HiGain Line Unit

Model	List Number	Part Number
HLU-319	4B	150-1140-42

PairGain Technologies, Inc.
Engineering Services Technical Practice
Section 150-319-142-01

Revision History of This Practice
Revision 01—December 22, 1997
A) Initial Release

PairGain

USING THIS MANUAL

Two types of messages, identified by icons, appear in the text.

Notes contain information about special circumstances.

Cautions indicate the possibility of equipment damage or the possibility of personal injury.

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OVERVIEW

The PairGain® HiGain® HiGain Line Unit Model HLU-319 List 4B is the Central Office (CO) side end of a repeaterless T1 transmission system. An HLU-319 List 4B connects to a HiGain Remote Unit (such as an HRU-412 List 8B), creating a HiGain system which provides 1.544 Mbps payload transmission on two unconditioned copper pairs covering 3658 m of 0.51 mm wire or 2743 m of 0.4 mm wire, including bridge taps and gauge changes.

A HiGain system utilizes 2B1Q High-bit-rate Digital Subscriber Line (HDSL) transmission technology. The HLU-319 List 4B complies with ANSI T1E1.4, T1.403-1989, and T1E1.4/92-002R2 technical standards and recommendations. The HLU-319 List 4B mounts in a single slot of an industry standard 3192-type Mechanics shelf. The system complies with Transport System Generic Requirements (TSGR) common requirements TR-TSY-000499.

The HLU-319 List 4B features:

- Selectable DSX-1 pre-equalizer
- Front panel HDSL S/N margin display
- Selectable loopback activation codes
- Craft port (RS-232)
- Network Management Administration (NMA) interface
- Front panel operator setup stored in non-volatile memory
- Front panel DS1 splitting and bridge access
- Lightning and power-cross protection on HDSL interfaces
- 784 kbps full duplex 2B1Q HDSL transmission on two pairs
- Front panel status indicating LED
- On/off front panel display power cycling
- DSX-1 LOS detector (125 consecutive zeros)
- Margin threshold alarm
- HDSL AIS and SmartJack AIS options

- Easy return to factory default user settings
- Circuit ID option
- Low power consumption

APPLICATION

A HiGain system, consisting of a HiGain line unit and a HiGain remote unit, provides a quick and cost-effective way of delivering T1 High Capacity Digital Service (HCDS) to customers over copper pairs. The HiGain system can be deployed on two unconditioned, non-loaded copper pairs without repeaters, and without the need for bridged tap removal or binder group separation.

The general guidelines for HiGain system usage is that each loop have less than 35 dB of loss at 196 kHz, with 135 ohm driving and terminating impedances.

Table 1 provides a guide for the loss over various cable gauges at 196 kHz and 135 ohms. The table applies to the HDSL cable pairs between the HiGain line unit and the HiGain remote unit. Without specific loop insertion loss data, add 3 dB for each bridged tap and 1 dB for each cable gauge change.

The DC cable resistance determines the simplex powering resistance path of the loops. The maximum allowable resistance for a HiGain system is 800 ohms over two HDSL simplex loops. This means, for example, where 3.7 km of 0.51 mm wire equals 34.08 dB (insertion loss), resistance is at 622 ohms which is well below the limit of 800 ohms.

Table 1. *HDSL Loss over Cables*

Cable Gauge	Loss at 196 kHz (db/km)	Ohms per km
0.4 mm	12.7	272.3
0.51 mm	9.3	170.6
0.61 mm	7.2	105
0.91 mm	5.1	52.5

A HiGain system operates with a variety of other T1, POTS, Digital Data Service (DDS) equipment or other HiGain systems sharing the same cable binder group. HiGain systems provide temporary or permanent DS1 service and can provide a means of deploying service in advance of fiber-optic transmission systems.

SPECIFICATIONS

HDSL Line Code	784 kbps 2B1Q
HDSL Output	+13.5 dBm ± 0.5 dB at 135 ohms
HDSL Line Impedance	135 ohms
Maximum Provisioning Loss	35 dB at 196 kHz, 135 ohms
Line Clock Rate	Internal Stratum 4 clock
HDSL Start-up Time	30 seconds (typical), 60 seconds (maximum) per span
One-way DS1 Delay	<220 microseconds per span
DSX-1 Line Impedance	100 ohms
DSX-1 Pulse Output	Pre-equalized for 0 to 655 feet of ABAM-specification cable
DSX-1 Input Level	+1.5 to -7.5 dB DSX
DSX-1 Line Rate	1.544 Mbps ± 200 bps
DSX-1 Line Format	AMI, B8ZS or ZBTSI
DSX-1 Frame Format	ESF, SF or UNFR
Maximum Power Consumption	4.8 Watts
Maximum Heat Dissipation	4.0 Watts
Fusing	Internal; connected to Fuse Alarm output on pin 10
Margin Indicator	Displays HDSL loop SNR margin for each HDSL loop relative to 10^{-7} BER operation
Electrical Protection	Secondary surge protection on DS1 and HDSL ports; Power cross protection on HDSL ports

Operating Temperature	-40° C to +65° C
Humidity	5% to 95% (non-condensing)
Mounting	STS, high-density slot
Dimensions	
Height:	12.1 cm
Width:	1.78 cm
Depth:	26.7 cm

FUNCTIONAL DESCRIPTION

This section describes the functions of the HLU-319 List 4B.

Operational Capabilities

The HiGain system utilizes PairGain 2-Bit 1-Quartenary (2B1Q) HDSL transceiver systems to establish two full duplex 784 kbps data channels between the HLU-319 List 4B and the HRU-412 List 8B. This provides a total capacity of 1.568 Mbps between the two units.

The HiGain HLU-319 List 4B receives a 1.544 Mbps DS1 data stream from the DSX-1 digital cross connect interface. The HLU-319 List 4B contains a DSX-1 frame synchronizer controlled by an 8-bit microprocessor that determines the type of framing on the DS1 stream and synchronizes to it. The HLU-319 List 4B recognizes Super Frame (SF), including D4 or Extended Super Frame (ESF) framing. The HLU-319 List 4B arbitrarily defines a frame bit for unframed data.

The HLU-319 List 4B contains a multiplexer that generates two parallel 784 kbps data streams. The data streams contain HDSL frames that are nominally 4704 bits (6 milliseconds) in length. The HDSL frames contain a 14-bit Frame Sync Word (FSW), 6-bit Cyclic Redundancy Check (CRC), 21-bit operations channel and DSX-1 payload. The DSX-1 stream separates into two parallel streams that comprise the payloads of the HDSL channels. The HLU-319 List 4B allocates DS0 time slots 1 through 12 to loop 1, and time slots 13 through 24 to loop 2 when used with an HRU-412 List 8B. The 8 kbps frame bits of the DSX-1 stream are included on both HDSL channels. The two formatted HDSL channels are passed to the HDSL transceivers which

convert them to the 2B1Q format on the HDSL lines. The 2B1Q line code is designed to operate in a full-duplex mode on unconditioned pairs. The transceiver echo canceler and adaptive equalizer receive the signal from the remote end in the presence of impairments and noise on the copper pairs.

The received HDSL channels are processed by the transceiver and then passed on to the HLU-319 List 4B demultiplexer module. The demultiplexer provides frame synchronization for each of the two HDSL loops. The demultiplexer and HDSL transceivers work under control of the HLU-319 List 4B microprocessor and compensate for data inversions caused by tip-ring reversals and loop swaps caused by pair reversals. The HiGain system allows for tip-ring or pair reversals, but does not allow split pairs. By synchronizing to the Frame Sync Word (FSW) of each loop, the demultiplexer can reconstruct the original 1.544 Mbps DS1 stream from the payloads of the two HDSL loops. The CRC fields on the HDSL streams allow the HLU-319 List 4B to determine if errors are present on the channel due to excessive impairments on the HDSL pairs or excessive impulse or crosstalk noise.

The demultiplexer removes data link messages from the HDSL loops and passes them to the microprocessor. This mechanism allows operations messages and status to be exchanged between the HLU-319 List 4B and the remote HRU-412 List 8B.

The reconstructed HDSL data is buffered in a first-in-first-out (FIFO) buffer within the demultiplexer. A frequency synthesizer, in conjunction with the FIFO buffer, regulates the output bit rate and reconstructs the DSX-1 clock frequency-locked to the DS1 clock at the remote end. The HiGain system operates at T1 rates of 1.544 Mbps with up to ± 200 bps of offset.

A DSX-1 interface driver converts the receive 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-319 List 4B 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.

The HLU-319 List 4B contains a main power supply that converts -48 Vdc power to voltage for the HLU-319 List 4B circuitry.

