

PAIRGAIN TECHNOLOGIES HIGAIN-2™ LINE UNIT MODEL HLU-619

LIST #	PART NUMBER	CLEI CODE
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Revision History of this practice.
 Revision 01 — August 5, 1996
 a) Initial release.

CAUTION

THIS PRODUCT INCORPORATES STATIC SENSITIVE COMPONENTS. PROPER ELECTROSTATIC DISCHARGE PROCEDURES MUST BE FOLLOWED.

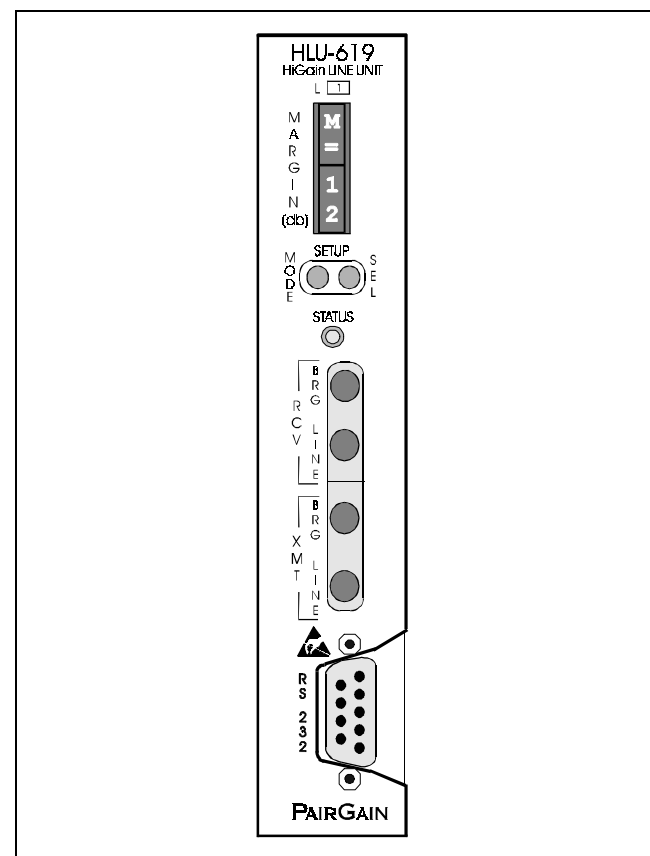


Figure 1. HLU-619 Front Panel. The PairGain HLU-619 is the Central Office side of a single pair repeaterless T1 transmission system.

A. PRODUCT OVERVIEW

1. DESCRIPTION AND FEATURES

1.01 PairGain's HiGain-2 Line Unit Model HLU-619, List 1 (see Figure 1) is the Central Office (CO) side of a single pair repeaterless T1 transmission system. When used in conjunction with an HRU-612 HiGain-2 Remote Unit, the system provides 1.544 Mbps transmission on one unconditioned copper pair over the cable ranges shown in Table 1. The HiGain-2 system uses Very High-bit-rate Digital Subscriber Line (VHDSL) transmission technology. All HiGain modules comply with the applicable requirements of Network Equipment Building System (NEBS) Generic Equipment requirements TR-TSY-000063 and Transport System Generic Requirements TSGR TR-TSY-000499.

1.02 The HLU-619 is compatible with the following T1 repeater shelves and associated equipment:

- Charles Ind. #3192 (28-slot connectorized)
- Charles Ind. #3192-9F Alarm Card
- Larus #1185 (28-slot connectorized)
- Larus #1184 Alarm Card
- Charles Ind. #3192-WR (28-slot wire wrap)
- Charles Ind. #343-00 (12- to 14-slot wire wrap)
- Charles Ind. #319-02 (22-slot connectorized)
- Charles Ind. #319-04 (22-slot wire wrap)
- Charles Ind. #340-00 (9- to 11-slot wire wrap)
- PairGain HMS-318 (22-slot, 19-inch shelf)
- PairGain HHS-319 (3-slot, 19-inch horizontal shelf)
- PairGain HMS-317 (28-slot, 23-inch shelf)
- PairGain HMS-308 (8-slot remote enclosure)

1.03 The Charles Ind. #343-00 and #340-00 shelves do not support the HLU-619's Minor Alarm output on pin H. Also, if slots 1 and 2 of these shelves were wired for the 3408 Fault Locate unit, they must be rewired to accept the HLU-619.

1.04 HLU-619, List 1 includes:

- Selectable DSX-1 pre-equalizer
- -170 Vdc line power for HRU-612
- Front panel VHDSL S/N margin display
- Selectable loopback activation codes
- RS-232 maintenance port
- Non-volatile front panel operator setup
- Front panel DS1 splitting and bridge access
- Lightning and power cross protection on VHDSL interfaces
- 1.568 Mbps full duplex 2B1Q VHDSL transmission on a single pair
- Front panel status indicating LED
- Compatible with HiGain-2's network management system
- On/Off front panel display power cycling
- DS1 LOS detector (125 consecutive zeros)
- Margin threshold alarm
- Smart-Jack Alarm Indicating Signal option
- Easy return-to-factory-default user settings
- Circuit ID option

TABLE 1. HIGAIN-2 VHDSL LOOP LIMITS

CABLE GAUGE	LOSS AT 392 KHZ DB/KFT	OHMS PER KFT	MAXIMUM LOOP FOR 35 DB LOSS	OHMS AT MAXIMUM LOOP LENGTH
26/0.4 mm	4.97	83.3	7 kft / 2.13 km	583
24/0.51 mm	3.87	51.9	9 kft / 2.74 km	467
22/0.61 mm	3.01	32.4	12 kft / 3.66 km	389
19/0.91 mm	2.17	16.1	16 kft / 4.87 km	258

2. APPLICATIONS

2.01 Cost-Effective. HiGain-2 provides easy-to-deploy method for delivering T1 High Capacity Digital Service (HCDS) over one metallic pair. The fiber-like quality service is deployed over one unconditioned, non-loaded copper pair. Conventional in-line T1 repeaters are not required. Cable pair conditioning, pair separation and bridged tap removal are not required.

2.02 General Guidelines. The range deployment rules in Table 1 require that the HiGain-2 loop has less than 35 dB of loss, at the 2B1Q line rate of 392 kHz, with 135 ohm driving and terminating impedances. Adhering to this rule results in an operating margin of at least 6 dB. The HiGain-2 system operates with any number of other T1, POTS, Digital Data Service (DDS) or other HiGain-2 Systems sharing the same cable binder group. HiGain-2 systems can be used with customers requiring DS1 service on a temporary or permanent basis. HiGain-2 also provides a means of quickly deploying service in advance of fiber-optic transmission systems. With the HiGain-2 system, service can be provided within hours. Fiber optic systems can be installed at a leisurely pace and cut over from HiGain-2 when it is convenient. The installed HiGain-2 system can then be easily removed and utilized elsewhere.

3. SPECIFICATIONS

VHDSL Line Code	1.568 Mbps 2B1Q
VHDSL Output	+13.5 dBm ± 0.5 dB at 135 ohms
VHDSL Line Impedance	135 ohms
Maximum Provisioning Loss	35 dB at 392 kHz, 135 ohms
Line Clock Rate	Internal Stratum 4 clock
VHDSL Start-up Time	30 seconds (typical), 60 seconds (maximum)
One-way DS1 Delay	<220 microseconds
DSX-1 Line Impedance	100 ohms

DSX-1 Pulse Output	Pre-equalized for 0 to 655 feet of ABAM
DSX-1 Input Level	+1.5 to -7.5 dB DSX
DS1 Line Rate	1.544 Mbps ± 200 bps
DS1 Line Format	AMI, B8ZS or ZBTISI
DS1 Frame Format	ESF, SF or unframed
Power Consumption	14 Watts (typical), 16 Watts (maximum)
Heat Dissipation	6 Watts (typical), 7 Watts (maximum)
Fusing	Internal; connected to fuse alarm output on pin 32
Span Voltage	-170 Vdc maximum
Margin Indicator	Displays span SNR margin for the span relative to 10 ⁻⁷ BER operation
Electrical Protection	Secondary surge protection on DS1 and VHDSL ports Power cross protection on VHDSL port
Operating Temperature and Humidity (non-condensing)	-40° to 65° Celsius, 5% to 95% humidity
Mounting	STS, 28-slot high-density shelf or equivalent
Dimensions	
Height:	5.9 in.
Width:	1.4 in.
Depth:	10 in.
Weight	1.26 lbs

4. ABOUT THE HLU-619

4.01 The HiGain-2 system uses PairGain's 2-Bit 1-Quaternary (2B1Q) VHDSL transceiver systems to establish one full duplex 1.568 kbps data channel between the HLU-619 and a remotely mounted HRU-612 HiGain-2 Remote Unit.

4.02 A block diagram of the HLU-619 is shown in Figure 2. The HiGain-2 HLU-619 receives a 1.544 Mbps DS1 data stream from the DSX-1 digital cross connect interface. The HLU-619 contains a DSX-1 frame synchronizer controlled by an 8-bit microprocessor, which determines the type of framing on the DSX-1 stream and synchronizes to it. The HLU-619 recognizes Super Frame (SF) or Extended Super Frame (ESF) framing. When the data is unframed, the HLU-619 arbitrarily defines a frame bit.

4.03 The HLU-619 contains a multiplexer that generates a 1.568 kbps data stream. The data stream contains VHDSL frames, which are 9,408 bits (6 milliseconds) in length. The VHDSL frames contain a 14-bit Frame Sync Word (FSW), 6-bit Cyclic Redundancy Check (CRC), 21-bit operations channel and DSX-1 payload.

4.04 The formatted VHDSL channel is passed to the VHDSL transceiver, which converts it to a 2B1Q format on the VHDSL line. The 2B1Q line code is designed to operate in a full-duplex mode on one unconditioned pair. The transceiver echo canceler and adaptive equalizer receive the signal from the remote end in the presence of impairments and noise on the copper pair.

4.05 The received VHDSL channel is processed by the transceiver and then passed on to the HLU-619 demultiplexer module. The demultiplexer provides frame synchronization for the VHDSL channel. The demultiplexer and VHDSL transceiver work under control of the HLU-619 microprocessor and compensate for data inversions caused by tip-ring reversals. By synchronizing to the Frame Sync Word (FSW) of the VHDSL channel, the demultiplexer can reconstruct the original 1.544 Mbps DS1 stream from the VHDSL channel. The CRC fields on the VHDSL streams allow the HLU-619 to determine if errors are present on the channel due to excessive impairments on the VHDSL pairs or excessive impulse or crosstalk noise.

4.06 The demultiplexer removes data link messages from the VHDSL channel and passes them to the microprocessor. This mechanism allows operations messages and status to be exchanged between the HLU-619 and the HRU-612 remote unit.

4.07 The reconstructed VHDSL data channel is buffered in a first-in-first-out buffer (FIFO) within the demultiplexer. A frequency synthesizer, in conjunction with the FIFO, regulates the output bit rate and reconstructs the DSX-1 clock at the exact rate received from the remote end. The HiGain-2 system operates at T1 rates of 1.544 Mbps with up to ± 200 bps of offset.

4.1 DSX-1 INTERFACE DRIVER

4.11 This driver converts the input data to an Alternate Mark Inversion (AMI) or Binary Eight Zero Substitution (B8ZS) format. The DSX-1 equalizer is programmable to five different lengths, as determined by the distance between the HLU-619 and the DSX-1 interface. This provides CB-119 specification compliant pulses at the DSX-1 interface over a range of 0 to 655 feet of ABAM-specification cable.

