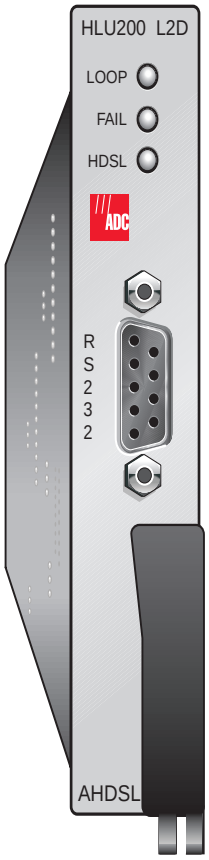
HiGain

USER MANUAL



HLU-200 List 2D Line Unit
Litespan-2000 Channel Bank
Product Catalog: 150-200-124-02
CLEI: SLILNSYA

Revision History of This Manual

To order copies of this document, use document catalog number 150-200-124-02.

Issue	Release Date	Revisions Made
1	February 10, 1999	Initial release
2	April 12, 2002	ADC Rebranding

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February 10, 1999

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USING THIS MANUAL

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

Notes contain information about special circumstances.

Cautions indicate the possibility of personal injury or equipment damage.

The Electrostatic Discharge (ESD) symbol indicates that a device or assembly is susceptible to damage from electrostatic discharge.

INSPECTING SHIPMENT

Upon receipt of the equipment:

- Unpack each container and inspect the contents for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to ADC DSL Systems, Inc. Order replacement equipment, if necessary.
- Check the packing list to ensure complete and accurate shipment of each listed item. If the shipment is short or irregular, contact ADC DSL Systems, Inc. as described in Product Support on page 44. If you must store the equipment for a prolonged period, store the equipment in its original container.

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OVERVIEW

The HiGain® HLU-200 List 2D is a HiGain Line Unit (HLU) that plugs into any channel unit slot of a Litespan® 2000 Channel Bank Assembly (CBA). Within Litespan, it is called an Asynchronous High-bit-rate Digital Subscriber Line (AHDSL) channel unit. When plugged into the CBA and paired with a HiGain Remote Unit (such as an HRU-412), the HLU-200 provides an AHDSL interface capable of 1.544 Mbps transmission on two unconditioned copper pairs over the full Carrier Service Area (CSA) range. (This includes loops of up to 12,000 feet of 24 American Wire Gauge [AWG] or 9,000 feet of 26 AWG, including bridged taps.)

The HiGain system uses High-bit-rate Digital Subscriber Line (HDSL) transmission technology as recommended by Bellcore TA-TSY-001210 and complies with the requirements found in TR-TSY-000063 (Network Equipment Building System [NEBS] generic equipment requirements) and TR-TSY-000499 Transport System Generic Requirements (TSGR).

FEATURES

The HLU-200 List 2D has the following features:

- Lightning and power-cross protection on HDSL interfaces
- 784 kbps full-duplex 2 Binary, 1 Quaternary (2B1Q) HDSL transmission on two pairs
- Front panel status Light Emitting Diodes (LEDs)
- Margin threshold alarm
- Low power consumption
- Compatible with the Litespan 2000 integrated management system called Litecraft™ Pro.

APPLICATIONS

The HiGain system provides a cost-effective, easy-to-deploy method for delivering T1 high capacity service over two unconditioned, non-loaded copper pairs. Conventional in-line T1 repeaters, cable pair conditioning, pair separation, and bridged tap removal are not required. For typical HLU-200 applications see Figure 1 on page 2.

General guidelines require the HDSL loop to have less than a 35 dB loss at 196 kHz with 135Ω driving and terminating impedances and to otherwise comply with CSA guidelines. The HiGain system operates with any number of other T1, Plain Old Telephone Service (POTS), Digital Data Service (DDS), or other HiGain systems sharing the same cable binder group. HiGain systems can be used for customers requiring Digital Signal, Level 1 (DS-1) service on a temporary or permanent basis. The HiGain system also provides a means of quickly deploying service in advance of fiber-optic transmission systems. With the HiGain system, service can be provided within hours. Fiber optic systems can then be installed over time to be cut in when convenient to do so. After fiber optic installation and connection, the HiGain system can be easily removed and utilized elsewhere.

