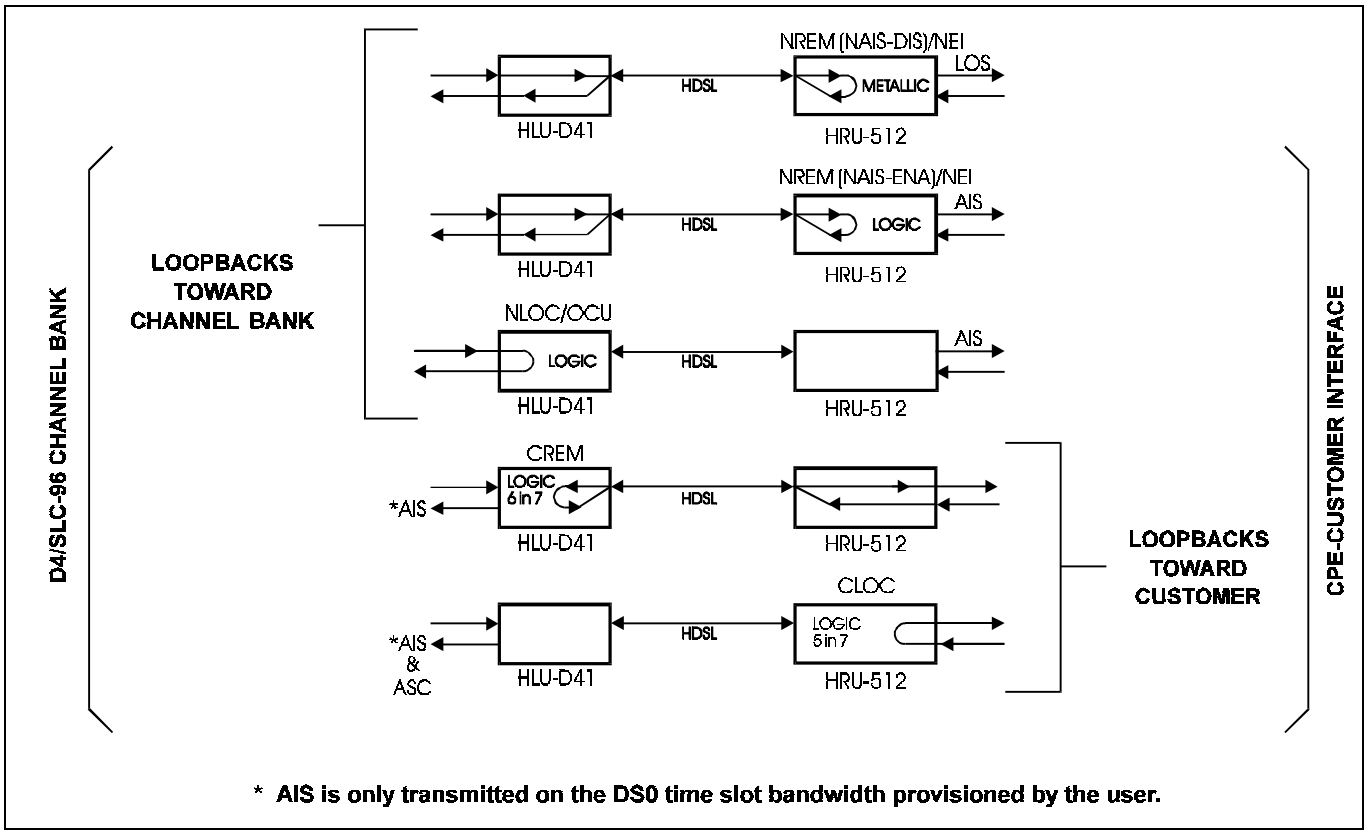

Figure 7. HiGain-FT1 Loopback Configurations.

TABLE 8. LOOPBACK CONTROLS

Loopback	*Activation Methods*	*Release*
NREM	NEI (DDS) latching HLU-D41 front panel buttons HRU-512 front panel button maintenance port	DDS release code HLU-D41 front panel buttons HRU-512 front panel button maintenance port
NLOC	OCU (DDS) latching HLU-D41 front panel buttons maintenance port	DDS release code HLU-D41 front panel buttons maintenance port
CREM	HLU-D41 front panel buttons 6 in 7 in-band code from CPE maintenance port	HLU-D41 front panel buttons 3 in 5 in-band code from CPE maintenance port
CLOC	HLU-D41 front panel buttons 5 in 7 in-band code from CPE maintenance port	HLU-D41 front panel buttons 3 in 5 in-band code from CPE maintenance port