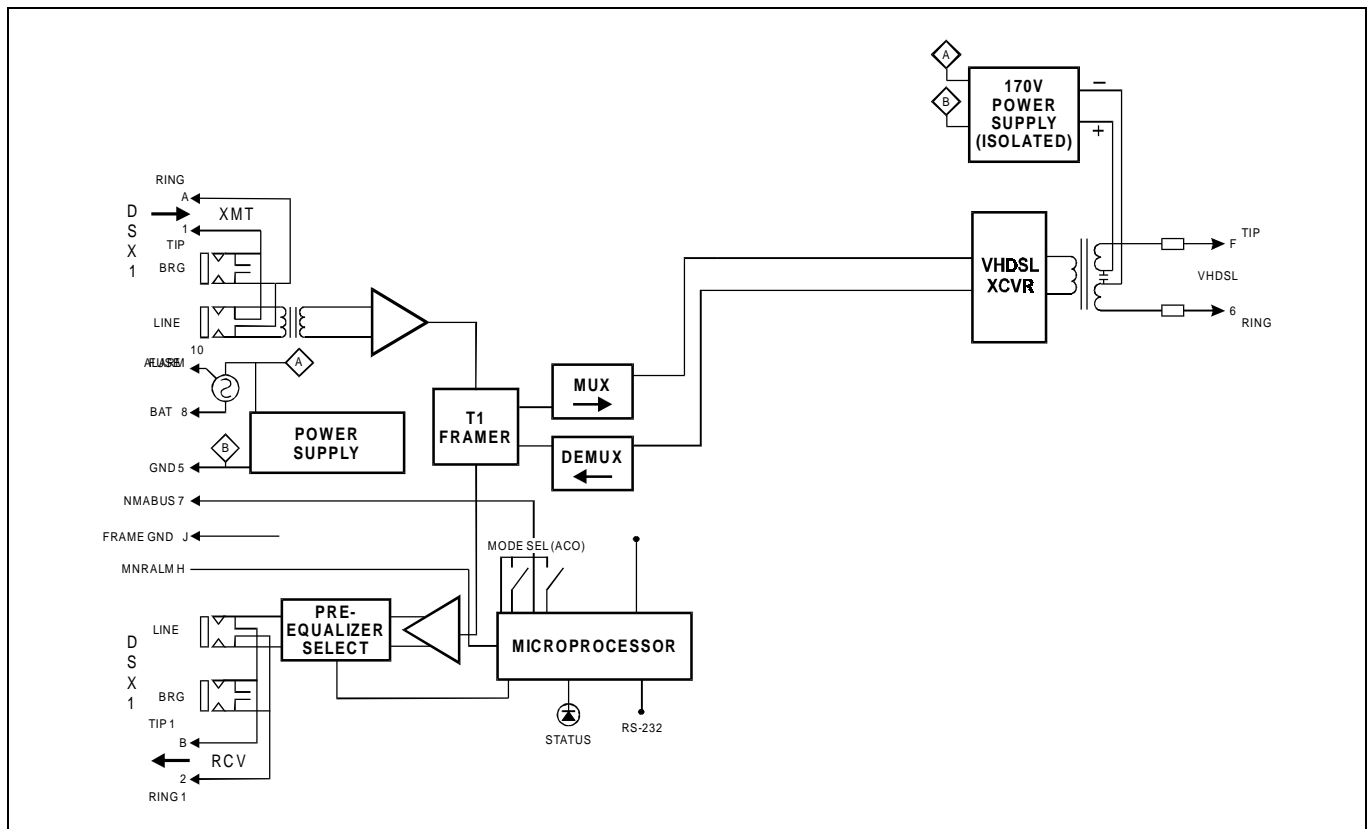


Figure 2. HLU-619 Block Diagram. PairGain's VHDSL technology provides full duplex services at standard T-1 rates over copper wires between an HLU and an HRU, which comprise one HiGain-2 system.

4.2 POWER CONSIDERATIONS

4.21 Power Conversion. The HLU-619 contains two separate power converters. The main power supply converts -48 Vdc local battery to logic power for the HLU-619 circuits. The line power supply converts the -48 Vdc battery to a -170 Vdc feed that provides loop power feed on the cable pair to the HRU-612. The line power supply can be turned on or off by the microprocessor and is automatically shut down in the presence of line short circuits or microprocessor failure.

4.22 Power Demands. The three most important power demands (on a per-slot and per-shelf basis), are as follows:

	Maximum	Per Slot	Per Shelf
Maximum Power Dissipation		Per Slot = 7 Watts	Per Shelf = 196 Watts
Maximum Power Consumption		Per Slot = 16 Watts	Per Shelf = 448 Watts
Maximum Current Drain		Per Slot = 0.38 Amps	Per Shelf = 10.5 Amps

Note that the worst case conditions, under which these parameters were measured, include a 7,000 ft., AWG 26 loop, 60 mA of Customer Provided Equipment (CPE) current, a fully loaded 28-slot shelf, and a 42.5 V shelf battery voltage with the HLU-619 four-character display "OFF."

4.23 The **Maximum Power Dissipation** measures the power that is converted into heat buildup within the unit. It contributes to the total heat generated in the space around the unit. It is used to determine the maximum number of fully loaded shelves per bay that does not exceed the maximum allowable power dissipation density in Watts/sq. ft.

4.24 In Central Office locations, the maximum power dissipation for open-faced, natural convection cooled mountings is limited to 120 Watts/sq. ft. per Section 4.2.3 of the NEBS standard TR-NWT-000063. The footprint of a 28-slot 23-inch HLU-619 shelf is 7.024 sq. ft. Therefore, the maximum bay dissipation is limited to 840 Watts. At 7 Watts per slot, this limits the number of loaded HLU-619 slots to 120 per bay.

4.25 Insert the heat deflecting baffles between every other shelf to reduce excess heat build-up.

4.26 To determine the thermal loading limitations, apply the HLU-619's power parameters to the manufacturer's requirements for each specific housing.

4.27 The **Maximum Power Consumption** is the total power that the HLU-619 consumes or draws from its -48 V shelf power source. This parameter is important when the HLU-619 is remotely located to its serving CO. It determines the battery capacity required to maintain an 8-hour standby battery reserve for emergency situations; this limits the maximum number of plugs per remote enclosure. Use the above data to perform this analysis on a case-by-case basis.

4.28 The **Maximum Current Drain** is the maximum current drawn from the shelf power supply when it is at its minimum voltage (42.5 V). It determines the shelf fusing requirements. All HLU shelves are partitioned into two equal halves. Each half should be fused at 10 A for a total of 20 A per shelf. A fully loaded shelf draws 10.5 A worst case. This is within the 20 A fuse limit.

4.3 USING THE RS-232 CONNECTION

4.31 A female 9-pin (DB-9) RS-232 connector is provided on the front panel (see Figure 3). This connector provides asynchronous access to the HiGain-2 system maintenance provisioning and performance monitoring software. The port is configured as DCE with 8 data bits, 1 stop bit and no

parity. You can connect an ASCII terminal or a Personal Computer loaded with or using communication software.

5. USING ALARMS

5.01 Pin H is the HLU-619 minor alarm (MNRALM) output pin, which replaces the Local Loss of Signal alarm on normal High Density (3192) repeaters. Its normally floating output can connect to pin 1 of the 1184 or 3192-9F Alarm Card in position 29 of the High Density (HD) shelf. This pin must never be taken above +5 V or below -60 V. The HLU-619 forces pin H to +5V (maximum of 10 mA) for any of the conditions listed below. More than one alarm condition can exist at any one time, but only one message can be displayed. For multiple alarms, only the highest priority alarm is displayed. The alarms are listed in their order of priority:

ALRM LOSW	The VHDSL loop lost sync
ALRM LLOS	Loss of HLU DSX-1 input signal
ALRM RLOS	Loss of HRU DSX-1 input signal
ALRM TLOS	A user option that causes the loss of the HRU DS1 input from the NI to initiate a logic loopback in the HRU.
ALRM HES	VHDSL loop has exceeded the 24-hour selected Errored Seconds CRC threshold.
ALRM DS1	The total number of bipolar violations (BPV), at either the HLU or the HRU DS1 inputs, have exceeded the 24-hour selected threshold.
ALRM MAL	The margin on the VHDSL loop has dropped below the minimum threshold value set by the RS-232 terminal Margin Alarm Threshold (see Section B Paragraph 9.09).

5.02 Pin H, MNRALM, remains at +5V for the duration of the alarm condition. If the Wescom 1184 Alarm Card is installed in the shelf, its LOS LED lights for every MNRALM. The HLU-619's Status LED flashes red for the duration of a minor alarm condition. Alarms 4 and 5 can be inhibited by selecting "None" for the ESAL system option (see Section 9 for System Settings information). The MAL(X) alarm can be DISabled by setting the margin alarm threshold to 0. The minor alarm can be retired by executing the Alarm CutOff (ACO) option. This is accomplished by pressing the **SEL** button on the front panel. This turns the alarm off and replaces the ALRM message with the ACO message. However, 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. Disabling the ALM also retires an ACO condition.

5.03 Setting the ALM option to **DIS**(able) only prevents the minor alarm output alarm bus on pin H from being activated on a minor alarm event. The Status LED still flashes red and the ALRM message is still displayed.

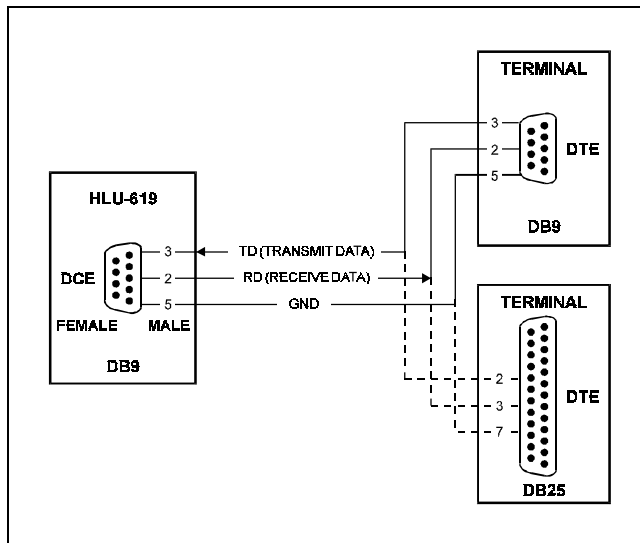


Figure 3. DB-9 RS-232 I/O Pin-Outs. A standard RS-232 (DB-9, female) connector on the front panel provides access to the menu interface feature via the RS-232 terminal.

5.04 The HLU-619 Pin 10, Fuse Alarm is driven to -48 V whenever its on-board fuse opens. It emulates the function of the Fuse Alarm output from Pin 10 of normal HD repeaters. The Pin 10 signal is connected to Pin 5 of the 1184 Alarm Card (slot 1 in HD shelf) and causes the 1184 Fuse ALM LED to light when the Pin 10 signal is activated. Its normally floating output must never be driven above ground or below -80 V. It can sink a current of 10 mA.

5.05 Pin 7 is the NMA serial bus. It is provided for access to the HMU-619 shelf controller card that brings the HLU-619 under network management.