The female 9-pin (DB-9) Craft (RS-232) port, on the front panel, provides access to HiGain system configuration, provisioning, and performance monitoring.

Alarms

Pin H is the HLU-319 List 4B minor alarm (MNRALM) output pin. It is normally floating and must never be driven above +5 V or below -60 V. The HLU-319 forces pin H to +5V (maximum source of 10 mA) for any of the conditions listed below. More than one alarm condition can exist at any given time, but only one message can be displayed. In the case of multiple alarms, the highest priority alarm is displayed. The alarms listed below are in order of priority:

1 ALRM LOSW: Either HDSL loop lost sync.

2 ALRM LLOS: Loss of HLU DSX-1 input signal.

3 ALRM RLOS: Loss of HRU DS1 input signal.

4 ALRM TLOS: A user option that, when enabled, causes a logic loopback in the HRU-412 List 8B when there is a loss of DS1 signal at the HRU-412 List 8B.

5 ALRM H1ES: HDSL loop 1 has exceeded the 24 hour user-selected Errored Seconds CRC threshold. If both H1ES and H2ES occur, only H1ES is displayed on the front panel.

6 ALRM H2ES: HDSL loop 2 has exceeded the 24-hour user-selected Errored Seconds CRC threshold. If both H1ES and H2ES occur, only H1ES is displayed on the front panel.

7 ALRM DS1: The total number of bipolar violations (BPV), at either the HLU or the HRU DS1 inputs, have exceeded the 24-hour user-selected threshold.

8 ALRM MAL1: The margin on HDSL loop 1 has dropped below the minimum threshold value set on the System Settings menu.

9 ALRM MAL2: The margin on HDSL loop 2 has dropped below the minimum threshold value set on the System Settings menu.

Pin H, MNRALM, remains at +5V for the duration of an alarm condition. If the Wescom 1184 Alarm Card is installed in the shelf, its LOS LED lights for every MNRALM. The HLU-319 List 4B Status LED flashes red for the duration of a minor alarm condition. Alarms 5 and 6, above, can be inhibited by selecting None for the ESAL system option on the Systems Setting menu. The MAL alarms (8 and 9, above) are disabled by setting the margin alarm threshold to 0 (on the Systems Settings menu). A minor alarm can be retired by executing the Alarm CutOff (ACO) option by pressing the SEL button on

the front panel. This turns the alarm off and replaces the alarm message with the ACO message. However, the second part of the alarm message, which defines the cause of the alarm, remains. The ACO message and the cause of the alarm remain until the alarm condition clears or another alarm occurs. Disabling the alarm also retires an ACO condition.

Setting the alarm option to disable prevents the activation of the minor alarm output alarm bus on pin H during a minor alarm event. The Status LED still flashes red and the alarm message is still displayed.

The HLU-319 List 4B Pin 10 FUSE ALARM is driven to -48 V whenever its on-board fuse opens. Its normally floating output must never be driven above ground or below -80 V. It can sink a current of 10 mA.

Pin 7 is the NMA serial bus. It allows access to the HMU-319 List 5B, which provides shelf management.

Front Panel Features

Figure 1 shows the front panel of the HLU-319 List 4B. Table 2 describes the front panel components.

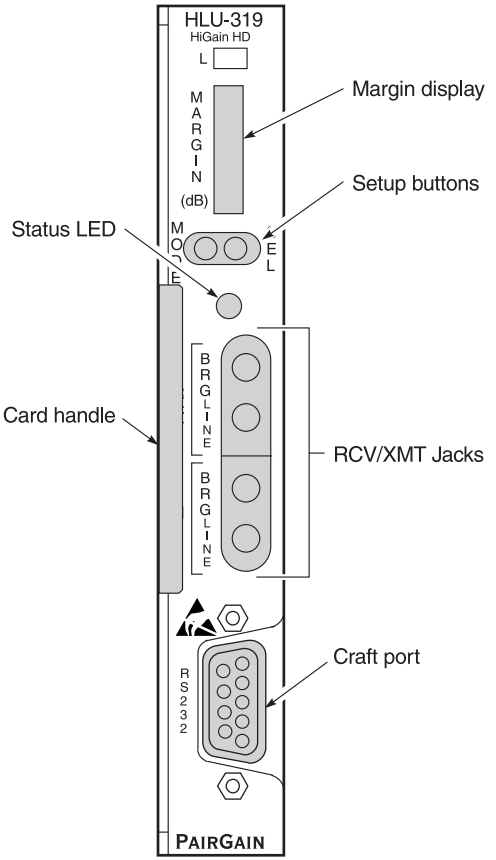


Figure 1. *HLU-319 List 4B Front Panel Components*

Table 2. *HLU-319 List 4B Front Panel Components*

Name	Function		
Front panel display	Displays information about the activity and status of the HLU-319 List 4B.		
Setup buttons	The MODE and SEL buttons allow configuration and provisioning of the HLU-319 List 4B.		
Status LED	Color	Mode	Function
	Green		Normal operation
	Green	Flashing	HDSL acquisition
	Red		Fuse alarm
	Red	Flashing	Minor alarm
	Yellow		Self-test in process, or an HLU loopback test is in effect
	Yellow	Flashing	HLU-319 List 4B in armed state for loopbacks
Receive (RCV) and transmit (XMT) jacks	Provide splitting and monitor access to the DSX-1 interface. The jacks are transformer isolated from the DSX-1 metallic interface.		
Craft port	Provides an RS-232 connection port for a dumb terminal. The dumb terminal allows access to the maintenance, provisioning, and performance monitoring menus and screens.		
Card handle	Pulls down to release the HLU-319 List 4B from the shelf slot. The handle closes when the HLU-319 List 4B is properly installed in a slot.		

INSTALLATION

This section describes how to install the HLU-319 List 4B.

Unpack and Inspect the Shipment

Upon receipt of the equipment:

1 Unpack the container and visually inspect the product for signs of damage. If the equipment has been damaged in transit, immediately report the extent of the damage to the transportation company and to your sales representative.

2 Verify the contents using the packing list to ensure complete and accurate shipment.

If you must store the equipment for a prolonged period, do so in the original container.

Install the HLU-319 List 4B

The HLU-319 List 4B mounts in wire-wrapped and connectorized shelves, including:

- PairGain HMS-318 (22 slot, 19 inch shelf)
- PairGain HMS-319 (3 slot, 19 inch horizontal shelf)
- PairGain HMS-317 (28 slot, 23 inch shelf)
- PairGain HMS-308 (8 slot remote enclosure)

The HLU-319 List 4B pinouts are shown in Figure 2. The active pins are shown in black.

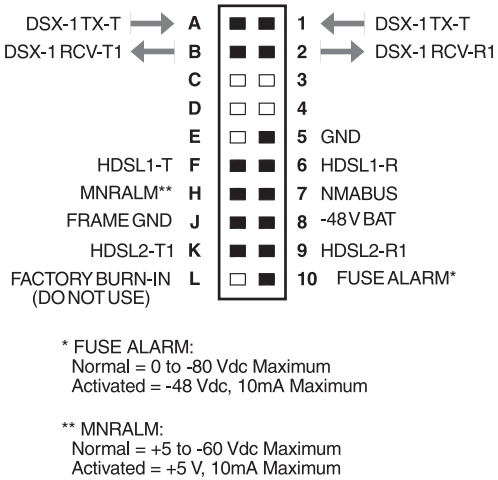


Figure 2. *HLU-319 List 4B Pinouts*

To install the HLU-319 List 4B:

1 Ensure that the shelf is correctly mounted and wired (refer to the shelf's technical practice if necessary).

2 Slide the HLU-319 List 4B into the card guides for the desired slot, then push the unit back until it touches the backplane card-edge connectors.

3 Place your thumbs on the HLU-319 List 4B front panel and push the HLU-319 List 4B into the card-edge connector until it is entirely within the card guides.

CONFIGURE, PROVISION, AND MONITOR PERFORMANCE

The following sections describe how to perform configuration, provisioning and performance monitoring functions using the HLU-319 List 4B menus and screens.

Connect a Dumb Terminal

Connect a dumb terminal:

1 Connect a standard 9-pin serial terminal cable to the Craft (RS-232) port (DB-9 female connector) on the HLU-319 List 4B. See Figure 3 for the DB-9 female connector wiring.