The HLU-200 operates as a channel card within an Alcatel Litespan 2000 Channel Bank. The Litespan 2000 system consists of a Central Office (CO) bank connected to a remote bank over an OC3 fiber link. Each bank has slots for 56 channel plug-in cards. Typically, the HLU-200 List 2D is installed in the remote bank where it is used to transmit a T1 payload to a remote HRU over two unconditioned HDSL cable pairs (with or without doublers). This HLU-200 is equivalent to an AT1U channel unit (used to transmit a T1 payload to a remote location over conventional T1 spans).

The HLU-200 List 2D is compatible with Litespan 2000 system software (Release 8.2 and later) and the TL1 based Litecraft Integrator Management System; the unit must be maintained, provisioned, and monitored from the Litecraft/TL1 since it cannot be managed from the front panel RS-232 craft port. (The front panel RS-232 craft port is used only for factory testing.) The HLU-200 List 2D works asynchronously with the Litespan bank timing.

The HLU-200 can be cross-connected to another HLU-200 or to any asynchronous T1 channel unit including an HLU-200 List 1D (AHT1U), within its own channel bank or a distant channel bank (as shown in Figure 1). In this arrangement, test access at either the remote or local ends can be accomplished by use of ADS1U and AT1U line cards. These point-to-point dedicated circuits are initiated by issuing the standard TL1-based cross-connect commands or Litecraft commands to the Maintenance and Test Interface (MTI) card, which identifies the HLU-200 List 2D as an AHDSL plug.