5.06 The HLU-619 does not support the BPV function (Pin E) of normal HD repeaters.

5.07 The front panel of the HLU-619 contains one tri-color LED with the following indicated states:

LIGHT	MEANS
Solid Green	Normal Operation
Flashing Green	VHDSL Acquisition
Flashing Red	Minor Alarm (for more information, see section 8.02)
Solid Red	Fuse Alarm
Solid Yellow	Self-test in process or an HLU Loopback in effect (CREM or NLOC)
Flashing Yellow	HLU in Armed state

B. INSTALLATION AND TESTING

6. INSTALLATION

6.01 Upon receipt of the equipment, visually 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.

6.02 The HLU-619 mounts in the group of both wire-wrapped and connectorized shelves listed in Section A Paragraph 1.02. The HLU-619 slot pin-outs are shown in Figure 3.

7. TESTING

7.01 Section D provide step-by-step test procedures for the HLU-619 as a function of the loopback option selected. These procedures allow verification of the integrity of the VHDSL channel to the HRU-612 remote unit as well as the DS1 channels to the customer and the local DSX-1 interface.

7.02 The HLU-619's four-character front panel display has many useful system diagnostic messages. They are listed in Table 3. This display turns on when power is initially applied to the HLU-619. To conserve power, the display remains on for only five minutes when neither the **Mode** nor **SEL** buttons are pressed. The use of either button activates the four-character display and restarts the five-minute power control timer.

7.03 If trouble is encountered on the HLU-619 DSX-1 interface, verify that the HLU-619 is making a positive connection with its mounting assembly (shelf) connector. Also, verify that the HLU-619 equalizer is set to the correct distance range (see EQL in Table 2). All installations should be set to the largest distance range value that does not exceed the distance from the DSX-1 to the shelf.

7.04 The transmit and receive DSX-1 ports have splitting access and bridging miniature 210 jacks (see Figure 2). Connecting one cable between the two Bridging jacks, and another between the two Span jacks, splits the XMT and RCV and creates metallic loopbacks toward both the DSX-1 and the HLU-619. If plugs are inserted into both Line jacks, the BRG jacks can be used to send and receive test patterns toward the DSX-1.

7.05 Viewing Maintenance Terminal Menu Screens. Figures 6 through 12 shows the HLU-619 maintenance menu screens. It contains useful information on the VHDSL loops and the DS1 input. Figures 10, 11 and 12 show the Performance Data and Alarm History screens. All the performance data shown in Figures 10 and 11 can be cleared to zero by selecting the **(C)**lear option from the HLU-619 Status Screen shown in Figure 7.

Note that since the HLU-619 is considered the master module, this clears *all* Performance Data screens at both the HLU-619 and the HRU-612. The Performance Data can not be cleared from the HRU-612. See the Glossary in Section 19 for definitions of Maintenance Menu terminology.

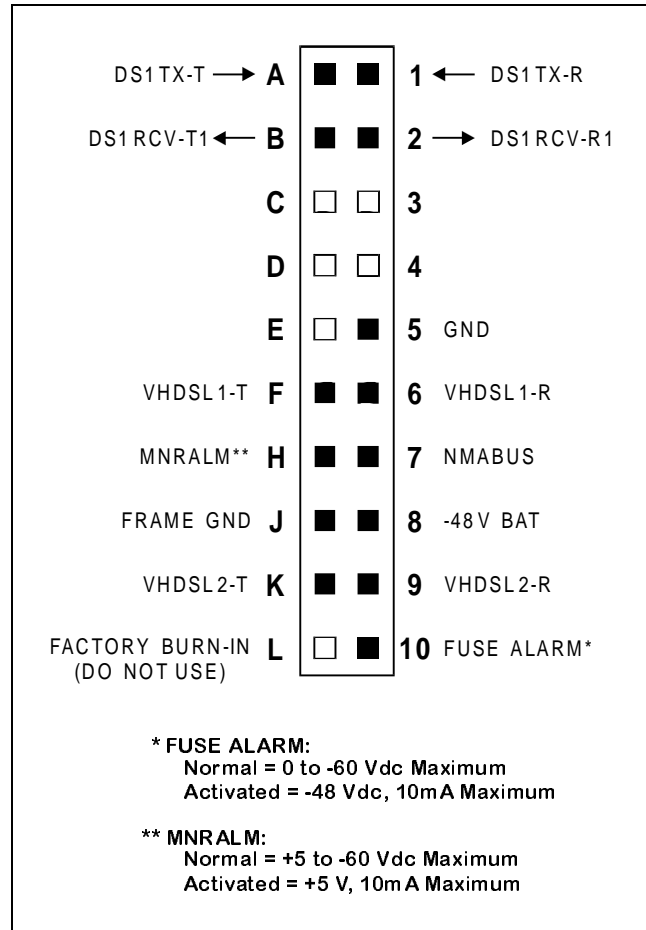


Figure 4. HLU-619 Card-Edge Connectors.
The active pins are highlighted in black in the above illustration.

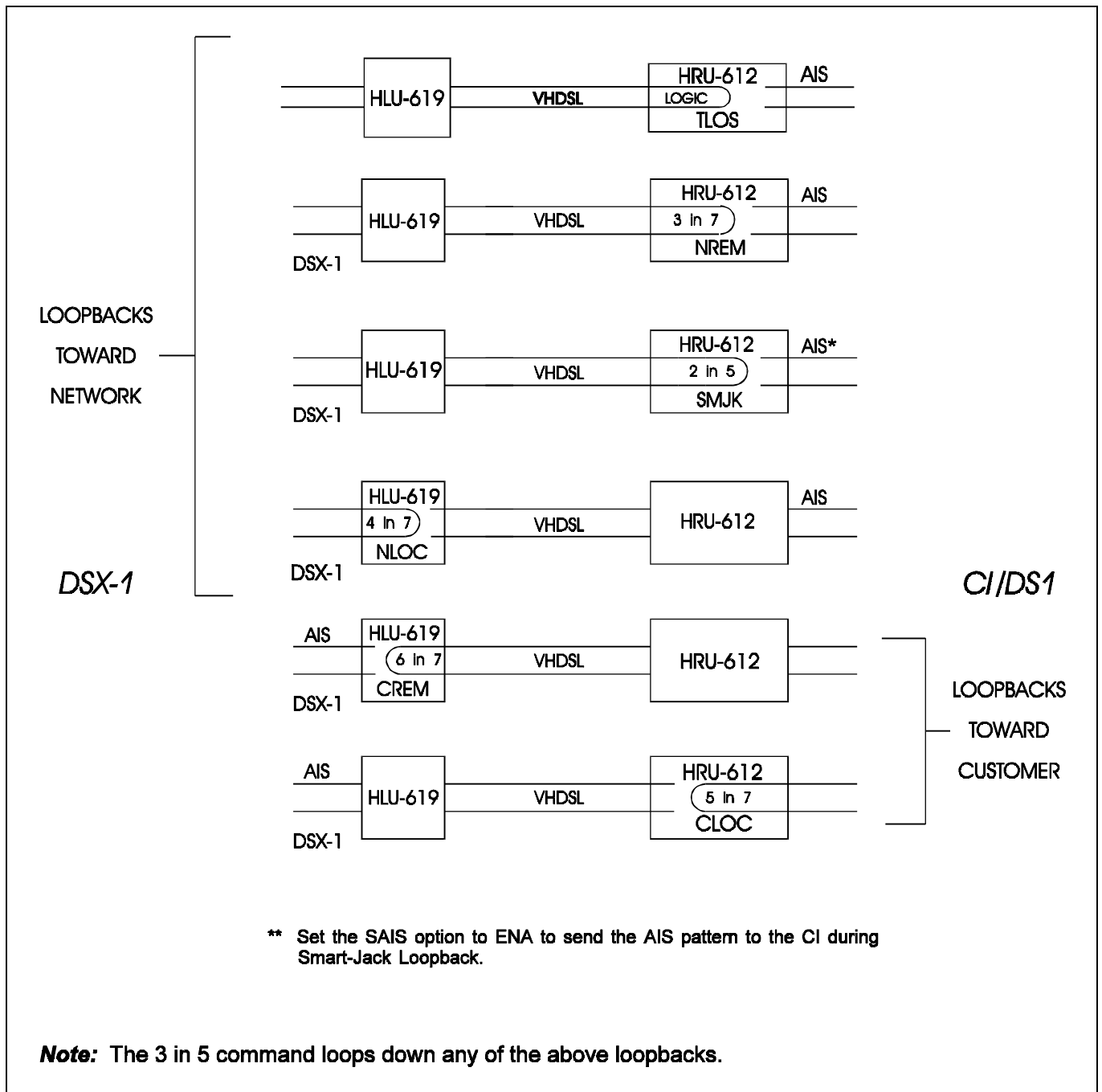


Figure 5. HLU-619 Loopback Configurations. The most important of the HiGain-2 family of loopback options is the Smart-Jack loopback, which emulates the functions of a standard NID.

8. SETTING THE SYSTEM OPTIONS

8.01 The HLU-619 contains a non-volatile RAM, which stores the System Options Settings. No dip-switches or jumpers are required to set the HLU-619 configuration. The System Options are set using buttons on the front panel or through the RS-232 interface or from the Network Management interface. The settings are retained if shelf power is lost or if the HLU-619 is unplugged. Table 2 lists the HLU-619 System Options. Figure 9 illustrates the same options on the HLU-619 System Settings Menu. The settings shown in the second column represent the factory default settings.

8.1 USING THE FRONT PANEL

8.01 Use the setup buttons located on the front panel (Mode and SEL) to set the options.

1. Start the **Options Settings mode** by pressing the **Mode** button, for at least one second, but less than three seconds, and release. The message displayed on the front panel alternates between the system parameter and its current setting.
2. Press the **SEL** button to scroll the display through all settings of the displayed parameter. After a setting has been selected, press the **Mode** button. This updates the currently displayed mode to the selected setting, then selects the next parameter.
3. After the last parameter has been selected, the display shows "CONF/NO." Do one of the following:
 - ◆ Press the **Mode** button, at this time, none of the changed parameters are installed.
 - ◆ Press the **SEL** button, a "YES" message appears, and the selected changes are installed.
 - ◆ The display returns to its normal mode. The display also returns to its normal mode without installing any new changes if, after 30 seconds, neither button is pressed.

8.02 All 14 user options can be set to the factory default values by pressing the **SEL** button for six seconds until the message "DFLT NO" appears.

1. To set the default values, press the **SEL** button while the "DFLT NO" message is displayed. "DFLT YES" appears, indicating the factory default values are now in effect.
2. To exit the Default mode, without setting the factory default values, press the **Mode** button or do nothing for 30 seconds.

8.03 Pressing the **Mode** button for three or more seconds scrolls through the HLU-619's software version number, its list number, the type of frame pattern being received from the DSX-1, the line code setting of the HLU-619, and all 14 options settings. The line code parameter is the actual DS1 line code being received by the HLU-619 when 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, and is not determined by the received line code.

8.04 The **DS1 line code option** should always be set to conform to the type of T1 service (AMI or B8ZS) being provided by the HiGain-2 system. The Auto mode, which can adapt to either AMI or B8ZS, should only be used in applications that require it (such as when HiGain-2 acts as a standby circuit to T1 circuits whose line codes are not known or may be both AMI and B8ZS), because it has the following limitations:

- ◆ The Auto mode sends one BPV in the T1 bit stream whenever it switches from AMI to B8ZS.
- ◆ The Auto mode allows each HiGain-2 end, (HLU and HRU) to set its DS1 mode to the code it is receiving at its local T1 input port. This makes each unit's code independent of the T1 code, which is sent from the distant T1 input port. If the line codes being received by HiGain-2 are different in each of the two T1 directions the HiGain-2 T1 output codes will not match their respective T1 input codes at the other end. This could cause the customer's received data to be AMI instead of B8ZS, and violate the one's density rules by having excessive zeros.