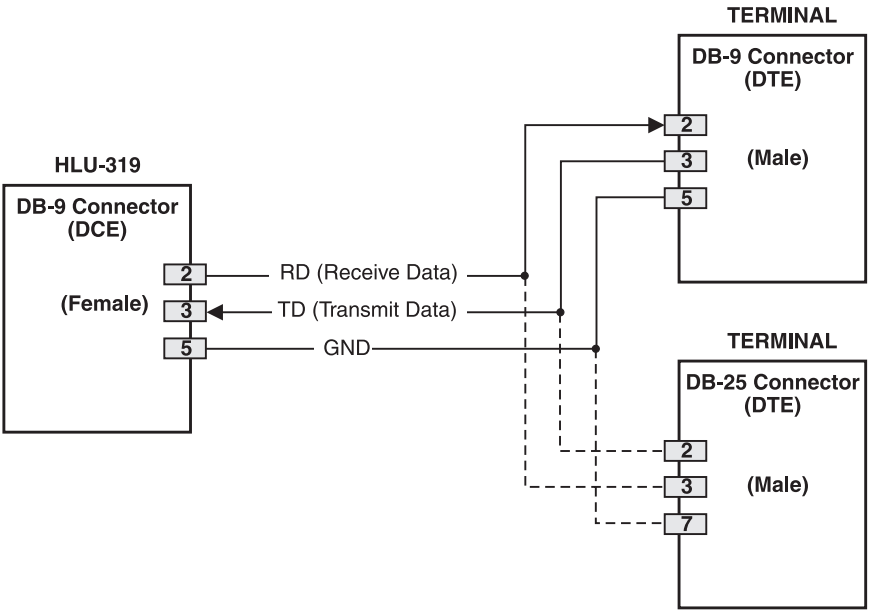


Figure 3. *HLU-319 List 4B Craft Port Wiring*

2 Connect the other end of the terminal cable to the console port on the dumb terminal.

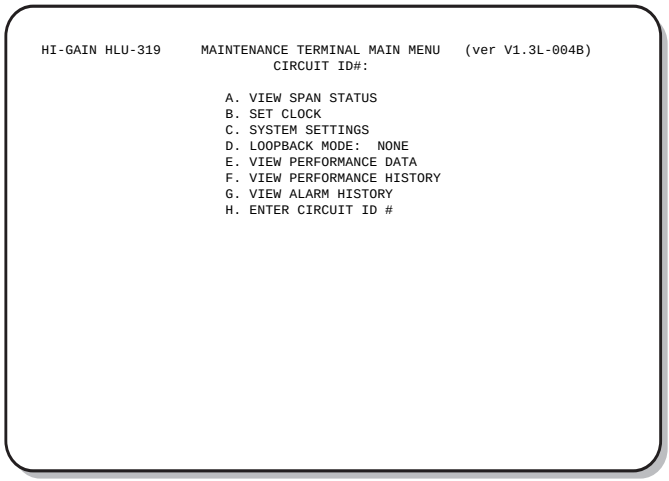
3 Configure the dumb terminal to the following communication settings:

- 1200 to 9600 baud
- no parity
- 8 data bits
- 1 stop bit
- hardware flow control to OFF

Log On and Use the Menus

This section describes how to log on and access the menus and screens using the dumb terminal.

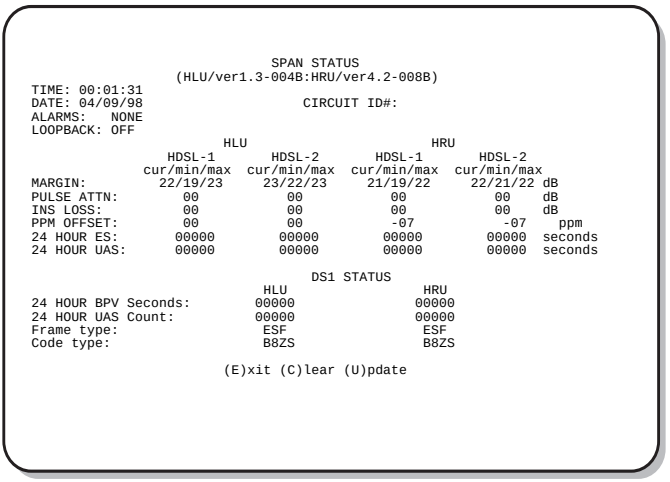
1 Press the spacebar several times to active the autobaud feature and to display the log on screen. The Main Menu displays.



2 Access options on the Main Menu by typing the letter of the desired option.

View Span Status

1 From the Main Menu, type **A** to display Span Status screen.



```
                              SPAN STATUS
                     (HLU/ver1.3-004B:HRU/ver4.2-008B)
TIME: 00:01:31
DATE: 04/09/98                        CIRCUIT ID#:
ALARMS:   NONE
LOOPBACK: OFF
                         HLU                              HRU
                    HDSL-1       HDSL-2        HDSL-1        HDSL-2
                  cur/min/max  cur/min/max  cur/min/max   cur/min/max
MARGIN:             22/19/23     23/22/23     21/19/22     22/21/22 dB
PULSE ATTN:           00           00           00           00    dB
INS LOSS:             00           00           00           00    dB
PPM OFFSET:           00           00           -07          -07    ppm
24 HOUR ES:        00000        00000        00000        00000  seconds
24 HOUR UAS:       00000        00000        00000        00000  seconds

                                   DS1 STATUS
                                  HLU                  HRU
24 HOUR BPV Seconds:            00000                00000
24 HOUR UAS Count:              00000                00000
Frame type:                      ESF                  ESF
Code type:                       B8ZS                 B8ZS

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

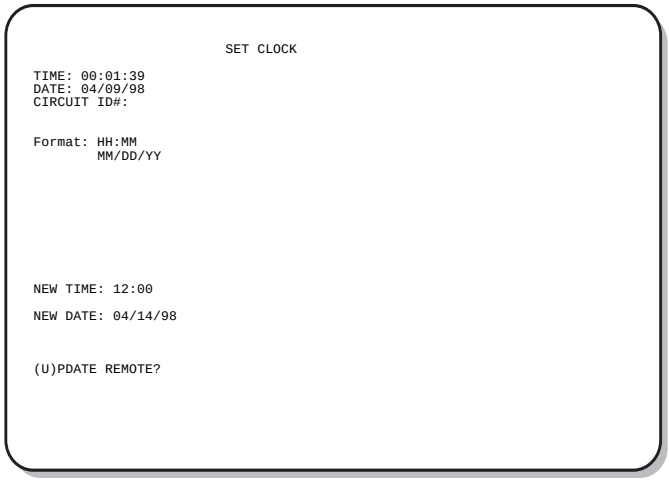
2 Type **U** to update the Span Status screen to the latest information.

3 Type **C** to clear the Span Status screen data.

4 Type **E** to exit to the Span Status screen.

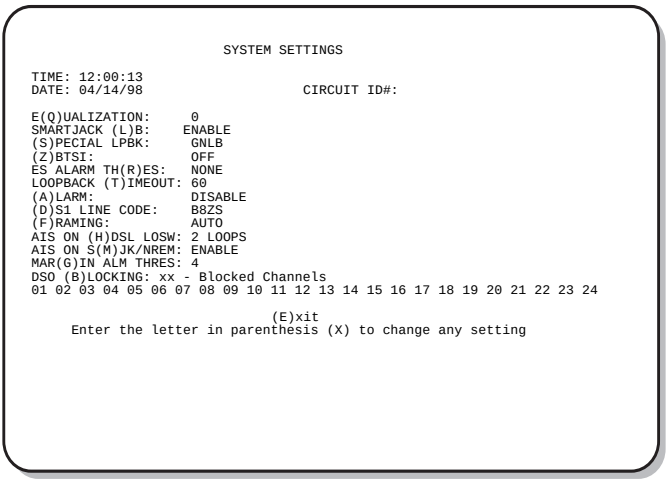
Set Clock

1. From the Main Menu, type **B** to display the Set Clock menu.
2. Enter the time (in 24 hour format, hours and minutes only) at the New Time prompt.
3. Press **ENTER**.
4. Enter the date (mm/dd/yy) at the New Date prompt.
5. Press **ENTER**.
6. Type the **U** at the Update Remote? prompt to update the HRU-412 List 8B clock.



System Settings

1 From the Main Menu, type **C** to display the System Settings screen.



2 Type the letter in parenthesis of the option you want to change. Typing the letter again scrolls to the next parameter for the option.

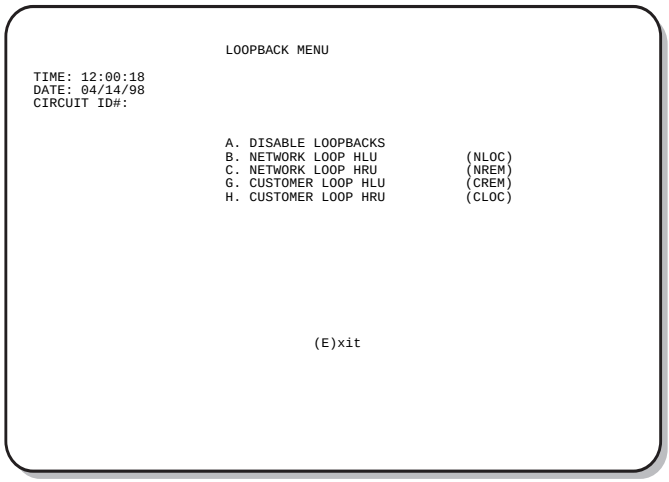
3 Press **ENTER** when the parameter you want displays. Refer to "System Setting Options" on page 23 and Table 3 on page 24 for more information about the options.

4 When all selections are made, type **E** to exit the option.

5 Type **C** to confirm the changes.

Select Loopback Test

1 From the Main Menu, type **D** to display the Loopback Menu.

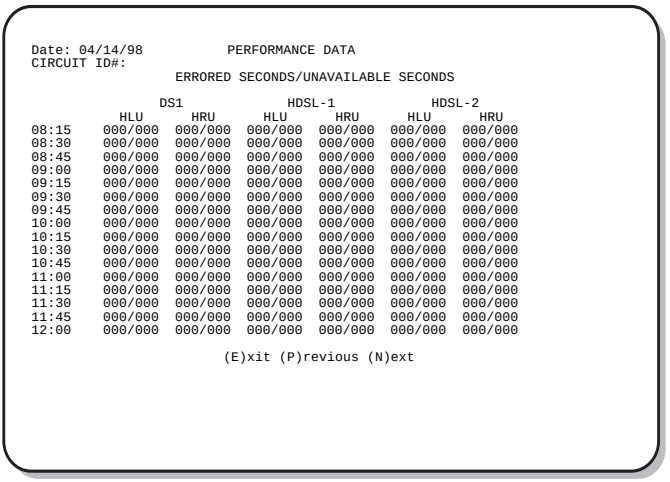


2 Type the number of the desired loopback option.

3 Type **E** to exit the Loopback Menu.

View Performance Data

1 From the Main Menu, type **E** to display Performance Data screens.