TABLE 9. HLU-D41 TERMINAL SCREEN SPAN STATUS MENU DEFINITIONS

Message	*Full Name*	*Description*
ALARMS:		
NONE	No Alarms	
RLOS	Remote Loss of Signal	No signal at the remote HRU-512 DS1 input port.
ALRM	Minor Alarm	Indicates that 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 user-selected ES threshold.
MOOS	Multiplexer Out of Sync	The D4 channel bank is generating a MOOS condition.
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.
LAIS	Local Alarm Indicating Signal	Indicates an AIS (all 1's) pattern is being transmitted from the Local HLU-D41 onto the D4 channel bank data bus (toward the network) for the DS0 time slots (bandwidth), as provisioned by the user.
RAIS	Remote Alarm Indicating Signal	Indicates an AIS (all 1's) pattern is being transmitted from the remote 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.
LOOPBACKS:		
NREM	Network Remote Loopback	Loopback at HRU (remote) toward the HLU. Initiated from HLU or HRU front panel buttons, the maintenance terminal, or the NEI/DDS latching loopback. See Figure 7.
NLOC	Network Local Loopback	Loopback at HLU (local) toward the channel bank. Initiated from HLU front panel buttons, the maintenance terminal, or the OCU/DDS latching loopback. See Figure 7.
CLOC	Customer Local Loopback	Loopback at HRU (local) toward the CPE. Initiated from CPE by 5-in-7 in-band code, HLU maintenance port, or HLU front panel buttons. See Figure 7.
CREM	Customer Remote Loopback	Loopback at HLU (remote) toward the CPE. Initiated from CPE by 6-in-7 in-band code, HLU maintenance port, or HLU front panel buttons. See Figure 7.

TABLE 10. GLOSSARY OF HIGAIN TERMS

Term	*Definition*
MARGIN	Indicates the excess signal-to-noise ratio at the HLU or HRU HDSL Line relative to a 10^{-7} Bit Error Rate. 1st value is current margin, 2nd value is minimum margin since (C)leared last, 3rd value is maximum value since cleared. NA means Not Available (loop is not in sync). The normal range is from 22 to 6 dB.
PULSE ATTN	Indicates the attenuation of the HDSL 2B1Q pulse from the distant end. The HiGain system operates with pulse attenuation 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.
PPM	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.
HDSL 24-hour ES (Errored Seconds)	The number of 1-second intervals that contained at least 1 CRC error. This value is a running total of the last 24 hours.
HDSL 24-hour UAS (Unavailable Seconds)	The number of seconds in which the HDSL loop was out of sync.
HRU DS1 BPV Seconds (ES)	The number of seconds in which at least 1 bipolar violation was detected at the HRU DS1 input port.
HRU DS1 UAS Count	The number of seconds during which the HRU DS1 input signal was absent (125 or more consecutive 0's).
HLU UAS Count	The number of seconds during which a MOOS condition was generated by the D4 channel bank.
Frame type	Type of DS1 framing used on the HRU-512 input stream (SF, ESF, or Unframed).
Code type	Type of DS1 line coding used (AMI, B8ZS) at the HRU DS1 input port. In either the AMI or B8ZS DS1 code mode, the selected code is displayed as opposed to the code type that is actually being received.
ver w.x-y	"w.x" = software version number of the HLU-D41. "y" = list number of HLU-D41.
ver a.b-c	"a.b" = software version number of the HRU-512. "c" = list number of HRU-512.
NA	Not Available. Data is not available for display.

```
HI-GAIN FT1 LU   MAINTENANCE TERMINAL MAIN MENU   (ver V1.3L-0001)
                        CIRCUIT ID#: PairGain Technologies

                    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 #
```

Figure 8. HLU-D41 Main Menu Screen.

```
                              SPAN STATUS
                    (HLU/ver1.3-0001:HRU/ver1.3-0001)
TIME: 10:37:02
DATE: 07/06/95
CIRCUIT ID#: PairGain Technologies

ALARMS:   NONE
LOOPBACK: OFF
                         HLU  HDSL           HRU  HDSL
                        cur/min/max         cur/min/max
MARGIN:                   21/18/22            21/20/22 dB
PULSE ATTN:                  00                  00    dB
PPM OFFSET:                  00                 -14    ppm
24 HOUR ES:                00001               00002  seconds
24 HOUR UAS:               00017               00000  seconds

                                    DS1 STATUS
                              HLU                 HRU
24 HOUR BPV Seconds:          -----               00002
24 HOUR UAS Count:            00000               00002
Frame type:                     SF                  SF
Code type:                     AMI                 AMI

                          (E)xit (C)lear (U)pdate
```