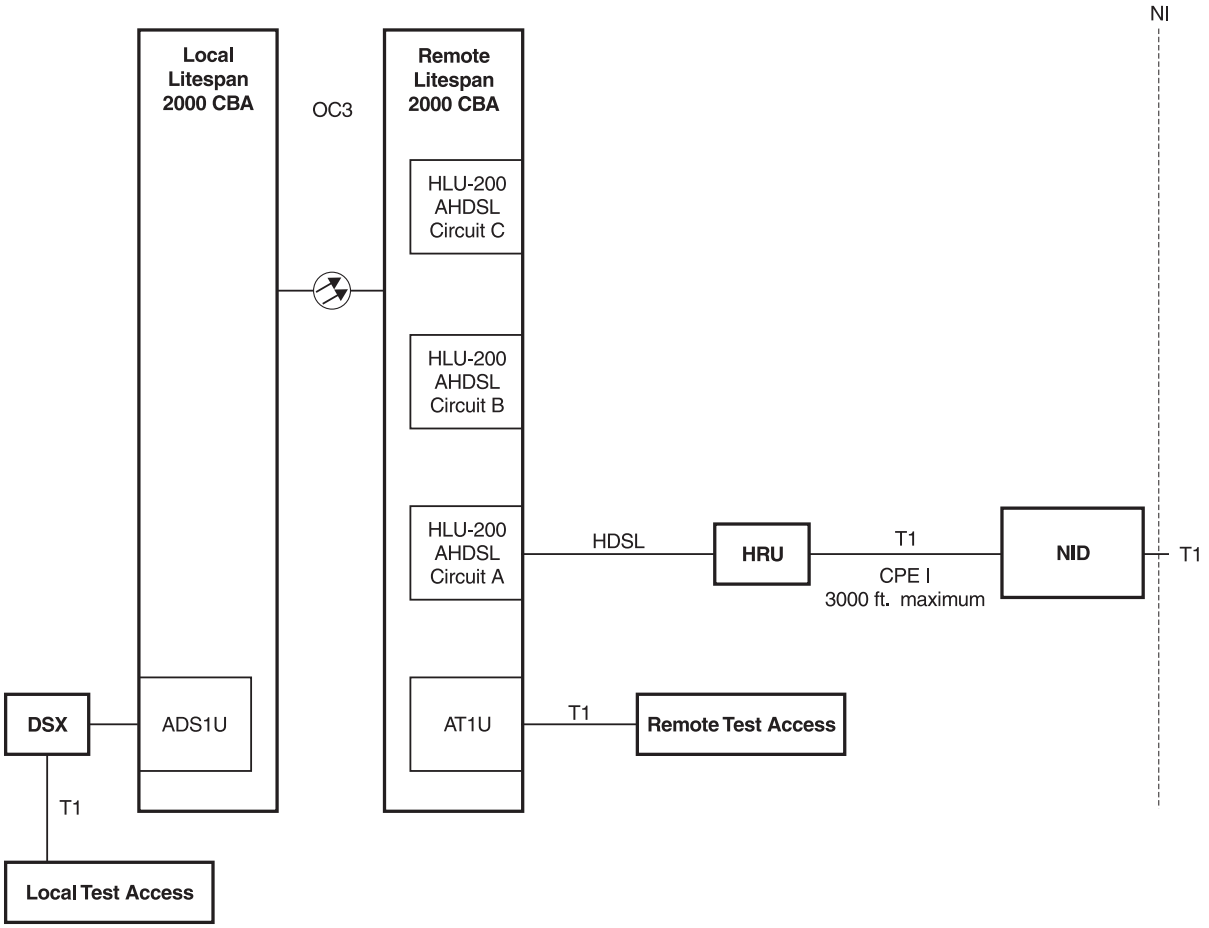


Figure 1. *HLU-200 List 2D Typical Applications*

Figure 1 shows a typical AHDSL application. As shown in Circuit A, the HRU can be placed up to 3000 feet from the network for extra range. This requires an external Network Interface Device (NID) to be placed at the Network Interface (NI). The HRU must have the SmartJack (SMJK) Loopback (LPBK) option (NIDLPBK) set to Disable for these external NID applications. Since the Litecraft Version 2.0 management system does not recognize doublers, it cannot be used to provision, maintain or monitor the HLU-200 List 2D doubler applications.

POWER PARAMETERS

Table 1 lists the HLU-200 List 2D current drain on the 4 CBA power supplies, its power consumption, and its dissipation. The same parameters are shown for two other higher power CBA plugs (the AT1U and REBS) for comparison.

The maximum power dissipation measures the power that is converted into heat build up within the unit. It contributes to the total heat generated in the space around the unit.

The maximum power consumption is the total power that the HLU-200 List 2D consumes or draws from the CBA power buses. This parameter is needed when the Litespan 2000 is battery powered. It determines the battery capacity required to maintain an 8-hour standby battery reserve for emergency situations.

Table 1. *HLU-200 List 2D Power Parameters*

Power Bus	HLU-200 I-CPE[a] Off	HLU-200 I-CPE On	HLU-200 HRU Local Power	AT1U	REBS
+5v	590 mA	590 mA	590 mA	147 mA	155 mA
-5V	66 mA	66 mA	66 mA	0 mA	191 mA
-48V SW Battery	133 mA	200 mA	0 mA	60 mA	0 mA
-48V Talk Battery	0 mA	0 mA	0 mA	0 mA	109 mA
Power Consumption	9.33 W	12.6 W	2.9 W	3.6 W	7 W
Power Dissipation	4.23 W	4.88 W	2.9 W	3.6 W	6.3 W

(a) Customer Premise Equipment (current option in the HRU)

COMPATIBILITY

This practice describes the functionality of the HLU-200 List 2D with Version 2.0 of Litecraft. This version of Litecraft has several deficiencies which are identified in the following pages of this document:

- DISC-JACK command in Table 4 on page 10
- Margin Threshold on page 21
- "HDSL Performance Monitoring" on page 24
- Release Loopback Test command on page 30

The HLU-200 List 2D is compatible with the following channel bank management systems:

- Alcatel Litespan 2000, Version 8.2 or later
- Litecraft, Version 2.0 or later

PRODUCT DESCRIPTION

Figure 2 shows the front panel of the HLU-200 List 2D card. The front-panel components are described in Table 2.