```
Date: 04/14/98           PERFORMANCE DATA
CIRCUIT ID#:
                ERRORED SECONDS/UNAVAILABLE SECONDS

              DS1             HDSL-1           HDSL-2
        HLU      HRU     HLU      HRU     HLU      HRU
08:15  000/000  000/000  000/000  000/000  000/000  000/000
08:30  000/000  000/000  000/000  000/000  000/000  000/000
08:45  000/000  000/000  000/000  000/000  000/000  000/000
09:00  000/000  000/000  000/000  000/000  000/000  000/000
09:15  000/000  000/000  000/000  000/000  000/000  000/000
09:30  000/000  000/000  000/000  000/000  000/000  000/000
09:45  000/000  000/000  000/000  000/000  000/000  000/000
10:00  000/000  000/000  000/000  000/000  000/000  000/000
10:15  000/000  000/000  000/000  000/000  000/000  000/000
10:30  000/000  000/000  000/000  000/000  000/000  000/000
10:45  000/000  000/000  000/000  000/000  000/000  000/000
11:00  000/000  000/000  000/000  000/000  000/000  000/000
11:15  000/000  000/000  000/000  000/000  000/000  000/000
11:30  000/000  000/000  000/000  000/000  000/000  000/000
11:45  000/000  000/000  000/000  000/000  000/000  000/000
12:00  000/000  000/000  000/000  000/000  000/000  000/000

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

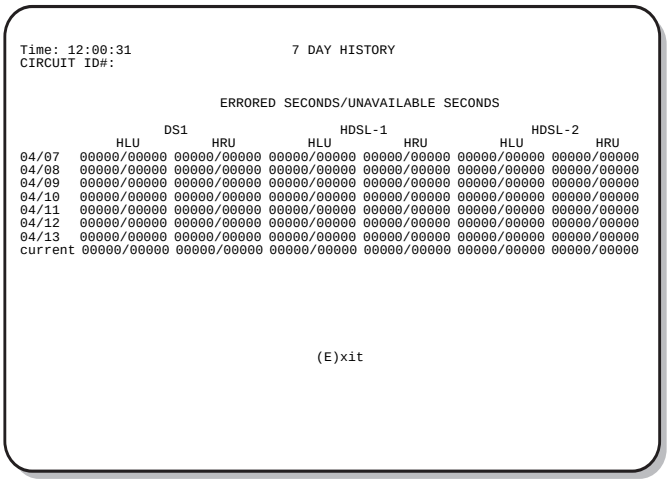
2 Type **P** to view the previous Performance Data screen.

3 Type **N** to view the next Performance Data screen.

4 Type **E** to exit the Performance Data screens.

View Performance History

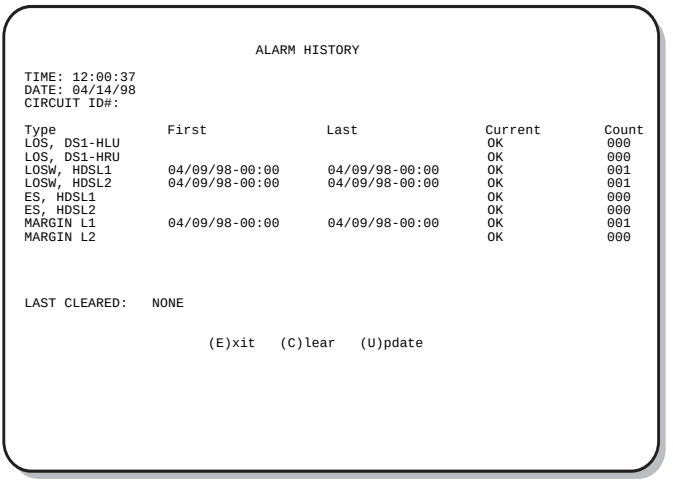
1 From the Main Menu, type **F** to display the 7 Day History screen.