8.2 USING AN RS-232 TERMINAL

8.21 The following three user options must be set with an RS-232 terminal:

- ◆ Circuit ID
- ◆ DS0 Blocking
- ◆ Margin Alarm Threshold.

8.22 The **Circuit ID option** is set by choosing the **H** option from the RS-232 terminal's Main Menu screen (see Figure 6). The message "ENTER CIRCUIT ID#:" (24 characters max) follows the "H" selection. Press the **Enter** key after entering the chosen set of alpha-numeric ID characters; choose **C** to confirm. Note that if more than 24 characters are entered, a "Beep" is emitted, and only the first 24 characters are accepted. The ID appears in all HLU-619 screens, as shown in Figures 6 through 12. The ID does not appear on the HRU-612 screens when the maintenance port is accessed at the remote unit. Note that the Circuit ID can not be set to its factory setting (all blanks) when the DFLT setting option is utilized.

8.23 To set the **DS0 Blocking option**, from the Main Menu screen, press **C** to select the System Settings Menu. The menu shown in Figure 9 appears. Next, press **B**, as shown in parentheses of the DS0 blocking selection. The DS0 channels are blocked or unblocked by entering each channel number. Multiple channels can be selected by inserting a space between each entry. After all the new settings have been made, press **E** ("Exit") and then **C** ("Confirm"). The new choices are now installed. Also, all blocked channels are temporarily "unblocked" for all HiGain-2 loopback tests. This allows the standard full bandwidth T1 loopback tests to be performed.

8.24 To set the **Margin Alarm Threshold**, select **G** from the System Settings Main Menu screen. 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 VHDSL loop drops **below** the selected threshold value (see Section B Paragraph 8.02). Since the margin can never drop below 0, choosing **0** for the margin threshold turns the margin alarm off.

8.25 The other RS-232 terminal system settings are set in a similar manner. Simply enter the key represented by the letter in parentheses of the

parameter to be changed. Each entry of this letter scrolls the parameter to its next value. Hit the **Enter** key after making each selection. After all selections have been made, press **E** to "Exit" and then **C** to "Confirm" the changes. This activates the new choices and returns control to the Main Menu screen.

8.26 The Self-test mode, which occurs when the VHDSL loop is not in-sync, includes the input DS1 transceiver chip in the self-test procedure. This process can cause the Alarm Indicating Signal (AIS) pattern, which is normally transmitted from the HLU-619 during these out-of-sync intervals, to exhibit occasional BPVs.

8.27 The HAIS option provides two selections (ENA and DIS) for the T1 transmit outputs at both the HLU-619 and HRU-612 for VHDSL loss-of-sync conditions. The "ENA" selection causes the AIS pattern to be transmitted at both T1 outputs when the VHDSL loop experiences a loss-of-sync (LOSW) condition or when a margin alarm occurs. This choice causes all 24 channels to be lost from the margin alarm, as they are replaced by the AIS pattern. However, it allows both down and upstream equipment to be made aware of the loss of the VHDSL loop or a loop with low margin. The ENA selection is the preferred setting to be able to start an AIS state with just one conductor open in the VHDSL pair. Short loops, below about 16 dB of loss at 392 kHz, can remain in-sync with one conductor open. Since the loop is still in-sync, no LOSW condition occurs. However, the margin on a one-conductor loop drops from 5 to 10 dB. Thus, if the margin alarm is set to 5 dB below the normal margin at turn-up, when one conductor opens, a minor alarm occurs and causes the AIS condition. This alerts the maintenance personnel of the problem. The "DIS" choice requires the VHDSL loop to be out-of-sync (LOSW) before the AIS signal is transmitted. This choice preserves the integrity of the 24 channels when a margin alarm occurs.

9. LOOPBACK OPERATION

9.01 HiGain-2 has several of loopback options. The most important is the “Smart-Jack” loopback, which allows the HRU-612 to respond to the standard (2/3 in 5) Smart-Jack in-band loopback codes. This option can be ENabled or DISabled from either the front panel settings or the RS-232 terminal System Settings Menu.

9.02 In addition to the Smart-Jack loopback, the HiGain-2 can be configured for one of five special in-band loopback command sequences. These are selected from the SPLB user options, shown in the GNLB Test Procedure and Figure 9 of the next section. The loopback locations are shown in Figure 5.

9.03 “GNLB” is the HiGain-2 system Generic Loopback code. The GNLB allows in-band codes to loop up either the HLU/NLOC (4 in 7) or the HRU/NREM (3 in 7) toward the network. In addition, it allows in-band codes to loop up the HLU/CREM (6 in 7) or the HRU/CLOC (5 in 7) toward the customer. Either loop-up condition is terminated (looped down) with the (3 in 5) loop-down code. Both in-band codes must be present for 5 seconds before the HiGain-2 system responds.

9.04 The A1LB loopback selection complies with that proposed for VHD SL systems in the T1E1.4/92 recommendation with the following:

- Query loopback
- Intelligent Office Repeater (IOR) power-down
- Three loopback time-out choices
- Initiation from either end
- Repeating bit error signatures
- Alternate Query loopback

These additions make A1LB identical to A2LB (described below), but they retain separate identities to allow future T1E1 enhancements to A1LB without affecting A2LB.

9.05 A2LB through A5LB are four special addressable repeater loopback functions. These loopbacks provide HiGain-2 with sophisticated maintenance and troubleshooting tools list the details of these Special Loopback (SPLB) functions. A2LB and A5LB are patterned after the Teltrend addressable T1 repeater loopbacks. A3LB and

A4LB are patterned after the Wescom addressable T1 repeater loopbacks. All four SPLBs have been enhanced to handle the specific requirements of the following HiGain-2 customers:

- A2LB (Teltrend) = Southwestern Bell
- A3LB (Wescom) = New England Telephone
- A4LB (Wescom Mod 1) = New York Telephone
- A5LB (Teltrend Mod 1) = Southern New England Telephone (SNET)

9.06 A5LB differs from A2LB in that A5LB does not block the arming (3 in 5) code from exiting the HLU-619 into the network. A2LB can be configured to either block this arming code after two seconds and replace it with the AIS code or unblock it by executing the Far-End Activate code. Since A5LB never blocks the arming code from exiting the HLU-619, it does not need this Far-End Activate code. A3LB differs from A4LB in that A3LB supports the additional Smart-Jack loopback (1 in 6) command. Refer to the PairGain HiGain-2 Intelligent Repeater Application Note #910 Part #325-910-100 for more SPLB details.

9.07 When T1 loopback tests are performed on the HiGain-2 system with metallic loopback connections at either end, the T1 code, which exists at the metallic loopback interface, may be different from the T1 code being received at the opposite end when the DS1 user code is set to Auto. This occurs because in the Auto DS1 code mode, the HLU-619 and HRU-612 set their own codes independently of each other. Each end sets its transmit code to match its receive code. So, if one end is receiving AMI, and the other B8ZS, their codes are different.

For example, if the HRU-612 has a metallic loopback, and the HLU-619 receive pattern code is changed from AMI to B8ZS, and next, the all “0” pattern is sent into the HLU-619, then the HLU-619 changes to its B8ZS mode while the HRU-612 remains in its AMI mode, and thus loops all “0.” This causes the HRU-612 to indicate an LOS condition, which causes the HLU-619 to output the AIS pattern.

9.08 HiGain-2 may take longer than normal to respond to in-band loopback commands when its framing mode is set to UNFR, and the in-band commands are sent in either an SF or ESF mode. The frame bits override the command bits and cause errors in the command sequence. These errors cause HiGain-2 to reject some sequences. This can extend the detection interval.

9.09 Pressing both the **Mode** and **SEL** front panel buttons for at least three seconds, to start a Manual Loopback session. This session allows the user to select one of four HiGain-2 loopbacks. The message, "MAN LPBK," appears on the front panel display followed by the message "NLO?" If you press the **SEL** button is pressed at this time, an NLOC loopback is executed changing the message from "NLO?" to "NLOC." If the **Mode** button is pressed instead of the **SEL** button, "NLO?" is replaced by "NRE?" This now allows an NREM loopback to be executed with the **SEL** button. Pressing the **Mode** button two more times yields the "CRE?" (CREM) and "CLO?" (CLOC) customer loop-back options in the sequence listed. This interactive button procedure permits any of the four

HiGain-2 loopbacks to be executed. The next loopback option can be presented by pressing the **Mode** push button, however, the previously executed loopback will remain active until the **SEL** push button is pressed, and a different loopback is activated. If, after 30 seconds, neither button is pressed, this manual loopback session terminates, and the normal margin displays reappear. If this time-out occurs with an active loopback in effect, the appropriate loopback and loop margin messages appear. Once the manual loopback session terminates, the loopback remains in effect until it times out in accordance with the user LBTO setting. It can also be terminated by re-entering the manual loopback mode and selecting another loopback. Only one loopback can exist at any given time. Pressing both the **Mode** and **SEL** buttons again for three seconds, terminates any active loopback, ends the Manual Loopback session, and returns the display to normal. Note that these same loopbacks can be initiated from the RS-232 maintenance port by choosing the Loopback Mode, option **D**, from the Main Menu. This displays the Loopback Menu (see Figure 9), from which any of the loopbacks can be initiated/terminated.

TABLE 2. HLU-619 SYSTEM OPTIONS

MODE	SELECTION	DESCRIPTION
EQL	0*	Sets the equalizer to DSX-1 for 0 to 132 feet.
	133	Sets the equalizer to DSX-1 for 133 to 265 feet.
	266	Sets the equalizer to DSX-1 for 266 to 398 feet.
	399	Sets the equalizer to DSX-1 for 399 to 532 feet.
	533	Sets the equalizer to DSX-1 for 533 to 655 feet.
LPBK	DIS	Configures the HiGain-2 system to ignore the (2 in 5) in-band Smart-Jack loopback command.
	ENA*	Enables the HiGain-2 system to recognize the (2 in 5) in-band Smart-Jack loopback command.
SPLB	GNLB*	Configures the HiGain-2 system to respond to the generic (3/4/5/6 in 7) in-band loopback codes.
	A1LB and A2LB	Configures the HiGain-2 system to respond to the Teltrend addressable repeater in-band loopback codes.
	A3LB	Configures the HiGain-2 system to respond to the Wescom addressable repeater in-band loopback codes.
	A4LB	Configures the HiGain-2 system to respond to the Wescom Mod 1 addressable repeater in-band loopback codes.
	A5LB	Configures the HiGain-2 system to respond to the Teltrend Mod 1 addressable repeater in-band loopback codes.
PWRF	DIS	Disables powering to the HRU-612.
	ENA*	Enables powering to the HRU-612.
ZBTS	ON	Tells the HiGain-2 system that the ESF frame is operating in its Zero Byte Time Slot Interface (ZBTSI) mode.
	OFF*	Tells the HiGain-2 system that the ESF frame is operating in its normal non-ZBTSI mode.
ESAL	17	Creates a minor alarm condition which flashes the red Status LED when 17 Errored Seconds (ES) (17 VHDSL CRC errors on the VHDSL loop or a total of 17 BPV) occur at either T1 input within a 24-hour period.
	170	Creates a minor alarm condition which flashes the red Status LED when 170 ES (170 VHDSL cyclic redundancy check (CRC) errors on the VHDSL loop or a total of 170 BPV) occur at either T1 input within a 24-hour period.
	NONE*	Prevents generation of a minor alarm due to excessive Errored Seconds.
LBTO	NONE	Disables automatic time-out cancellation of all loopbacks.
	20	Sets automatic cancellation of all loopbacks to 20 minutes after initiation.
	60*	Sets automatic cancellation of all loopbacks to 60 minutes after initiation.
	120	Sets automatic cancellation of all loopbacks to 120 minutes after initiation.
ALM	DIS*	Disables the activation the output alarm has on pin H when a minor alarm occurs.
	ENA	Enables the activation the output alarm has on pin H when a minor alarm occurs.