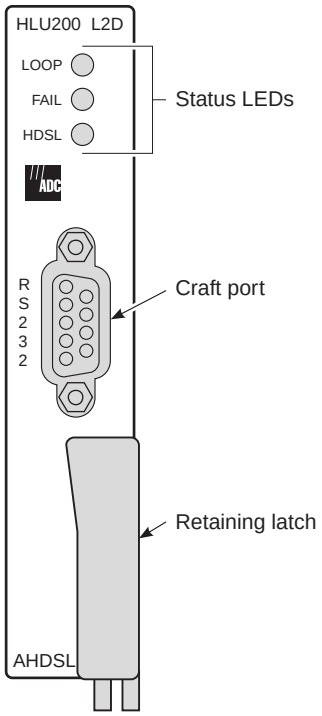


Figure 2. *HLU-200 List 2D Front Panel*

Table 2. *Front-Panel Features*

Features	Function
Status LEDs	Loop, Fail, and HDSL (see Table 3 for status LED descriptions)
RS-232 craft port	Communication port for factory test only.
Retaining latch	Retains the card in the shelf. Pull down to remove the card from the shelf.

Table 3 describes the functions of the Status LEDs on the front panel.

Table 3. *HLU-200 List 2D Status LED Descriptions*

LED Status	Description
Loop	Flashes Green whenever any of the HLU-200 List 2D loopbacks are in effect (see "Loopback Operation" on page 27).
Fail	Flashes Red and is controlled by the bank. It lights when the HLU-200 is first plugged into the bank and remains on until the bank has finished its program download and hand-shake with the HLU-200. It also lights whenever there is a service-affecting failure within the bank.
HDSL	A tri-colored LED that: • Flashes Green during HDSL sync acquisition on either HDSL loop • Flashes Red for any of the alarm conditions described in Table 8 on page 26 • Is steady Green when both HDSL loops are in sync and no minor alarms exist • Is steady Red if the on-board 48 V fuse opens • Is steady Yellow during self-test

FUNCTIONAL DESCRIPTION

The HiGain system uses ADC's 2B1Q HDSL transceivers to establish two full-duplex 784 kbps data channels between the HLU-200 and an HRU remote unit. This provides a total capacity of 1.568 Mbps between the two units.

A block diagram of the HLU-200 List 2D is shown in Figure 3 on page 6. The Litespan gate array circuit controls the exchange of the 1.544 Mbps data payload between the backplane and the "2180" T1 framer. The 2180 processes the T1 data and reorganizes Super Frame (SF) or Extended Super Frame (ESF) format. It also performs Alternate Mark Inversion (AMI) and Bipolar with 8-zero Bit Substitution (B8ZS) coding and decoding and hands the T1 payload off to the HDSL framer.

The header port J1 is used to download the boot loader to the Litespan microprocessor during factory testing. This provisions the microprocessor to communicate to the CBA and allows it to be recognized and initialized by the bank's common control equipment.

The Test Loop feature allows metallic test access to the two facility cable pairs as shown in Figure 3.