2 Type **E** to exit the 7 Day History screen.

View Alarm History

1 From the Main Menu, type **G** to display the Alarm History screen.



```
                              ALARM HISTORY

TIME: 12:00:37
DATE: 04/14/98
CIRCUIT ID#:

Type              First               Last                Current        Count
LOS, DS1-HLU                                              OK             000
LOS, DS1-HRU                                              OK             000
LOSW, HDSL1       04/09/98-00:00:00   04/09/98-00:00:00   OK             001
LOSW, HDSL2       04/09/98-00:00:00   04/09/98-00:00:00   OK             001
ES, HDSL1                                                 OK             000
ES, HDSL2                                                 OK             000
MARGIN L1         04/09/98-00:00:00   04/09/98-00:00:00   OK             001
MARGIN L2                                                 OK             000



LAST CLEARED:   NONE

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

2 Type **E** to exit the Alarm History screen.

Enter Circuit ID Number

From the Main Menu, type **H** to enter a circuit identification number.

System Options

The HLU-319 List 4B contains non-volatile RAM (NVRAM) that stores the system settings options. No dip-switches or jumpers are required to configure the system options. They are set using the MODE and SEL buttons on the front panel, through an dumb terminal connected to the Craft (RS-232) port, or from a Network Management interface. The System Settings are retained if shelf power is lost or if the HLU-319 List 4B is unplugged.

Set Options Using the MODE and SEL Buttons

To provision the HLU-319 List 4B using the front panel MODE and SEL buttons:

1 Press the MODE button at least for one second, but less than three seconds, and release. The message on the front panel display alternates between the first system parameter and its current setting.

2 Press the SEL button repeatedly to scroll through all possible parameters of the option being displayed.

3 After selecting the desired option, press the MODE button. This updates the current displayed mode to the setting selected, then selects the next configurable parameter.

After the last option is selected, the following
`Confirm? (Yes/No)`
message appears in the front panel display:
`CONF NO`

4 Do one of the following:

- Cancel the session without saving the requested parameter changes by pressing the MODE button. (The display also returns to its normal mode, without installing any new changes, if neither button is pressed for 30 seconds.)
- Accept the requested parameter changes by pressing the SEL button. `Yes` displays and the changes are made.

The display returns to its normal mode.

Set Factory Default Values

To set all options to the factory default values:

1 Press the SEL button for six seconds. The DFLT NO message appears.

2 Do one of the following:

- To set the default values, press the SEL button while the DFLT NO message displays. DFLT YES displays, indicating the factory default values are now in effect.
- To terminate the Default mode, without setting the factory default values, press the MODE button or do nothing for 30 seconds.

Product Identification

Pressing the MODE button for three or more seconds causes the display to scroll through the HLU-319 List 4B software version number, its list number, the type of frame pattern being received from the DSX-1, the line code setting of the HLU-319 List 4B, and all options settings. The line code parameter is the actual DSX-1 line code being received by the HLU-319 List 4B when Framing is set to AUTO (on the System Settings menu). When the framing parameter is not set to AUTO, the HLU-319 LIST 4B mimics one of the other line code settings, AMI or B8ZS. This is not determined by the received line code.

The DS1 line code option should be set to conform to the type of T1 service (AMI or B8ZS) being provided by the HiGain system. The AUTO mode, which can adapt to either AMI or B8ZS, should be used in applications that require it, such as when the HLU-319 List 4B acts as a standby circuit to T1 circuits whose line codes are not known or may be both AMI and B8ZS. Before selecting AUTO, consider the following limitations:

1 AUTO induces one BPV in the T1 bit stream whenever it switches from AMI to B8ZS.

2 AUTO allows each HiGain system end 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 being sent from a distant T1 input port. Thus, if the line codes received by the HiGain system are different at each end of the two T1 directions, the HiGain T1 output codes will not match, causing the received data to be AMI instead of B8ZS (or vice versa), and thus violating the 1s density rules by having excessive zeroes.

System Setting Options

The following user options can be set only using an dumb terminal connected to the Craft (RS-232) port: Circuit ID, DS0 Blocking, and Margin Alarm Threshold.

Circuit ID Option. This option is set by choosing H on the Main Menu.

1. Type in the alpha-numeric Circuit ID. If more than 24 characters are entered, a Beep sounds and only the first 24 characters are accepted.
2. Type C to confirm. The ID appears in all HLU-319 List 4B screens. The ID does not appear on HRU screens when the maintenance port is accessed at the remote unit.

DS0 Blocking Option. This option is selected on the System Setting Menu by typing B. The DS0 channels are blocked or unblocked by entering each channel number. Select multiple channels by inserting a space between each entry. After all the settings are made, press to E to exit the blocking option then C to confirm. The new choices are now installed. All blocked channels are temporarily unblocked when a loopback test is running. This allows the standard full bandwidth T1 loopback tests to be performed.

Margin Alarm Threshold. This option is selected on the System Settings Menu screen by typing G. Enter the desired minimum acceptable alarm threshold by selecting a number from 0 to 15 (representing 0 to 15 dB). A minor alarm to will occur if the margin on HDSL loop 1 (MAL1) or loop 2 (MAL2) drops below the selected threshold value. Since the margin display can never drop below 0, choosing 0 for the margin threshold turns the margin alarm off.

The HLU-319 List 4B processes B8ZS and AMI code inputs, regardless of the DS1 code setting (AMI or B8ZS). When the HLU-319 List 4B is in the AMI mode, it can receive B8ZS but can only transmit AMI.

The Self-test mode, which occurs when both HDSL loops are out of sync, causes the Alarm Indicating Signal (AIS) pattern to exhibit occasional BPVs.

The HAIS (HDSL AIS) option provides two selections (1LP and 2LP) for the T1 transmit outputs at both the HLU-319 List 4B and HRU for HDSL loss-of-sync conditions. Selecting 1LP causes the AIS pattern to be transmitted at both T1 outputs when either of the two HDSL loops experience a loss of sync word (LOSW) condition or when a margin alarm occurs. This causes the loss of the 12 channels on the surviving loop because they are replaced by the AIS pattern. However, it allows both down and upstream equipment to be made aware of the loss of one HDSL loop or of a loop with low margin. The 1LP selection is the preferred setting to initiate an AIS state with just one conductor open in either of the HDSL pairs. Short loops, below about 16 dB of loss at 200 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.

2LP requires both HDSL loops to be out of sync before the AIS signal is transmitted. This choice preserves the integrity of the 12 surviving channels when just one loop is lost.

Table 3. *HLU-319 List 4B System Setting Menu Options*

Option	Parameter	Description
Q	0*	Sets the equalizer to DSX-1 for 0 m to 40 m.
	133	Sets the equalizer to DSX-1 for 41 m to 80 m.
	266	Sets the equalizer to DSX-1 for 81 m to 121 m.
	399	Sets the equalizer to DSX-1 for 122 m to 162 m.
	533	Sets the equalizer to DSX-1 for 163 m to 200 m.

* Indicates HLU-319 List 4B factory (default) settings. *(Continued)*

Table 3. *HLU-319 List 4B System Setting Menu Options (Continued)*

Option	Parameter	Description
L	DIS	Configures the HiGain system to ignore the (2-in-5) in-band SmartJack loopback command.
	ENA*	Enables the HiGain system to recognize the (2-in-5) in-band SmartJack loopback command.
S	GNLB*	Configures the HiGain system to respond to the generic (3/4/5/6-in-7) in-band loopback codes.
(S cont)	A1LB and A2LB	Configures the HiGain system to respond to the Teltrend addressable repeater in-band loopback codes.
	A3LB	Configures the HiGain system to respond to the Wescom addressable repeater in-band loopback codes.
	A4LB	Configures the HiGain system to respond to the Wescom Mod 1 addressable repeater in-band loopback codes.
	A5LB	Configures the HiGain system to respond to the Teltrend Mod 1 addressable repeater in-band loopback codes.
P	DIS	Disables powering to the HRU-412 List 8B and doubler.
	ENA*	Enables powering to the HRU-412 List 8B and doubler.
Z	ON	Tells the HiGain system that the ESF frame is operating in its Zero Byte Time Slot Interface (ZBTSI) mode.
	OFF*	Tells the HiGain system that the ESF frame is operating in its normal non-ZBTSI mode.
R	17	Flashes the red Status LED when 17 Errored Seconds (ES) (17 HDSL cyclic redundancy check (CRC) errors on either HDSL loop or a total of 17 BPVs on DSX-1) occur within a 24 hour period.
	170	Flashes the red Status LED when 170 ES (170 HDSL CRC errors on either HDSL loop or a total of 170 BPVs on DSX-1) occur within a 24 hour period.
	NONE*	Prevents generation of a minor alarm due to excessive errored seconds.