* Factory default settings.

Table continued on next page

TABLE 2. HLU-619 SYSTEM OPTIONS (CONTINUED)

MODE	SELECTION	DESCRIPTION
DS1	AUTO	The HLU-619 and HRU-612 independently monitor their incoming T1 bit streams for the Binary Eight Zero Substitution (B8ZS) pattern. If either unit 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 both the HLU-619 and HRU-612 into their B8ZS modes.
	AMI*	Places both the HLU-619 and HRU-612 into their AMI modes.
FRMG	AUTO*	Configures the HiGain-2 system to operate in an auto-framing (Auto) mode in which it continuously searches the input T1 bit stream for a valid SF or ESF frame pattern. This feature is required for fractional T1 applications (DS0 blocking) where it insures proper channel time slot alignment. While the HiGain-2 system can also process unframed data in Auto mode, it is recommended that the unframed (UNFR) mode be used for all unframed applications. Using the Auto mode for unframed applications runs the risk of detecting "pseudo-valid" frame sequences, which can affect data integrity.
	UNFR	Configures the HiGain-2 system to operate in an unframed mode. This mode disables the auto framing process and forces the HiGain-2 system to function as a transparent bit pipe.
HAIS	DIS*	Causes the HiGain-2 system to transmit the AIS signal at both the HLU-619 and HRU-612 T1 output ports when the VHDSL loop is not in-sync (LOSW).
	ENA	Causes the HiGain-2 system to transmit the AIS signal at both the HLU-619 and HRU-612 T1 output ports when the VHDSL loop is not in-sync (LOSW) or if a MARGin alarm occurs.
SAIS	ENA*	Causes the HRU-612 to transmit the AIS signal toward the Network Interface (NI) when in NREM or Smart-Jack loopback (see Figure 9).
	DIS	Causes the HRU-612 to transmit the signal from the network toward the NI when an HRU-612 NREM or Smart-Jack loopback is executed. The AIS signal is off.
CONF	YES	Confirms that all twelve operating modes (listed above) are updated to their current selections.
	NO*	Prevents the most recently selected operating mode selections from being updated. They remain as they were before the system options settings mode were changed.
MARG	0 to 15 dB	The Margin Alarm Threshold can only be set, using a terminal (see Figure 9). It determines the minimum allowable margin below which a minor alarm can occur. Setting the threshold to "0" inhibits the margin alarm.
	4 dB*	(Default value)
DS0	BLK	The DS0 blocking option can only be set using a terminal (see Figure 9). The four-character HLU-619 front panel LED readout only displays the status of the blocking option. BLK indicates at least one channel is blocked.
	NONE*	"None" indicates no channels are blocked.

TABLE 3. HLU-619 FOUR-CHARACTER FRONT PANEL MESSAGES

MESSAGE	FULL NAME	DESCRIPTION
CREM	Customer Remote Loopback	Signal from customer is looped back to customer at HLU-619.
NLOC	Network Local Loopback	DSX-1 signal is looped back to DSX-1 at HLU.
CLOC	Customer Local Loopback	Signal from customer is looped back to customer at HRU-612.
NREM	Network Remote Loopback	DSX-1 signal is looped back to DSX-1 at HRU.
SMJK	Remote Smart-Jack Loopback	DSX-1 signal is looped back to DSX-1 at HRU.
TLOS	Transmit Loss Of Signal	HRU is in a logic loopback state, caused by a loss of its DS1 input from the CI, when ENABled at the HRU via its TLOS switch option.
FERR	Framing Bit Error occurred	Framing bit error occurred at HLU DSX-1 input.
LBPV	Local Bipolar Violation	A bipolar violation has been received at the DSX-1 input to the HLU-619.
SIG	Signal	The HLU and HRU transceivers are trying to establish contact with each other on the VHDSL loop.
ACQ	Acquisition	The HLU and HRU multiplexers are trying to establish synchronization over the VHDSL loop.
HES	VHDSL CRC Error	VHDSL CRC error.
ARM	HiGain-2 System is Armed	Armed and ready to respond to Intelligent Repeater loop codes.
ACO	Alarm CutOff	A minor alarm occurred and was retired to an ACO condition, after pressing the SEL button on the HLU front panel.
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.
M=xx	VHDSL Loop Margin	Indicates the power of the received VHDSL signal on the loop relative to noise. Any value of "06" or greater is adequate for reliable system operation.

Table continued on next page

TABLE 3. HLU-619 FOUR-CHARACTER FRONT PANEL MESSAGES (CONTINUED)

MESSAGE	FULL NAME	DESCRIPTION
PWR FEED SHRT	Power Feed Short	Indicates a short between the VHDSL conductors. This same message can occur with an HRU, which 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 in the T and R of either VHDSL pair.
PWR FEED OFF	Power Feed Off	VHDSL span power has been turned off by setting the PWFD option to DIS.
BAD RT?	No response from HRU	The HLU does not receive any response from the HRU. The HRU's integrity is questionable.
VER XXXX	HLU software Version number	Displayed during the System Settings review mode. Press the Mode button for 3 seconds.
LIST XXXX	HLU's List number	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 review mode defined above.
CODE	Line Code: AMI, B8ZS	The line code that the HLU-619 is receiving at its DSX-1 interface, if the DS1 option is set to Auto. Otherwise, it mimics either of the other two DS1 line code settings, AMI or B8ZS. Displayed during System Settings review mode defined above.
LOSW	Loss of Sync Word	Indicates that the VHDSL loop has lost sync. Causes a minor alarm.
LLOS	Local Loss of Signal	Indicates that no signal is detected at the DSX-1 input to the HLU. Causes a minor alarm.
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the DS1 input to the HRU. Causes a minor alarm.
DS1	DS1 BPV Errors	Indicates that the number of BPVs at the HLU or HRU T1 inputs have exceeded the 24-hour ES threshold. Causes a minor alarm.
DS0	DS0 Blocked Channels	Indicates status of DS0 blocked channels. "None" indicates no channels are blocked. BLK indicates some channels are blocked.
MAL	Margin Alarm Loop	The margin on the VHDSL loop has dropped below the threshold (0 to 15 dB) set by the user.
MNGD	Managed	The HLU-619 is under control of the HMU-619 network management unit. In this state, the RS-232 maintenance port on the HLU-619 front panel is inoperative.

TABLE 4. HLU-619 STATUS MENU MESSAGES

MESSAGE	FULL NAME	DESCRIPTION
ALARMS:		
LLOS	Local Loss of Signal	No signal from HLU-619 local DSX-1 interface.
RLOS	Remote Loss of Signal	No signal from HRU-612 remote DS1 interface.
LOSW	Loss of Sync Word	VHDSL loop has lost sync.
HES	VHDSL Errored Second	CRCs have exceeded the user-selected ES threshold.
DS1	Digital Service 1	T1 input BPVs, at either the HLU-619 or HRU-612, have exceeded the user-selected ES threshold.
RAIS	Remote Alarm Indicating Signal	Indicates an AIS (all "1") pattern is being transmitted from the remote T1 output port.
LAIS	Local Alarm Indicating Signal	Indicates an AIS (all "1") pattern is being transmitted from the local T1 output port.
MAL	Margin Alarm	The margin on the VHDSL loop has dropped below the threshold (0 to 15 dB) set by the user. Setting the threshold to 0 inhibits the margin alarm.
ACO	Alarm CutOff	A minor alarm occurred and was retired to an ACO condition after pressing the SEL button on the HLU front panel.
LOOPBACKS:		
SMJK	Smart-Jack Loopback	The loopback at HRU-612 (remote) toward network (see Figure 5) initiated by either the (2 in 5) in-band loopback code or the out-of-band ESF data link loopback code.
NREM	Network Remote Loopback	The loopback at HRU-612 (remote) toward network (see Figure 5) initiated from CO (network) by either the Intelligent Line Repeater (ILR) number 2 code, the HLU-619 front panel Manual Loopback push buttons, the HRU-612 front panel push button, or the maintenance terminal.
NLOC	Network Local Loopback	The loopback at HLU-619 (local) toward network (see Figure 5) initiated from CO (network) by either the Intelligent Office Repeater (IOR) code, the HLU-619 front panel Manual Loopback push buttons, or the maintenance terminal.

Table continued on next page

TABLE 4. HLU-619 STATUS MENU MESSAGES (CONTINUED)

MESSAGE	FULL NAME	DESCRIPTION
CLOC	Customer Local Loopback	The loopback at HRU-612 (local) toward CI (see Figure 5) initiated from CPE (customer) by either the ILR number 2 code, the HLU-619 front panel Manual Loopback push buttons, or the maintenance terminal.
CREM	Customer Remote Loopback	The loopback at HLU-619 (remote) toward customer (see Figure 5) initiated from CPE (customer) by either the IOR code, the HLU-619 front panel Manual Loopback push buttons, or the maintenance terminal.
ARM	Armed	The HiGain-2 system detected the IR loopback (2 in 5) arming code.
TLOS	Transmit Loss of Signal (Loopback)	HRU-612 is in a logic loopback state, caused by a loss of its DS1 input from the CI when ENABled at the HRU-612, via its TLOS switch option.
ACO	Alarm Cutoff	The alarm output on pin H has been turned off. This state is created by pressing the SEL button on the front panel when an alarm has occurred and persists.

TESTING PROCEDURES

10. HLU-619 GNLB TEST PROCEDURE

1. Send the HRU-612 (3 in 7) in-band loop-up code for five seconds. The HLU-619 displays "NREM" indicating an HRU-612 loopback is in effect (see Figure 5).

2. Transmit a DSX-1 test signal into the HLU-619 and verify that the returned (looped) signal is error free.

If the above test fails, transmit the (3 in 5) in-band loop-down code. Verify that the HLU-619 display returns to normal.

3. Send the HLU-619 (4 in 7) in-band loop-up code for five seconds. The HLU-619 displays "NLOC" indicating that an HLU-619 loopback is in effect.

4. Repeat Step 2. If the test passes, the problem is in the cable pair or the HRU-612. If it fails, the problem is in the CO equipment.

The NREM, NLOC, CREM and CLOC loopbacks can also be initiated from the front panel of the HLU-619 with the Mode and SEL push buttons (see Section B Paragraph 10.09).

The HLU-619 can be looped up from the remote location (CREM) by issuing the (6 in 7) command at the HRU-612 DS1 input port.

The HRU-612 can be looped up from the remote location (CLOC) by issuing the (5 in 7) command at the HRU-612 DS1 input port.

11. HLU-619 A1LB TEST PROCEDURE

1. Send the in-band Arming and NI LPBK code 11000 into the HLU-619 for at least five seconds or at least four repetitions of the 16-bit ESF data link Arming code 1111 1111 0100 1000 (FF48). (Left bit arrives first.)