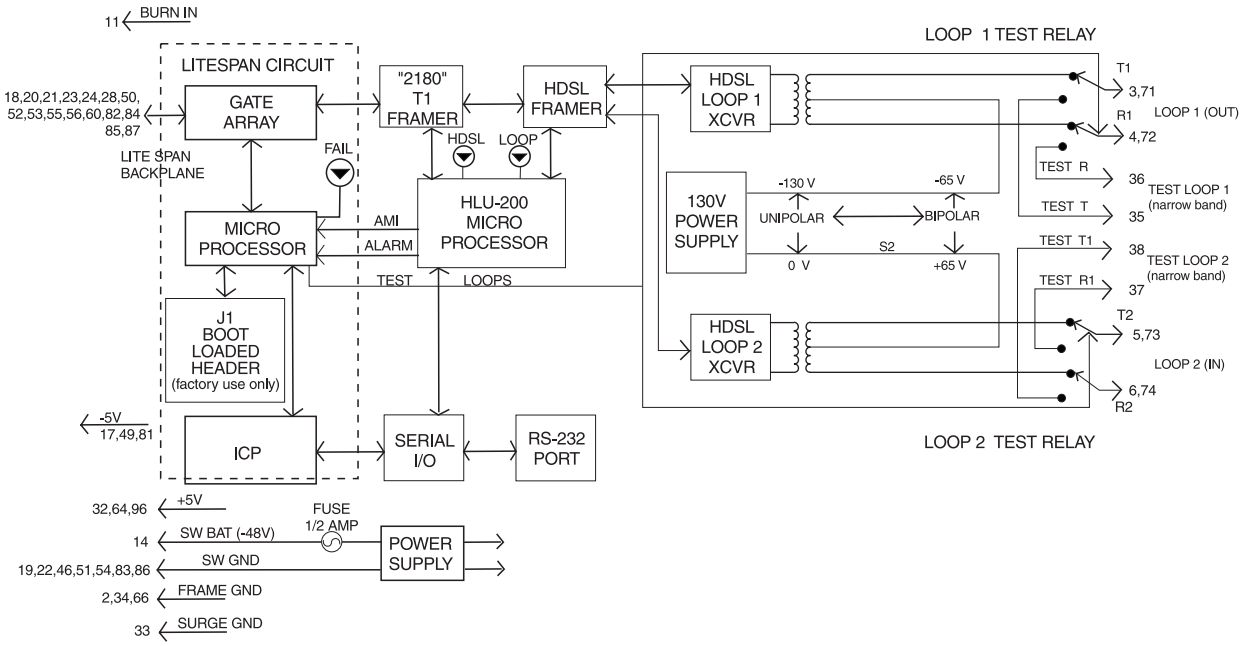


Figure 3. *HLU-200 List 2D Block Diagram*

The HLU-200 List 2D contains an HDSL framer 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 DS-1 payload. The DS-1 stream is separated into two parallel streams that comprise the payloads of the 2 HDSL loops. The HLU-200 List 2D allocates the DS0 time slots according to the version of HRU to which it is connected. Older version HRUs require the odd DS0 time slots allocated to Loop 1 and the even DS0 time slots to Loop 2. Newer versions allocate DS0 time slots 1 through 12 to Loop 1, and time slots 13 through 24 to Loop 2. The 8 kbps frame bits of the DS-1 stream are included on both HDSL channels. The two formatted HDSL channels are passed to the HDSL transceivers which convert them to 2B1Q format for application to 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 data is processed by the transceivers and then passed on to the HLU-200 framer module. The framer provides frame synchronization for each of the two HDSL loops. The framer and HDSL transceivers work under control of the HLU-200 microprocessor and compensate for data inversions caused by Tip-Ring reversals and for loop swaps caused by pair reversals. The HiGain system allows for Tip-Ring or pair reversals, but does not tolerate split pairs. By synchronizing to the Frame Sync Word (FSW) of each loop, the framer can reconstruct the original 1.544 Mbps DS-1 stream from the payloads of the two HDSL loops. The CRC fields on the HDSL streams allow the HLU-200 List 2D to determine if errors are present on the loop due to excessive impairments on the HDSL pairs, or due to excessive impulse or crosstalk noise.

The framer 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-200 List 2D and the HRU-412 remote unit.