* Indicates HLU-319 List 4B factory (default) settings. *(Continued)*

Table 3. *HLU-319 List 4B System Setting Menu Options (Continued)*

Option	Parameter	Description
T	NONE	Disables automatic time-out cancellation of all loopbacks, except SMJK.
	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.
A	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.
D	AUTO	The HLU-319 List 4B and HRU-412 List 8B 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-319 List 4B and HRU-412 List 8B into their B8ZS modes.
	AMI	Places both the HLU-319 List 4B and HRU-412 List 8B into their AMI modes.

* Indicates HLU-319 List 4B factory (default) settings. *(Continued)*

Table 3. *HLU-319 List 4B System Setting Menu Options (Continued)*

Option	Parameter	Description
F	AUTO*	Configures the HiGain 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 system can also process unframed data in this 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 the data integrity.
	UNFR	Configures the HiGain system to operate in an unframed mode. This mode disables the auto framing process and forces the HiGain system to function as a transparent bit pipe.
H	2LP*	Causes the HiGain system to transmit the AIS signal at both the HLU-319 List 4B and HRU-412 List 8B T1 output ports when both of the HDSL loops are not in-sync (LOSW).
	1LP	Causes the HiGain system to transmit the AIS signal at both the HLU-319 List 4B and HRU-412 List 8B T1 output ports when either of the two HDSL loops is not in-sync (LOSW) or if a MARGin alarm occurs.
M	ENA*	Causes the HRU-412 List 8B to transmit the AIS signal toward the Customer Interface (CI) when in NREM or SmartJack loopback.
	DIS	Causes the HRU-412 List 8B to transmit the signal from the network toward the CI when an HRU NREM or SmartJack loopback is executed. The AIS signal is off.
G	0 to 15 dB	The Margin Alarm Threshold must be set using a dumb terminal connected to the Craft port. The Margin Alarm Threshold determines the minimum allowable margin below which a minor alarm can occur. Note that setting the threshold to 0 inhibits the margin alarm.
	4 dB*	

* Indicates HLU-319 List 4B factory (default) settings. *(Continued)*

Table 3. *HLU-319 List 4B System Setting Menu Options (Continued)*

Option	Parameter	Description
B	BLK	The DS0 blocking option can only be set via the Craft port with a terminal. The four-character HLU-319 List 4B front panel display gives the status of the blocking option. BLK, on the front panel display, indicates at least one channel is blocked.
	NONE*	No channels are blocked.

* Indicates HLU-319 List 4B factory (default) settings. *(Continued)*

Power Consumption

The most important power demands of an HLU-319 List 4B on the shelf power supply are its maximum power consumption, its maximum power dissipation, and its maximum current drain. These three parameters for the HLU-319 List 4B are as follows:

- Maximum Power Dissipation: per slot = 4.0 Watts
- Maximum Power Consumption: per slot = 4.8 Watts
- Maximum Current Drain: per slot = 113 mA at -42.5 volts

Maximum Power Dissipation measures the power converted to heat buildup within the unit. It contributes to the total heat generated in the space around the unit. It determines the maximum number of fully loaded shelves per bay that does not exceed the maximum allowable power dissipation density in watts/sq. ft.

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.

Heat baffles should be placed between every shelf to deflects the rack’s heat outward and reduces thermo stress on the plugs.

LOOPBACK OPERATION

HiGain has a family of loopback options. The most important of these is the Smart Jack (SMJK) loopback which enables an HRU response to the standard (2/3-in-5) SMJK in-band loopback codes in emulation of standard Network Interface Device (NID) functions. This option can be enabled or disabled from the front panel using the MODE and SEL buttons or through the System Settings menu.

Generic Loopback Code (GNLB)

The HiGain generic loopback code is GNLB. The GNLB allows in-band codes to loop-up either the HLU/NLOC (4-in-7) or 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 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 five seconds before the HiGain system responds. Table 4 on page 36 lists the applicable test commands when using the GNLB mode.

The A1LB loopback selection, see Table 5 on page 39, complies with the T1E1.4/92 recommendation for HDSL systems, with the following additions:

- Query loopback
- IOR (Intelligent Office Repeater) 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. A1LB is given a separate identity to allow future T1E1 enhancements without affecting A2LB.

Addressable Repeater Loopback Functions

A HiGain system is capable of five special in-band loopback (SPLB) command sequences.

A2LB through A5LB are special addressable repeater loopback functions supported by the HLU-319 List 4B. These loopbacks provide the HiGain system with sophisticated maintenance and troubleshooting tools. 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 system 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)

A5LB differs from A2LB in that A5LB does not block the arming code from exiting the HLU-319 List 4B into the network. A2LB can be configured to block this arming code after two seconds and replace it with the AIS code, or to unblock it by executing the FAR-END ACTIVATE code. Since A5LB never blocks the arming code from exiting the HLU-319 List 4B, it does not need this FAR-END ACTIVATE code.

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

When the framing mode is set to UNFR and in-band commands are received in SF or ESF, a HiGain system may take longer than normal to respond to in-band loopback commands. The frame bits override the command bits and cause errors in the command sequence. These errors cause the HiGain system to reject some sequences.

Initiating Manual Loopback Sessions

The following are some general guidelines to keep in mind when executing a manual loopback session using the MODE and SEL buttons:

- Press the MODE button to present the next available loopback option. If a loopback is running, it remains active until the SEL button is pressed and another loopback is activated.
- If the MODE or SEL button is not pressed for 30 seconds and no loopback is in effect, the manual loopback session terminates and the the front panel display returns to normal mode.

- If a loopback is in effect, the 30 second time-out does not occur. The active loopback session continues until the loopback times out in accordance with the LBTO setting.
- Only the SMJK loopback can exist with other networks at any given time.
- When a loopback is active, pressing both buttons for three seconds terminates the loopback, ends the manual loopback session, and returns the front panel display to the normal mode.

To initiate a manual loopback session:

1 Simultaneously press the MODE and SEL buttons for at least three seconds. The following message appears on the front panel display:

`MAN LPBK`

followed by the message:

`NLO`

2 Do one of the following:

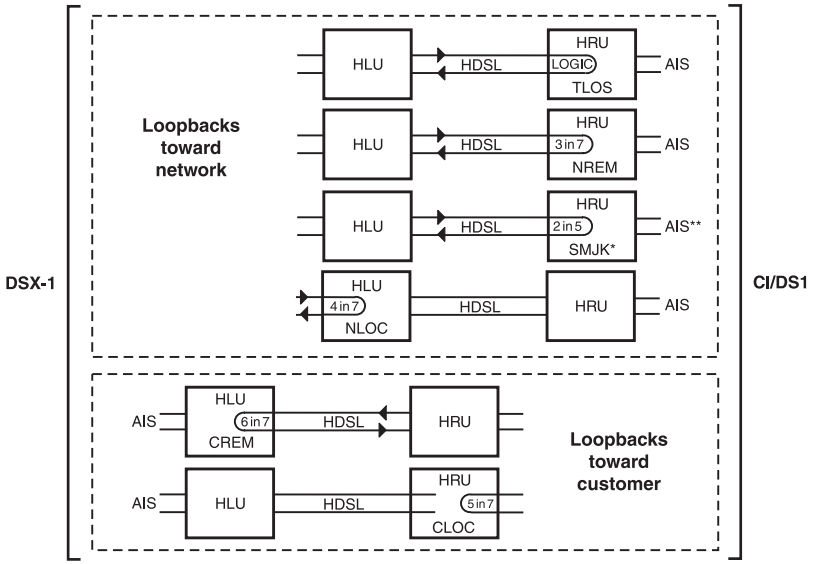
- To execute an NLOC loopback, press the SEL button. The message changes from `NLO` to `NLOC`.
- To execute an NREM loopback:
  - Press the MODE button. The message changes from `NLO` to `NRE`.
  - Press the SEL button to execute the NREM loopback.
- To execute a CREM loopback, press the MODE button again.
- To execute a CLOC loopback, press the MODE button a third time.

Note that these same loopbacks can be initiated from the Craft (RS-232) port by choosing the Option D, Loopback Mode, on the Main Menu.

All loopbacks, except the SMJK loopback, are initiated by in-band commands in the T1 payload or by a command from the HLU-319 List 4B (front panel buttons or maintenance screen selections). Initiate loopbacks using HG for the HLU-319 List 4B or PL for T1 payload on the Loopback Menu and Span Status screen.

Loopback Test Procedures

The loopback configurations are shown in Figure 4.



* The Smart-Jack loopback is a metallic loopback in the HRU-412, List 8B.

** Set the SAIS option to ENA to send the AIS pattern to the CI during Smart-Jack Loopback.

Figure 4. *HLU-319 List 4B Loopback Configurations*

These following loopback procedures verify the integrity of the HDSL channels at every module location as well as the DS1 channels to the customer and the local DSX-1 interface.

If trouble is encountered on the HLU-319 List 4B DSX-1 interface, verify that the HLU-319 List 4B is making a positive connection with its mounting assembly (shelf) connector. Also, verify that the HLU-319 List 4B internal equalizer is set to the correct distance range. All equalizers should be set to the distance from the DSX-1 to the shelf.

The transmit and receive T1 DSX-1 ports have splitting access and bridging miniature 210 series jacks. Connecting one cable between the two bridging

jacks and another between the two SPAN jacks splits the XMT and RCV and creates metallic loopbacks towards both the DSX-1 and the HLU-319 List 4B. If separate plugs are inserted into both SPAN jacks with their other end disconnected, the BRG jacks can be used to send and receive test patterns towards the DSX-1.

GNLB Loopback Test Procedures

To perform the GNLB loopback test procedure:

1 Have the CO tester send into the HLU-319 List 8B a (3-in-7) in-band loop up code for five seconds. Verify, if possible, that an NREM loopback is in effect. (Loopback states are indicated by the green LOOP LED on the front panel display and on the Span Status screen.)