Figure 9. HLU-D41 Status Display.

```
                                SYSTEM SETTINGS

        TIME: 10:45:33
        DATE: 07/06/95
        CIRCUIT ID#: PairGain Technologies

        (I)DLE CODE:         FF
        NETWORK (L)OOPBACK: DISABLE
        (P)OWER:             ENABLE
        ES ALARM TH(R)ES:    NONE
        LOOPBACK (T)IMEOUT: 60
        HRU (D)S1 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:     128K
        SIG(N)ALING: rb - Robbed Bits:     01 02


                                (E)xit
             Enter the letter in parenthesis (X) to change any setting
```

Figure 10. HLU-D41 System Settings Screen.

```
                                  SET CLOCK

        TIME: 10:46:48
        DATE: 07/06/95
        CIRCUIT ID#: PairGain Technologies


        Format: HH:MM
                MM/DD/YY









        NEW TIME:

        NEW DATE:


        (U)PDATE REMOTE?
```

Figure 11. HLU-D41 Set Clock Screen.

```
Date: 07/06/95            PERFORMANCE DATA
CIRCUIT ID#: PairGain Technologies
                  ERRORED SECONDS/UNAVAILABLE SECONDS

                 DS1                HDSL
            HLU       HRU       HLU       HRU
07:00     ---/000   000/000   000/000   000/000
07:15     ---/000   000/000   000/000   000/000
07:30     ---/000   000/000   000/000   000/000
07:45     ---/000   000/000   000/000   000/000
08:00     ---/000   000/000   000/000   000/000
08:15     ---/000   000/000   000/000   000/000
08:30     ---/000   000/000   000/000   000/000
08:45     ---/000   000/000   000/000   000/000
09:00     ---/000   000/000   000/000   000/000
09:15     ---/000   000/000   000/000   000/000
09:30     ---/000   000/000   000/000   000/000
09:45     ---/000   000/000   000/000   000/000
10:00     ---/000   000/000   000/000   000/000
10:15     ---/000   000/000   000/000   000/000
10:30     ---/000   002/002   001/017   002/000
10:45     ---/000   000/000   000/000   000/000

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

Figure 12. HLU-D41 Performance Data Screen.

```
Time: 10:53:44                    7 DAY HISTORY
CIRCUIT ID#: PairGain Technologies


                        ERRORED SECONDS/UNAVAILABLE SECONDS

                 DS1                        HDSL
            HLU          HRU          HLU          HRU
06/29    -----/00000 00000/00000 00000/00000 00000/00000
06/30    -----/00000 00000/00000 00000/00000 00000/00000
07/01    -----/00000 00000/00000 00000/00000 00000/00000
07/02    -----/00000 00000/00000 00000/00000 00000/00000
07/03    -----/00000 00000/00000 00000/00000 00000/00000
07/04    -----/00000 00000/00000 00000/00000 00000/00000
07/05    -----/00000 00000/00000 00000/00000 00000/00000
current  -----/00000 00002/00002 00001/00017 00002/00000

                                  (E)xit
```

Figure 13. HLU-D41 Performance History Screen.

```
                                ALARM HISTORY

        TIME: 10:55:29
        DATE: 07/06/95
        CIRCUIT ID#: PairGain Technologies

        Type              First              Last              Current        Count
        LOS, DS1-HRU                                         OK             000
        LOSW, HDSL                                           OK             000
        ES, HDSL                                             OK             000
        MARGIN LP                                            OK             000
        PWR-OPEN                                             OK             000
        PWR-SHRT                                             OK             000

        LAST CLEARED:  06/30/95-00:01




                              (E)xit (C)lear (U)pdate
```

Figure 14. HLU-D41 Alarm History Screen.

```
                                LOOPBACK MENU

        TIME: 10:56:29
        DATE: 07/06/95
        CIRCUIT ID#: PairGain Technologies


                              A. DISABLE LOOPBACKS
                              B. NETWORK LOOP HLU          (NLOC)
                              C. NETWORK LOOP HRU          (NREM)
                              G. CUSTOMER LOOP HLU         (CREM)
                              H. CUSTOMER LOOP HRU         (CLOC)









                                    (E)xit
```

Figure 15. HLU-D41 Loopback Menu.