2. Monitor the output of the HLU-619 for the return of the pattern. Return of pattern indicates that either the HRU-612 has looped up (if the Smart-Jack Loopback option is ENabled) or an external NI has looped up (if the Smart-Jack Loopback option is DISabled), and that the HLU-619 and HRU-612 units have been Armed. Verify that the HLU-619 display intermittently indicates "Arm" and also "SMJK," if the HRU-612 is in loopback.

Also verify, if possible, that the Loopback LED of the HRU-612 is flashing indicating that the HRU-612 is armed, or, that the Loopback LED lights steadily indicating that the HRU-612 is both armed and in loopback.

3. Once armed the HLU-619 can be looped back (NLOC in Figure 5) by sending the Intelligent Office Repeater Loopback (IOR LPBK) activation code 1101 0011 1101 0011 (D3D3) for at least five seconds. you see the following activation response:

- ◆ Two seconds of AIS (all ones), followed by:
- ◆ Five seconds of returning data pattern, followed by:
- ◆ 231 logic errors (including the frame bit) occur in the returned pattern (20 errors if ILR-2 was sent), followed by:
- ◆ Normal looped data.

Note: This error pattern repeats every 20 seconds, as long as the IOR loopback pattern is being sent. This same 20-second repeat scenario also applies to the Time-out Override and Query commands. It also applies (with the appropriate number of bit errors) to the other ILR commands.

The HiGain-2 Line Unit is now in Logic Loopback (NLOC of Figure 5). The display on the HLU-619 periodically shows "NLOC" (network local loop) and "Arm" (the HLU-619 is still armed) in addition to the margin displays. The Loopback Time-out option (which is user settable to "None," 20, 60, or 120 minutes) determines the duration of this loopback, unless it is overridden by the Time-out Override command or a loop-down command is sent. If the Time-out Override code 1101 0101 1101 0110 (D5D6) is received, the "activation sequence," described in step 3 above is repeated, and the automatic timed expiration of the loopback is inhibited. If this Time-out Override is sent, then the only way to loop the HLU-619 down is to issue the Intelligent Repeater Loop-down (IR LPDN) code 1001 0011 1001 0011 (9393) or to issue the NI LPDN and Disarm code 11100. The automatic time-out timer is restored during subsequent loopback sessions.

4. Upon completion, the tester sends the IOR LPDN code 1001 0011 1001 0011 (9393) to loop down

the HLU-619. The unit remains armed, however, as indicated by the “Arm” message on the HLU-619 and the flashing of the HRU-612 Loopback LED.

5. Using the following codes, a network tester can activate loopbacks NLOC or NREM or SMJK (if ENabled) (see Figure 5). A customer tester can activate loopbacks CLOC or CREM.

ADDRESSABLE 1 (A1LB) REPEATER LOOPBACK COMMANDS

COMMAND	DESCRIPTION	CODE
ARMING or NI LPBK (in-band)	Arming code	11000 11000 ...
ARMING or NI LPBK (ESF data link)	Arming code	1111 1111 0100 1000 (FF48)
IR LPDN or DISARM (in-band)	Disarming code	11100 11100 ...
DISARM (ESF data link)	Disarming code	1111 1111 0010 0100 (FF24)
IOR LPBK		
(NLOC and CREM 231 errors)	HLU Loop-up	1101 0011 1101 0011 (D3D3)
ILR-2 LPBK		
(NREM and CLOC 20-bit errors)	HRU Loop-up	1100 0111 0100 0010 (C742)
IR LPDN	Loop-down (HLU or HRU)	1001 0011 1001 0011 (9393)
IR QUERY LPBK	Query Loopback	1101 0101 1101 0101 (D5D5)
IR ALTERNATE QUERY LPBK	Alternate Query Loopback	1101 0101 1110 1010 (D5EA)
TIME-OUT OVERRIDE	Loopback Time- out Override	1101 0101 1101 0110 (D5D6)
FAR END NI ACTIVATE	Unblock AIS and pass 2 in 5	1100 0101 0101 0100 (C554)
IOR POWER-DOWN (HLU)	Removes VHDSL line power	0110 0111 0110 0111 (6767)

Note: The left-most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} Bit Error Ratio (BER) on the facility. The IOR Power-down code must remain present for the duration of the power-down mode. When this code is removed, the HiGain-2 system returns to its normal unlooped and unarmed state.

- After testing is complete, send the universal Intelligent Repeater Loop-down (IR LPDN) code if the system is to loop down but remain Armed. Send the disarm code 11100 if all the equipment is to be looped down, disarmed, and returned to normal operation. The Armed mode has an automatic time-out of 120 minutes.
- All of the above loopbacks can also be initiated from the front panel of the HLU-619 with the Mode and SEL buttons. See paragraph 8.01.

12. HLU-619 A2LB TEST PROCEDURE

1. Send the in-band Arming and NI LPBK code 11000 into the HLU-619 for at least five seconds or at least four repetitions of the 16-bit ESF data link Arming code 1111 1111 0100 1000 (FF48). (Left bit arrives first.)
2. Monitor the output of the HLU-619 for the return of the pattern. Return of pattern indicates that either the HRU-612 has looped up (if the Smart-Jack Loopback option is ENabled) or an external NI has looped up (if the Smart-Jack Loopback option is DISabled), and the HLU-619 and HRU-612 units have been Armed. Verify that the HLU-619 display intermittently indicates "Arm" and also "SMJK," if the HRU-612 is in loopback. Also verify, if possible, that the Loopback LED of the HRU-612 is flashing indicating that the HRU-612 is armed, or, that the Loopback LED lights steadily indicating that the HRU-612 is both armed and in loopback.
3. Once armed, the HLU-619 can be looped back (NLOC in Figure 5) by sending the IOR LPBK activation code 1101 0011 1101 0011 (D3D3) for at least five seconds. You can see the following activation response:
 - ◆ Two seconds of AIS (all ones), followed by:
 - ◆ Five seconds of returning data pattern, followed by:
 - ◆ 231 logic errors (including the frame bit) occur in the returned pattern (20 errors if ILR-2 was sent), followed by:
 - ◆ Normal looped data.

- Note:** This error pattern repeats every 20 seconds, as long as the IOR loopback pattern is being sent. This same 20-second repeat scenario also applies to the Time-out Override and Query commands. It also applies (with the appropriate number of bit errors) to the other ILR commands.
4. The HiGain-2 Line Unit is now in Logic Loopback (NLOC of Figure 5). The display on the HLU-619 periodically shows "NLOC" (network local loop) and "Arm" (the HLU-619 is still armed) in addition to the margin displays. The Loopback Time-out option determines the duration of this loopback, unless it is overridden by the Time-out Override command or a loop-down command is sent. If the Time-out Override code 1101 0101 1101 0110 (D5D6) is received, the "activation sequence," described in step 3 above is repeated, and the automatic timed expiration of the loopback is inhibited. If this Time-out Override is sent, then the only way to loop the HLU-619 down is to issue the Intelligent Repeater Loop-down (IR LPDN) code 1001 0011 1001 0011 (9393) or to issue the NI LPDN and Disarm code 11100. The automatic time-out timer is restored during subsequent loopback sessions.
 5. When you are done, send the IOR LPDN code 1001 0011 1001 0011 (9393) to loop down the HLU-619. The unit remains armed, as indicated by the "Arm" message on the HLU-619 and the flashing of the HRU-612 Loopback LED.
 6. Using the following codes, a network tester can activate loopbacks NLOC or NREM or SMJK (if ENabled) (see Figure 5). A customer tester can activate loopbacks CLOC or CREM.

ADDRESSABLE 2 (A2LB) REPEATER LOOPBACK COMMANDS

COMMAND	DESCRIPTION	CODE
ARMING or NI LPBK (in-band)	Arming code	11000 11000 ...
ARMING or NI LPBK (ESF data link)	Arming code	1111 1111 0100 1000 (FF48)
IR LPDN or DISARM (in-band)	Disarming code	11100 11100 ...
DISARM (ESF data link)	Disarming code	1111 1111 0010 0100 (FF24)
IOR LPBK		
(NLOC and CREM 231 errors)	HLU Loop-up	1101 0011 1101 0011 (D3D3)
ILR-2 LPBK		
(NREM and CLOC 20-bit errors)	HRU Loop-up	1100 0111 0100 0010 (C742)
IR LPDN	Loop-down (HLU or HRU)	1001 0011 1001 0011 (9393)
IR QUERY LPBK	Query Loopback	1101 0101 1101 0101 (D5D5)
IR ALTERNATE QUERY LPBK	Alternate Query Loopback	1101 0101 1110 1010 (D5EA)
TIME-OUT OVERRIDE	Loopback Time- out Override	1101 0101 1101 0110 (D5D6)
FAR END NI ACTIVATE	Unblock AIS and pass 2 in 5	1100 0101 0101 0100 (C554)
IOR POWER-DOWN (HLU)	Removes VHDSL line power	0110 0111 0110 0111 (6767)

Note The left-most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} Bit Error Ratio (BER) on the facility. The IOR Power-down code must remain present for the duration of the power-down mode. When this code is removed, the HiGain-2 system returns to its normal unlooped and unarmed state.

6. After testing is complete, send the universal Intelligent Repeater Loop-down (IR LPDN) code if the system is to loop down but remain Armed. Send the disarm code 11100 if all the equipment is to be looped down, disarmed, and returned to normal operation. The Armed mode has an automatic time-out of 120 minutes.
7. All of the above loopbacks can also be initiated from the front panel of the HLU-619 with the Mode and SEL push buttons (see paragraph 8.01).

13. HLU-619 A3LB TEST PROCEDURES

1. The HiGain-2 Line Unit can be looped back (NLOC in Figure 5) by sending the Addressable Office Repeater (AOR) LPBK activation code 1111 1111 0001 1110 (FF1E) for at least five seconds. The HLU-619 enters the NLOC state (see Figure 5). The display on the HLU-619 alternates between NLOC (network local loop) and the margin displays. The Loopback Time-out option (which is user settable to "None," 20, 60, or 120 minutes) determines the duration of this loopback, unless it is overridden by the reception of a second identical 16-bit loop-up command before the timer expires. When this

time-out override state exists, the only way to loop the HLU-619 down is to issue one of the three loop-down commands listed in Step 2. The automatic time-out mode is restored during subsequent loopback sessions.

The following list summarizes the codes required to execute all the HiGain-2 loopbacks (see Figure 5). All code sequences must be present for at least five seconds.

2. All of the above loopbacks can also be initiated from the front panel of the HLU-619 with the Mode and SEL push buttons (see section 10.09).

ABBREVIATIONS USED BELOW

LU	Loop Up
LD	Loop Down
NI	Network Interface
CI	Customer Interface
ESF-DL	Extended Super Frame Data Link

ADDRESSABLE 3 (A3LB) REPEATER LOOPBACK COMMANDS

POSITION	NAME	CODE
HLU-619 LU from NI	NLOC	1111 1111 0001 1110 (FF1E)
HLU-619 LU from CI	CREM	0011 1111 0001 1110 (3F1E)
HRU-612 LU from NI	NREM	1111 1111 0000 0010 (FF02)
HRU-612 LU from CI	CLOC	0011 1111 0000 0010 (3F02)
HRU-612 LU from NI	SMJK	11000 11000 11000 ...
HRU-612 LU from NI	SMJK	100000 100000 100000 ...
HRU-612 LU from NI (ESF-DL)	SMJK	1111 1111 0100 1000 (FF48)
HLU and HRU LD from NI or CI	Loop Down	11100 11100 11100 ...
HLU and HRU LD from NI or CI	Loop Down	100 100 100 ...
HLU and HRU LD from NI or CI (ESF-DL)	Loop Down	1111 1111 0010 0100 (FF24)

Note The left-most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} Bit Error Ratio (BER) on the facility.