2 Have the CO tester transmit a T1 test signal into the HLU-319 List 4B and verify that the returned (looped) signal is error-free.

3 If step 2 fails, have the CO tester transmit a (3-in-5) in-band loopdown code.

4 Have the CO tester send into the HLU-319 List 4B a (4-in-7) in-band loop up for five seconds. Verify that an NLOC HLU-319 List 4B loopback is in effect. (Loopback states are indicated by the green LOOP LED on the front panel display and on the Span Status screen.)

5 Repeat step 2. If the test passes, the problem is in the downstream direction. If it fails, the problem is in the upstream (CO) direction.

Notes on GNLB Loopback Test Procedures:

- The HLU-319 List 4B can be looped up from the remote location (CREM) by issuing the (6-in-7) command at the HRU-412 List 8B DS1 input port.
- The HRU-412 List 8B can be looped up from the remote location (CLOC) by issuing the (5-in-7) command at the HRU DS1 input port.

A1LB, A2LB, and A5LB Test Procedures

To perform the HLU-319 List 4B A1LB, A2LB, and A5LB test procedures:

1 Send the HLU-319 List 4B the in-band ARMING and NI LPBK code 11000 for at least five seconds.

2 Monitor the output of the HLU-319 List 4B for the return of the pattern. Return of the pattern indicates that:

- the HRU has looped up (if the SMJK loopback option is enabled)
- an external NI has looped up (if the SMJK loopback option is disabled) and that the HLU-319 List 4B and the HRU-412 List 8B are ARMED

3 Verify, if possible, that the HRU-412 List 8B Loopback LED is flashing, indicating that the HRU-412 List 8B is armed, or is lit steadily, indicating that it is both armed and in loopback.

4 Once armed, the HLU-319 List 4B can be looped back by sending Intelligent Office Repeater (IOR) LPBK activation code 1101 0011 1101 0011 (D3D3) for at least five seconds. The tester observes the following activation response, in the order shown below:

a two seconds of AIS (all 1s)

b five seconds of returning data pattern

c 231 logic errors (including the frame bit) occurring in the returned pattern comprising 20 errors if ILR-2 (HRU-412 List 8B) was sent

d normal looped data

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 ILR, Time-out Override, and Query commands.

Some Intelligent Repeater (IR) test sets do not count frame errors as bit errors when the test pattern is framed and the HLU-319 List 4B is set to the AUTO framing mode. To improve compatibility with those test sets, the HLU-319 List 4B generates 232 (NLOC) ID bit errors. The HLU-319 List 4B can indicate one more or one less bit error, depending on the test set type and the number of frame bits contained in the block of errored bits. To avoid this uncertainty, PairGain recommends sending the IR commands unframed.

The HLU-319 List 4B is now in Logic Loopback. The Loopback Time-out option is user settable to:

- NONE (0 minutes)
- 20 minutes
- 60 minutes
- 120 minutes

on the System Settings menu (Loopback Timeout option).

The loopback time option determines the duration of a 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 is repeated and the automatic timed expiration is inhibited. If this Time-out Override is sent, loop down the HLU-319 List 4B by:

- issuing the IR (Intelligent Repeater) LPDN (loop-down) code 1001 0011 1001 0011 (9393) or
- issuing the NI LPDN and Disarm code 11100

The automatic time-out timer is restored during subsequent loopback sessions.

5 Once the test is complete, do one of the following:

- If the system is to loopdown but remain ARMED, send the IR (Intelligent Repeater) LPDN code (universal loopdown).
- If all the equipment is to loopdown, disarmed and returned to normal operation, send the disarm code 11100.

The ARMED mode has an automatic time out of 120 minutes. The timer is reset to 120 for any of the following events:

- **loopback terminates (manually or time-out)**
- **query**
- **alternate query**
- **far end activate**
- **another ARM command**

Using the codes listed in Table 5 on page 39, a network tester can activate loopbacks NLOC or NREM or SMJK (if enabled). A customer tester can activate loopbacks CLOC or CREM. All loopbacks shown in Table 5 can be initiated from the HLU-319 List 4B front panel MODE and SEL buttons.

Table 4. *Addressable 1, 2, 5 (A1LB, A2LB, A5LB) Repeater Loopback Commands**

Name	Description	Code
ARMING or NI LPBK (in-band)	Arming code	11000 11000...
ARMING or NI LPBK (ESF Data Link)	Arming code	1111(F)**1111(F)0100(4)1000(8)
IR LPDN or DISARM (in-band)	Disarming code	11100 11100...
DISARM (ESF Data Link)	Disarming code	Disarming code
IOR LPBK (NLOC 230-232 bit errors) (CREM 229-231 bit errors)†	HLU Loop up	1101(D)0011(3)1101(D)0011(3) 1100C)0111(7)0100(4)0010(2)
ILR-2 LPBK (NREM and CLOC 20 bit errors)	HRU Loop up	1101(D)0101(5)1101(D)0101(5)
IR LPDN	Loopdown (HLU or HRU)	1001(9)0011(3)1001(9)0011(3)
IR QUERY LPBK	Query loopback	1101(D)0101(5)1101(D)0101(5)
IR ALTERNATE QUERY LPBK	Alternate Query loopback	1101(D)0101(5)1110(E)1010(A)

(Continued)

Table 4. *Addressable 1, 2, 5 (A1LB, A2LB, A5LB) Repeater Loopback Commands* (Continued)*

Name	Description	Code
TIME-OUT OVERRIDE	Loopback Time-out Override	1101(D)0101(5)1101(D)0110(6)
FAR END NI ACTIVATE	Unblock AIS and pass 2-in-5	1100(C)0101(5)0101(5)0100(4)
IOR POWER DOWN (HLU)	Removes HDSL line power	0110(6)0111(7)0110(6)0111(7)

* 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 system returns to its normal unlooped and unarmed state. Note that the entire arming and loopback sequence can be initiated at the remote HRU location.

** This is the HEX number for the 4-bit group.

†The HRU identifies CREM with 231 bit errors, including the frame bits. When framed data is being sent in the AUTO framing mode, the number of the 231 bit errors detected by the test set varies from 229 to 231, depending on whether or not the test set counts frame errors as bit errors, and on the number of frame bits contained in the block of 231 error bits.

‡The HRU generates this bit pattern in a series of discontinuous bursts containing 20 bit errors each, including frame bits. Those test sets that do not count frame error bits as data bit errors will indicate fewer bits than the HRU transmits for this CI loopback.

A3LB and A4LB Test Procedures

The HLU-319 List 4B can provide a local loopback (NLOC) by sending the Addressable Office Repeater (AOR) LPBK activation code 1111(F) 1111(F) 0001(1) 1110(E) for at least five seconds. This causes the HLU-319 List 4B to enter the NLOC state. The Loopback Time-out option is user settable to:

- NONE (0 minutes)
- 20 minutes
- 60 minutes
- 120 minutes

on the System Settings menu (Loopback Timeout option).

The loopback time option determines the duration of a loopback unless it is overridden by the reception of a second identical 16-bit loop-up command before the timer expires. When the time-out override state exists, the only way to loop down the HLU-319 List 4B is to issue one of the three loopdown commands. The automatic time-out mode is restored during subsequent loopback sessions.

Table 5 summarizes the executable codes for HiGain loopbacks. Note that all code sequences must be present for at least five seconds. The abbreviations used in the table are as follows:

- LU = LoopUp
- LD = LoopDown
- NI = Network Interface
- CI = Customer Interface
- ESF-DL = Extended Super Frame-Data Link

Table 5. *Addressable 3 and 4 (A3LB and A4LB) Repeater Loopback Commands**

Position	Name	Code
HLU-319 LU FROM NI	NLOC	1111(F)**1111(F)0001(1)1110(E)
HLU-319 LU from CI	CREM	0011(3)1111(F)0001(1)1110(E)
HRU LU FROM NI	NREM	1111(F)1111(F)0000(0)0010(2)
HRU LU FROM CI	CLOC	0011(3)1111(F)0000(0)0010(2)
HRU LU FROM NI	SMJK	11000 11000 11000...
HRU LU FROM NI	SMJK	100000 100000 100000...
HRU LU FROM NI (ESF-DL)	SMJK	1111(F)1111(F)0100(4)1000(8)
HLU and HRU LD FROM NI OR CI	Loopdown	11100 11100 11100...
HLU and HRU LD FROM NI OR CI	Loopdown	100 100 100...
HLU and HRU LD FROM NI OR CI (ESF-DL)	Loopdown	1111(F)1111(F)0010(2)0100(4)

* 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. Note that the entire arming and loopback sequence can be initiated at the remote HRU location.

****** The number in ( ) identifies the HEX number for the 4-bit group.

HiGain Terms

Table 6 lists common HiGain terms.

Table 6. *HiGain Terms*

Term	Definition
Margins	Indicates the excess signal-to-noise ratio, at either the HRU-412 List 8B or HLU 319 List 4B HDSL ports, relative to a 10^{-7} Bit Error Rate. First value is current margin. Second value is minimum margin since (C)leared last. Third value is maximum value since cleared. NA means 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 attenuation in excess of 30 dB. This value is related to the 196 kHz cable pairs 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 1 to 32 dB.
PPM	Indicates the relative offset of the crystal oscillator in the HRU-412 List 8B from the HLU-319 List 4B 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 Hours ES (Errored Seconds)	The number of one second intervals containing at least one HDSL CRC error. This value is a running total of the last 24 hours.
HDSL 24 Hours UAS (Unavailable Seconds)	The number of seconds the HDSL loop was out-of-sync.
DS1 BPV Seconds (Errored Seconds)	The number of seconds where least one bipolar violation was detected on the T1 input.
DS1 UAS Count	The number of seconds during which the T1 input signal was absent (125 or more consecutive 0s).
Frame Type	Type of T1 framing input stream (SF, ESF, Unframed or No Activity).