14. HLU-619 A4LB TEST PROCEDURES

1. The HiGain-2 Line Unit can be looped back (NLOC in Figure 5) by sending the Addressable Office Repeater (AOR) LPBK activation code 1111 1111 0001 1110 (FF1E) for at least five seconds. The HLU-619 enters the NLOC state (see Figure 5). The display on the HLU-619 alternates between NLOC (network local loop) and the margin displays. The Loopback Time-out option (which is user settable to "None," 20, 60, or 120 minutes) determines the duration of this loopback, unless it is overridden by the reception of a second identical 16-bit loop-up

command before the timer expires. When this time-out override state exists, the only way to loop the HLU-619 down is to issue one of the three loop-down commands listed in Step 2. The automatic time-out mode is restored during subsequent loopback sessions.

2. The following list summarizes the codes required to execute all the HiGain-2 system loopbacks (see Figure 5). All code sequences must be present for at least five seconds.
3. All of the above loopbacks can also be initiated from the front panel of the HLU-619 using the Mode and SEL buttons ,see paragraph 8.01.

ABBREVIATIONS USED BELOW

LU	Loop Up
LD	Loop Down
NI	Network Interface
CI	Customer Interface
ESF-DL	Extended Super Frame Data Link

ADDRESSABLE 4 (A4LB) REPEATER LOOPBACK COMMANDS

POSITION	NAME	CODE
HLU-619 LU from NI	NLOC	1111 1111 0001 1110 (FF1E)
HLU-619 LU from CI	CREM	0011 1111 0001 1110 (3F1E)
HRU-612 LU from NI	NREM	1111 1111 0000 0010 (FF02)
HRU-612 LU from CI	CLOC	0011 1111 0000 0010 (3F02)
HRU-612 LU from NI	SMJK	11000 11000 11000 ...
HRU-612 LU from NI (ESF-DL)	SMJK	1111 1111 0100 1000 (FF48)
HLU and HRU LD from NI or CI	Loop Down	11100 11100 11100 ...
HLU and HRU LD from NI or CI	Loop Down	100 100 100 ...
HLU and HRU LD from NI or CI (ESF-DL)	Loop Down	1111 1111 0010 0100 (FF24)

Note: The left-most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10⁻³ Bit Error Ratio (BER) on the facility.

15. HLU-619 A5LB TEST PROCEDURES

1. Send the in-band Arming and NI (Network Interface) LPBK code 11000 into the HLU-619, for at least five seconds or at least four repetitions of the 16-bit ESF data link Arming code 1111 1111 0100 1000 (FF48). (Left bit arrives first.)
2. Monitor the output of the HLU-619 for the return of the pattern. Return of pattern indicates that either the HRU-612 has looped up (if the Smart-Jack Loopback option is ENabled) or an external NI has looped up (if the Smart-Jack Loopback option is DISabled) and that the HLU-619 and HRU-612 units have been Armed. Verify that the HLU-619 display intermittently indicates "Arm" and "SMJK," if the HRU-612 is in loopback. Also verify, if possible, that the Loopback LED of the HRU-612 is flashing indicating that the HRU-612 is armed or, that the Loopback LED lights steadily indicating that the HRU-612 is both armed and in loopback.
3. Once armed, the HLU-619 can be looped back (NLOC in Figure 5) by sending the Intelligent Office Repeater Loopback (IOR LPBK) activation code 1101 0011 1101 0011 (D3D3) for at least five seconds. You see the following activation response:
 - ◆ Two seconds of AIS (all ones), followed by:
 - ◆ Five seconds of returning data pattern, followed by:
 - ◆ 231 logic errors (including the frame bits) occur in the returned pattern (20 errors if ILR-2 was sent), followed by:

- ◆ Normal looped data.

Note This error pattern repeats every 20 seconds, as long as the IOR loopback pattern is being sent. This same 20-second repeat scenario also applies to the Time-out Override and Query commands. It also applies (with the appropriate number of bit errors) to the other ILR commands.

The HiGain-2 Line Unit is now in Logic Loopback (NLOC of Figure 5). The display on the HLU-619 periodically shows "NLOC" and "Arm" (the HLU-619 is still armed) in addition to the margin displays. The Loopback Time-out option determines the duration of this loopback, unless it is overridden by the Time-out Override command or a loop-down command is sent. If the Time-out Override code 1101 0101 1101 0110 (D5D6) is received, the activation sequence, described in step 3 above is repeated, and the automatic timed expiration of the loopback is inhibited. If this Time-out Override is sent, then the only way to loop the HLU-619 down is to issue the Intelligent Repeater Loop-down (IR LPDN) code 1001 0011 1001 0011 (9393) or to issue the NI (Network Interface) LPDN and Disarm code 11100. The automatic time-out timer is restored during subsequent loopback sessions.

4. When you are done, send the IOR LPDN code 1001 0011 1001 0011 (9393) to loop down the HLU-619. The unit remains armed as indicated by the "Arm" message on the HLU-619 and the flashing of the HRU-612 Loopback LED.
5. Using the following codes, a network tester can activate loopbacks NLOC or NREM or SMJK (if ENabled) (see Figure 5). A customer tester can activate loopbacks CLOC or CREM.

ADDRESSABLE 5 (A5LB) REPEATER LOOPBACKS

Command	Description	Code
ARMING or NI LPBK (in-band)	Arming code	11000 11000 ...
ARMING or NI LPBK (ESF data link)	Arming code	1111 1111 0100 1000 (FF48)
IR LPDN or DISARM (in-band)	Disarming code	11100 11100 ...
DISARM (ESF data link)	Disarming code	1111 1111 0010 0100 (FF24)
IOR LPBK (NLOC and CREM 231 errors)	HLU Loop-up	1101 0011 1101 0011 (D3D3)
ILR-2 LPBK		
(NREM and CLOC 20-bit errors)	HRU Loop-up	1100 0111 0100 0010 (C742)
IR LPDN	Loop-down (HLU or HRU)	1001 0011 1001 0011 (9393)
IR QUERY LPBK	Query Loopback	1101 0101 1101 0101 (D5D5)
IR ALTERNATE QUERY LPBK	Alternate Query Loopback	1101 0101 1110 1010 (D5EA)
TIME-OUT OVERRIDE	Loopback Time- out Override	1101 0101 1101 0110 (D5D6)
IOR POWER-DOWN (HLU)	Removes VHDSL line power	0110 0111 0110 0111 (6767)

Note The left-most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} Bit Error Ratio (BER) on the facility. The IOR Power-down code must remain present for the duration of the power-down mode. When this code is removed, the HiGain-2 system returns to its normal unlooped and unarmed state.

- After testing is complete, send the universal Intelligent Repeater Loop-down (IR LPDN) code if the system is to loop down but remain Armed. Send the disarm code 11100 if all the equipment is to be looped down, disarmed, and returned to normal operation. The Armed mode has an automatic time-out of 120 minutes.
- All of the above loopbacks can also be initiated from the front panel of the HLU with the Mode and SEL buttons, see paragraph 8.01.

F. CERTIFICATION AND WARRANTY

16. CERTIFICATION

16.01 FCC compliance: The HLU-619 was 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 on in a commercial environment. This equipment generates, uses and can radiate radio frequency energy. If it is not installed and used in accordance with the instruction manual, harmful interference to radio communications can result. Operation of this equipment in a residential area is likely to cause harmful interference, in which case, the user is required to correct the interference at his own expense.

17. WARRANTY

17.01 PairGain Technologies warrants this product to be free of defects and fully functional for a period of 60 months from the date of original shipment, given proper installation. During the 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.

17.02 Do not try to repair this 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.

17.03 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 92780
ATTN: Repair and Return Dept.
(714) 832-9922
(800) 638-0031

18. FINDING TECHNICAL HELP

18.01 PairGain Technical Assistance is available 24-hours-a-day, 7-days-a-week by contacting PairGain's Customer Service Engineering group at: Telephone: (800) 638-0031 or (714) 832-9922 Fax: (714) 832-9924.

18.02 During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday - Friday, excluding holidays), technical assistance calls are answered 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. After you make a request for technical assistance, you are called back in 30 minutes or less.

18.03 In addition, PairGain maintains a computer bulletin board system (BBS) 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. Transmission speeds up to 28.8 kbps are supported with a character format of 8-N-1. To reach the PairGain BBS, call (714) 730-3299.

19. GLOSSARY

MARGINS	Indicates the excess signal to noise ratio, at either the HRU-612 or HLU HDSL ports, relative to a 10^{-7} Bit Error Rate. 1st value is current margin, 2nd value is minimum margin since the clear option was last chosen, 3rd 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.
PULSE ATTENUATION	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 pairs' 392 kHz loss. The pulse attenuation is a more direct indication of the loop attenuation to the 2B1Q signal than the 392 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-612 from the HLU-619 crystal oscillator. Any value between -100 and +100 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 the HDSL loop was out of sync.
DS1 BPV Seconds (ES)	The number of seconds in which at least 1 bipolar violation was detected on the DS1 input.
DS1 UAS Count	The number of seconds during which the DS1 input signal was absent (125 or more consecutive "0").
Frame type	Type of DS1 framing used on the input stream (SF, ESF, Unframed or No Activity).
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 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.
HLU/Ver w.x-y	"w.x" = software version number of the HLU-619. "y" = list # of HLU-619.
HRU/Ver a.b-c	"a.b" = software version number of the HRU-612. "c" = list # of HRU-612.

20. USING THE SOFTWARE

20.01 Once you have installed the HLU-619, you can monitor performance using the software and a video terminal.

20.02 A standard RS-232 (DB9) connector on the front panel provides access to the software program using a terminal.

Note: If you need to use a 25-pin (DB25) connector, you can use a DE9-to-DB25 adapter cable between the 9-pin serial port and the RS-232 connector. For more information, refer to the manual for the DB25 adapter cable.

1. Make sure your computer or dumb terminal is properly connected.
2. Start your terminal emulation program.
3. Press the space bar on the keyboard 6 to 8 times. The Main Menu screen appears, from which you can:
 - ◆ View span status
 - ◆ Check and modify system settings
 - ◆ View performance data
 - ◆ View the performance history
 - ◆ View the alarm history

20.03 Span Status Screen. The Span Status screen allows you to look at equipment links.

To use the Span Status screen

1. Go to the Main menu, as described in section 20.02.
2. Press <A> on the keyboard. The Span Status screen appears.
3. Do one of the following:
 - ◆ Press <S> on the keyboard to see more span information.
 - ◆ Press <U> on the keyboard to update the information displayed on the Span Status screen.

Figure 7 shows an example HLU-619 span status displays.

4. Press <M> on the keyboard to return to the Main menu.

20.04 System Settings Screen. Viewing system settings allows you to specify any special settings for the HLU-619. For more information about these settings, see section 9-Setting System Options.

To use the System Settings screen

1. Go to the Main menu, as described in section 20.02.
2. Press <C> on the keyboard. The System Setting screen appears. Figure 9 shows an example System Settings screen.
3. Make any needed changes.
4. Press <E> on the keyboard to return to the Main screen.

20.05 Performance Data Screen. Viewing performance data allows you to see performance information about the last 24 hours. This information is grouped into 15 minute slices for the last 24 hours.

To use the Performance Data Screen

1. Go to the Main menu, as described in section 20.02.
2. Press <E> on the keyboard. The Performance screen appears.

Figure 10 shows an example Performance display. The Errored and Unavailable Seconds for the HDSL loop and the T1 input are listed at 15-minute intervals over a 4-hour time duration.

2. Do one of the following:
 - ◆ Press <P> on the keyboard to go back in time one screen.
 - ◆ Press <N> on the keyboard to go forward in time from where you are. If you are at current time, this takes you to the time 24 hours before the current time.
3. Press <M> on the keyboard to return to the Main menu.

20.06 Performance History Screen. Viewing performance history allows you to see the performance totals for the last seven days. Unlike the performance data above, you cannot see

specific information about a time slice, but rather you see information about the entire 24 hour period in one figure.

To use the Performance History Screen

1. Go to the Main menu, as described in section 20.02.
2. Press <E> on the keyboard. The Performance History screen appears.
3. Press <S> on the keyboard, to view more span information, if it is available.

Figure 11 shows the system 7-Day History Performance Data display. The Errored and Unavailable Seconds for the HDSL loop and the DS1 inputs are listed for the current and the seven previous days.

4. Press <M> on the keyboard to return to the Main menu.

20.07 Alarm History Screen Viewing the Alarm History allows you to see information about alarms and their status since the last time the information was cleared.

To use the Alarm History Screen

1. Go to the Main menu, as described in section 20.02.
2. Press the <G> key. The Alarm Status screen appears.
 - ◆ Press <S> on the keyboard to view more span information, if it is available.
 - ◆ Press <U> on the keyboard to see an updated screen of span information.
 - ◆ Press <C> on the keyboard to clear the screen and delete the displayed information. Once you have deleted the displayed information, you cannot retrieve it.

Figure 12 shows an example system Alarm History screen. The alarms are defined in section 8.

3. Press <M> on the keyboard to return to the Main menu.

20.08 When you are done, return to the Main screen. The system automatically logs you out after 5 minutes of keyboard inactivity.

```
HI-GAIN HLU-619 MAINTENANCE TERMINAL MAIN MENU (ver U1.0L-0001)
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 #

█
```

Figure 6. HLU-619 Main Menu.

```
SPAN STATUS
( HLU/ver1.0-0001: HRU/ver1.4-0001)

TIME: 00:14:20
DATE: 08/08/95
CIRCUIT ID#:

ALARMS: NONE
LOOPBACK: OFF

          HLU                      HRU
          HDSL                      HDSL
          cur/min/max              cur/min/max
MARGIN:    17/16/18                19/18/20 dB
PULSE ATTN: 11                    11 dB
PPM OFFSET: 00                    -18 ppm
24 HOUR ES: 00000                  00002 seconds
24 HOUR UAS: 00018                 00000 seconds

          DS1 STATUS
          HLU                      HRU
24 HOUR BPU Seconds: 00000         00002
24 HOUR UAS Count:  00001         00002
Frame type:         Unframed       Unframed
Code type:          AMI             AMI

(E)xit (C)lear (U)pdate█
```

Figure 7. HLU-619 Status Display.


```
                                SET CLOCK

TIME: 00:15:35
DATE: 08/08/95
CIRCUIT ID#:

Format: HH:MM
        MM/DD/YY

NEW TIME:

NEW DATE:

(U)PDATE REMOTE?█
```

Figure 8. HLU-619 Set Clock Menu.

```
                                SYSTEM SETTINGS

TIME: 00:18:24
DATE: 08/08/95
                                CIRCUIT ID#:

E(Q)UALIZATION:      0
SMART-JACK (L)B:     ENABLE
(S)PECIAL LPBK:      GNLB
(P)OWER:              ENABLE
(Z)BTSI:              OFF
ES ALARM TH(R)ES:    NONE
LOOPBACK (T)IMEOUT:  60
(A)LARM:              DISABLE
(D)S1 LINE CODE:     AMI
(F)RAMING:            AUTO
AIS ON (H)DSL ALRM:  DISABLE
AIS ON S(M)JK/NREM:  ENABLE
MAR(G)IN ALM THRES:  4
DSO (B)LOCKING:      xx - Blocked Channels
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

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

Figure 9. HLU-619 System Settings Menu.

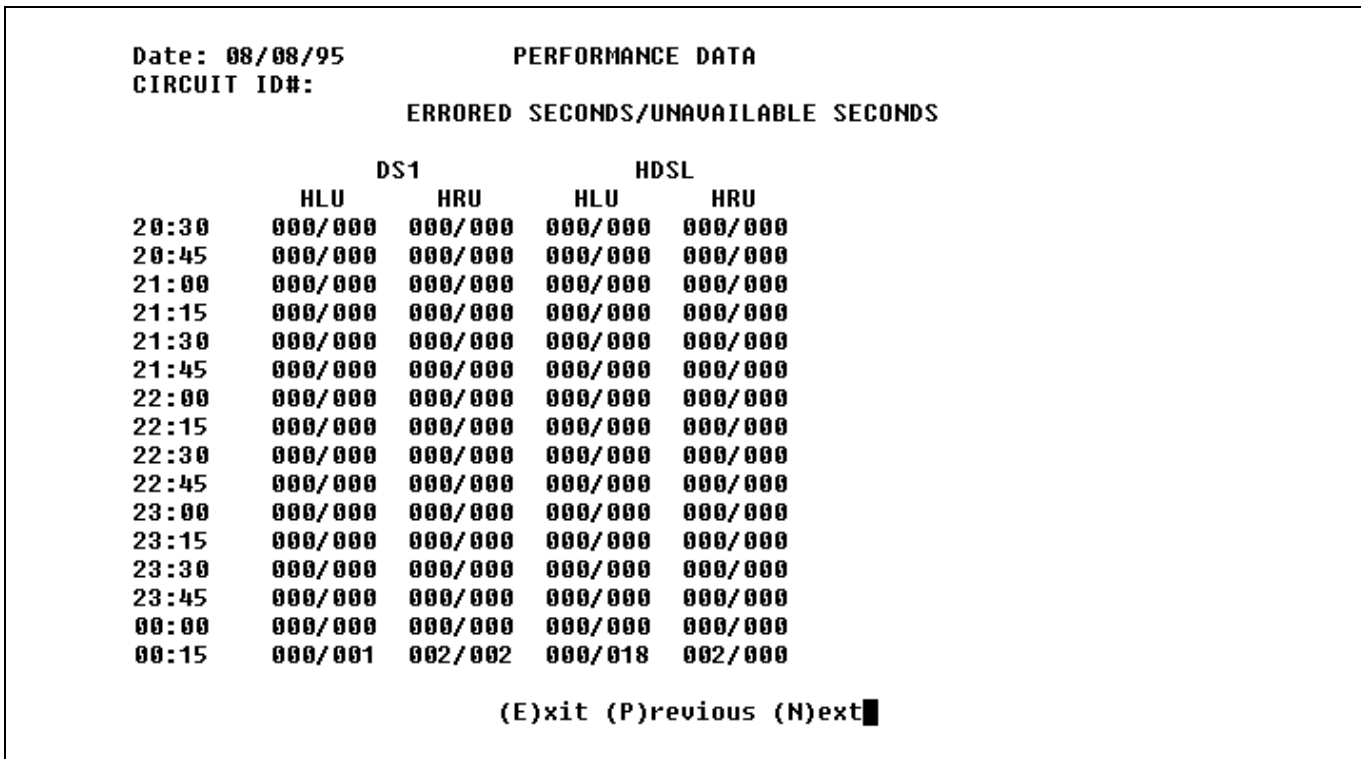


Figure 10. HLU-619 Performance Data Screen.

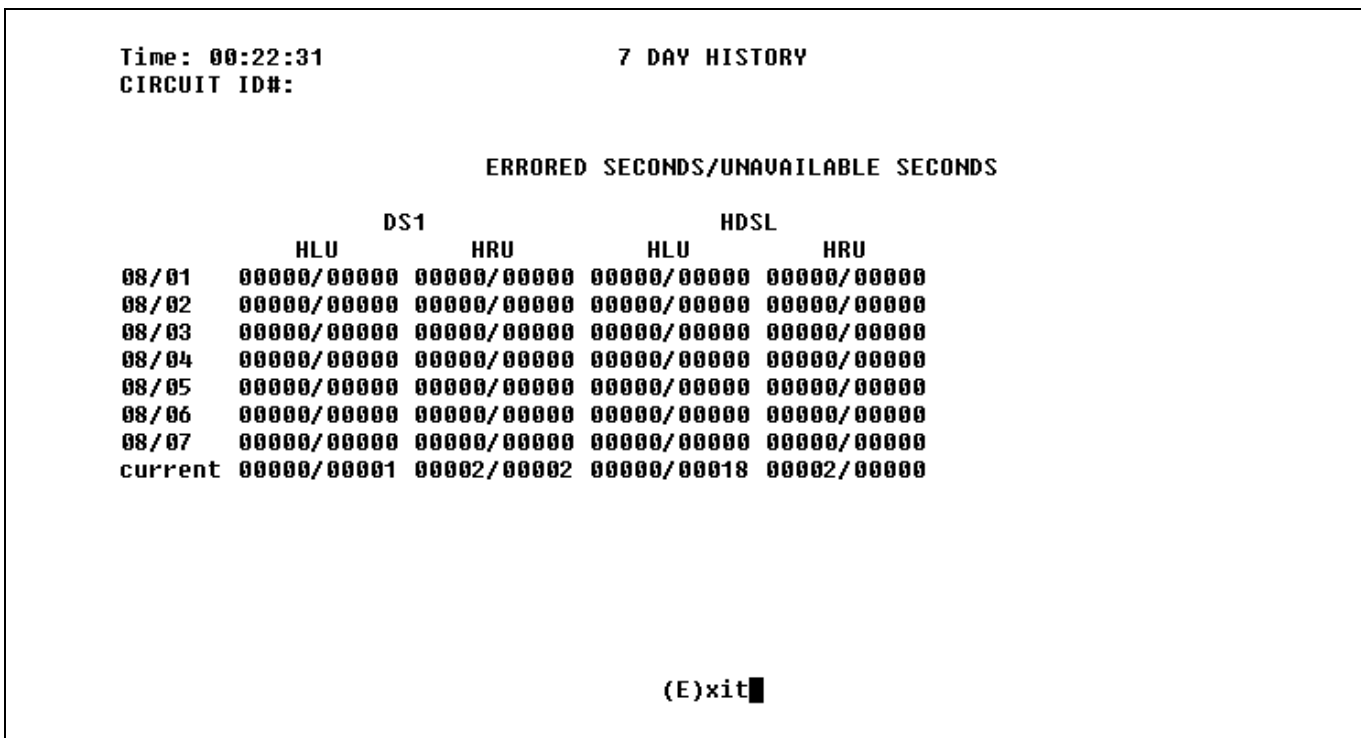


Figure 11. HLU-619 7-Day Performance History Screen.

ALARM HISTORY				
TIME: 00:20:52				
DATE: 08/08/95				
CIRCUIT ID#:				
Type	First	Last	Current	Count
LOS, DS1-HLU			OK	000
LOS, DS1-HRU			OK	000
LOSW, HDSL	08/08/95-00:00	08/08/95-00:00	OK	001
ES, HDSL			OK	000
MARGIN LP			OK	000
PWR-OPEN			OK	000
PWR-SHRT	08/08/95-00:00	08/08/95-00:00	OK	001
LAST CLEARED: NONE				
(E)xit (C)lear (U)pdate				

Figure 12. HLU-619 Alarm History Screen.