(Continued)

Table 6. *HiGain Terms (Continued)*

Term	Definition
Code Type	Type of T1 line coding used (AMI, B8ZS, AMI:ZBTSI or B8ZS:ZBTSI). The latter two conditions indicate the receiving line code is set to its ZBTSI mode. In AMI or B8ZS conditions, the code type displays the user-selected code, rather than the type of code that is actually being received. (The user selected code is displayed when in the AUTO mode.)
HLU/Ver w.x-y	"w.x" = software version number of the HLU-319 List 4B. "y" = list number of HLU-319 List 4B.
HRU/Ver a.b-c	"a.b" = software version number of the HRU-412 List 8B. "c" = list number of HRU-412 List 8B.

FRONT PANEL MESSAGES

Table 7 lists the front panel four-character messages.

Table 7. *HLU-319 List 4B Four-Character Front Panel Messages*

Message	Full Name	Description
CREM	Customer Remote Loopback	Signal from customer is looped back to customer at HLU-319 List 4B.
NLOC	Network Local Loopback	DSX-1 signal is looped back to DSX-1 at HLU-319 List 4B.
CLOC	Customer Local Loopback	Signal from customer is looped back to customer at HRU-412 List 8B.
NREM	Network Remote Loopback	DSX-1 signal is looped back to DSX-1 at HRU-412 List 8B.
SMJK	Remote SmartJack Loopback	DSX-1 signal is looped back to DSX-1 at HRU-412 List 8B.

(Continued)

Table 7. *HLU-319 List 4B Four-Character Front Panel Messages (Continued)*

Message	Full Name	Description
TLOS	Transmit Loss Of Signal	HRU-412 List 8B is in a logic loopback state, caused by a loss of its DS1 input from the CI, when enabled at the HRU-412 List 8B via its TLOS switch option.
FERR	Framing Bit Error occurred	Framing bit error occurred at HLU-319 List 4B DSX-1 input.
LBPV	Local Bipolar Violation	A bipolar violation has been received at the DSX-1 input to the HLU-319 List 4B.
SIG1	Signal 1	The HLU-319 List 4B and HRU-412 List 8B transceivers are trying to establish contact with each other on loop 1.
SIG2	Signal 2	The HLU-319 List 4B and HRU-412 List 8B transceivers are trying to establish contact with each other on loop 2.
ACQ1	Acquisition 1	The HLU-319 List 4B and HRU-412 List 8B multiplexers are trying to establish synchronization over loop 1.
ACQ2	Acquisition 2	The HLU-319 List 4B and HRU-412 List 8B multiplexers are trying to establish synchronization over loop 2.
H1ES	HDSL CRC Error Channel 1	HLU-319 List 4B HDSL loop 1 CRC error.
H2ES	HDSL CRC Error Channel 2	HLU-319 List 4B HDSL loop 2 CRC error.
ARM	HiGain 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-319 List 4B front panel.

(Continued)

Table 7. *HLU-319 List 4B Four-Character Front Panel Messages (Continued)*

Message	Full Name	Description
SELF-TEST	Self-test	The HLU-319 List 4B is in a self-test mode. This occurs every power on/off cycle.
ALRM	Alarm condition exists	A minor alarm condition is in effect.
1=xx	HDSL Loop 1 Margin	Indicates the power of the received HDSL signal on loop 1 relative to noise. Any value of 6 or greater is adequate for reliable system operation.
2=yy	HDSL Loop 2 Margin	Indicates the power of the received HDSL signal on loop 2 relative to noise. Any value of 6 or greater is adequate for reliable system operation.
PWR FEED SHRT	Power Feed Short	Indicates a short between the two HDSL pairs. This same message can occur with an HRU-412 List 8B which is drawing the correct amount of power over good cable pairs, but can not communicate with the HLU-319 List 4B.
PWR FEED OPEN	Power Feed Open	Indicates an open circuit in the transmit (T) and receive (R) of either HDSL pair.
PWR FEED OFF	Power Feed Off	HDSL span power has been turned off by setting the PWFD option to DIS.
BAD RT?	No response from HRU-412 List 8B	The HLU-319 List 4B does not receive any response from the HRU-412 List 8B. Thus, the HRU's integrity is questionable.
VER XXXX	HLU-319 List 4B software Version number	This is displayed during the System Settings review mode. Depress the Mode button for three seconds.
LIST XXXX	HLU-319 List 4B List number	Displayed during System Settings review mode.
FRM	Frame: SF, ESF, UNFR, None	Defines the type of frame pattern being received from the DSX-1. Displayed during System Settings review mode.

(Continued)

Table 7. *HLU-319 List 4B Four-Character Front Panel Messages (Continued)*

Message	Full Name	Description
CODE	Line Code: AMI, B8ZS	The line code that HLU-319 List 4B 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.
LOSW	Loss of Sync Word	Indicates that one of the HDSL loops 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-319 List 4B. Causes a minor alarm.
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the DSX-1 input to the HRU-412 List 8B. Causes a minor alarm.
DS1	DS1 BPV Errors	Indicates that the number of BPVs at the HLU-319 List 4B or HRU-412 List 8B 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.
MAL1	Margin Alarm Loop 1	The margin on HDSL loop 1 has dropped below the threshold (0 to 15 dB) set by the user.
MAL2	Margin Alarm Loop 2	The margin on HDSL loop 2 has dropped below the threshold (0 to 15 dB) set by the user.
MNGD	Managed	The HLU-319 List 4B is under control of the HMU-319 List 5B network management unit. In this state, the Craft port on the HLU-319 List 4B front panel is inoperative.

CERTIFICATION AND WARRANTY

The HLU-319 List 4B is VCCI certified and UL listed. Information on certification and warranty is shown below.

VCCI Certification

This equipment has been tested and found to comply with the limits for VCCI Class A Requirements. 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 this instruction manual, may cause harmful interference to radio communication.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

UL Listing

The HLU-319 List 4B is listed with the Underwriter Laboratory.

Use caution when installing or modifying telephone lines. Dangerous voltages may be present. Do not install telephone wiring during a lightning storm. Always disconnect telephone lines and power connections from wall outlets before servicing or disassembling this equipment.

All wiring external to the product should follow the provisions of the current edition of the National Electrical Code.

Warranty

PairGain Technologies, Incorporated warrants its products to be free of defective and faulty workmanship for a period of 60 months, under normal use, from the date of shipment. PairGain's obligation, under this warranty, is limited to replacing or repairing, at PairGain's option, any such product which is returned during the warranty period per PairGain's instructions and which product, in PairGain's sole opinion, is determined to be defective upon examination at our plant.

The transportation charges from the Buyer to PairGain will be prepaid by the Buyer. When the equipment is shipped back to the Buyer, PairGain will pay the charges, unless no trouble is found (NTF), in which case the buyer will pay for the shipment.

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

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

Modules sent to PairGain for repair will be repaired or replaced and returned to you as soon as possible. Normally, current products are repaired within 14 calendar days, and out-of-production products are repaired within 30 calendar days.

TECHNICAL SUPPORT

PairGain provides technical support by phone, fax, and the World Wide Web.

Phone or Fax

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

A Customer Service Engineer answers technical assistance calls Monday through Friday between 8:00 AM and 5:00 PM, Pacific Time, excluding holidays. At all other times, an on-duty Customer Service Engineer returns technical assistance calls within 30 minutes.

Returns

To return equipment to PairGain:

1 Locate the number of the purchase order under which the equipment was purchased. You will need to provide this number to PairGain Customer Service to obtain a return authorization.

2 Call or write PairGain Customer Service to ask for a Return Material Authorization (RMA) number and any additional instructions. Use the telephone or fax number listed below:

- Telephone: (800) 370-9670
- Fax: (714) 730-2961

3 Include the following information, in writing, along with the equipment you are returning:

- Company name, address, and the name of a person PairGain can contact regarding this equipment.
- The purchase order number provided to Customer Service when the RMA number was requested.

- A description of the equipment, as well as the number of units that you are returning. Be sure to include the model and part number of each unit.
- The shipping address to which PairGain should return the repaired equipment.
- The reason for the return:

  a) The equipment needs an ECO/ECN upgrade.

  b) The equipment is defective.

If the equipment is defective, please tell us what you observed just before the equipment malfunctioned. Be as detailed in your description as possible.

  c) If there is another reason for returning the equipment, please let us know so we can determine how best to help you.

4 Pack the equipment in a shipping carton.

5 Write PairGain's address and the Return Material Authorization Number you received from Customer Service clearly on the outside of the carton:

PairGain Technologies, Inc.
14352 Franklin Ave.
Tustin, CA 92780-7013

Attention: **CRF RMA (Number)**

World Wide Web

PairGain product, company, and application information can be found at http://www.pairgain.com using any Web browser.

Corporate Office
14402 Franklin Avenue
Tustin, CA 92780
Tel: (714) 832-9922
Fax: (714) 832-9924
For Technical Assistance:
(800) 638-0031

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