The reconstructed HDSL data is buffered in a First-in-First-Out (FIFO) buffer within the framer. A frequency synthesizer in conjunction with the FIFO regulates the output bit rate and reconstructs the DS-1 clock at the exact rate received from the remote end. The HiGain system operates at DS-1 rates of 1.544 Mbps with up to ±200 bps of offset. The HLU-200 List 2D line power supply converts the -48 Vdc battery to a -130 Vdc which provides simplex power feed on the two HDSL line interfaces.

The symmetry of the HDSL line powering voltage can be set by the S1 switch, located on the printed circuit board, as shown in Figure 4.

The factory default setting is UNI (-). It sets the HDSL line voltage to 0V on Loop 2 and to -130V on Loop 1. This setting keeps the HDSL cable pair voltages at or below ground potential, thereby avoiding corrosion problems caused by cable voltages more positive than ground.

The bipolar selection BIP (±) sets the HDSL line voltage to +65V on Loop 2 and -65V on Loop 1. This setting reduces the maximum ground referenced voltage, but applies positive voltage to Loop 2, which could accelerate corrosion.

The line voltage power supply, used for both options, is ground referenced, but also ground isolated by 200 kΩ. This ground isolation reduces problems due to induced noise currents and large surge voltages, which are ground referenced. It also reduces ground fault currents, which improves the product's safety. The safety issue thus depends solely on the differential voltage across Loop 1 and Loop 2, and is independent of the S1s setting.

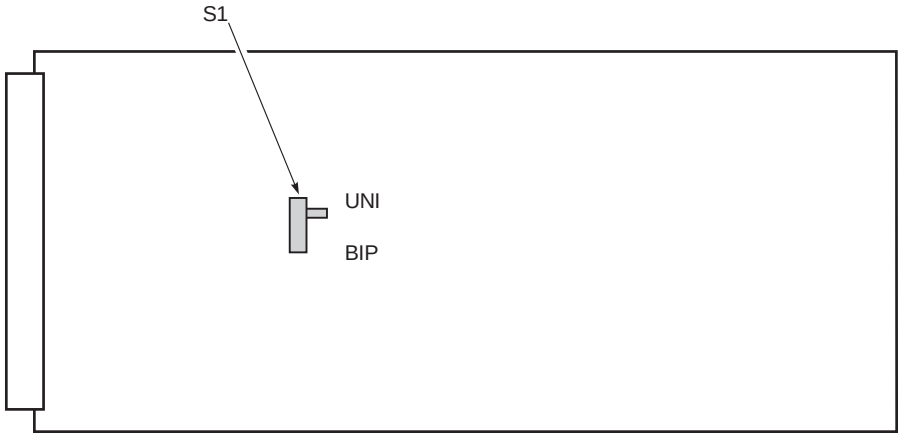


Figure 4. *HDSL Line Voltage Switch S1*

INSTALLATION

This section explains how to install the HLU-200 card into a compatible CBA. The HLU-200 mounts in a Litespan 2000 CBA.

INSTALLING THE HLU-200

To install the HLU-200, follow these steps:

1 Hold the HLU-200 along the edges of the card. Avoid contact with connectors and chips.

2 Slide the card into the guides for the desired slot.

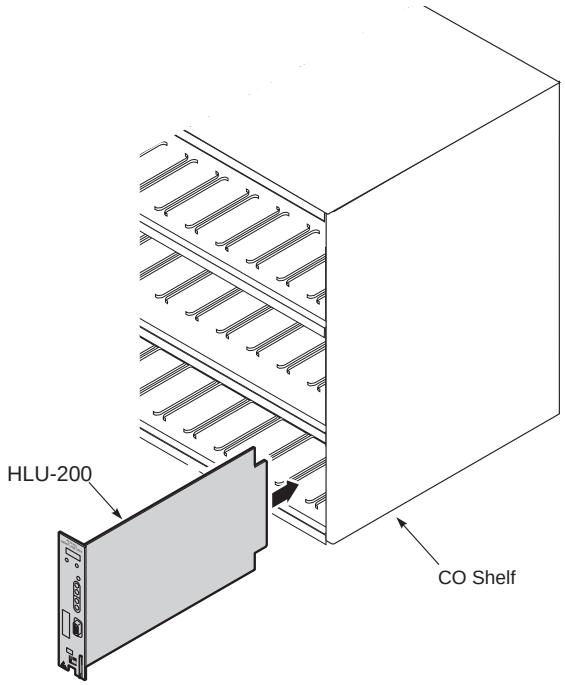


Figure 5. *Installing the HLU-200 into a Litespan 2000 CBA*

3 Push the card all the way into the CBA slot until the edge connector of the card becomes seated into the slot connector on the backplane of the CBA.

REMOVING THE HLU-200

If the HLU-200 List 2D is removed from a slot, it must not be reinserted for at least 15 seconds. Reinserting it sooner may temporarily lock the HLU-200 List 2D into an unstable state.

The dormant state occurs because the rapid re-insertion inhibits the CBA's ability to detect the unit's removal. The CBA must find the slot empty for three consecutive polling inquiries before it declares the slot empty. If the unit is removed and re-inserted before three polling periods occur, the CBA does not detect the removal and the unit enters a dormant state. This dormant state remains until the CBA performs an audit. Such an audit can take up to an hour to occur if the CBA is fully loaded.

This dormant state is easy to detect since a dormant unit's Fail LED remains on and does not change it's state within 15 seconds after insertion, as a normal unit does.

MANAGING THE HLU-200

The AHDSL unit can only be managed from either of the two Litespan 2000 integrated management systems: TL1 or Litecraft.

This AHDSL unit cannot be managed from the front panel RS-232 craft port. This port is for factory testing purposes only.

Access to Litespan management systems can be established by connecting a maintenance terminal, dial-up modem, or X.25 packet network directly to the RS-232 connector on either the front panel of the MTI board or the Fuse and Alarm panel. For more information, refer to the *TL1 Command Set Reference* or *Litecraft Reference Practice*.

Version 8.x of Litespan introduces a new management interface called Litecraft. Litecraft is Windows-based Graphic User Interface (GUI) based on standard TL1 Litespan system commands. The various Litecraft (TL1) commands that apply to the AHDSL line unit fall into the following categories:

- **Administration**: used to remove or restore the AHDSL unit to service, perform cross connectors, place equipment and facilities in and out of service (IS/OOS) and system inventory.
- **Provisioning**: used to set all of the AHDSL user options and parameter threshold values.
- **Monitoring**: used to clear and retrieve Performance Monitoring (PM) data and also to retrieve alarms.
- **Testing**: used to initiate and terminate loopbacks and to disconnect the HDSL pairs for testing by the Maintenance Test Access Unit (MTAU).

The TL1 and Litecraft related commands, for all but the Provisioning category, are shown in Table 4 on page 10.

Table 5 on page 11 lists HiGain Provisioning options supported by the AHDSL and relates these options to their corresponding Litecraft/TL1 commands. Table 6 on page 12 defines the HiGain system options supported by the HLU-200.

Table 4. *AHDSL-TL1/Litecraft System Commands*

Category	TL1 Commands	Litecraft Parameters	Litecraft Choices	HiGain Options	HiGain Choices
Testing	OPR-LPBK-HDSL	LOCN/R	NEND	Loop Up	NLOC
	OPR-LPBK-HDSL	LOCN/C	NEND	Loop Up	CLOC
	OPR-LPBK-HDSL	LOCN/R	FEND	Loop Up	NREM
	OPR-LPBK-HDSL	LOCN/C	FEND	Loop Up	CREM
	RLS-LPBK-HDSL	LOCN/R	NEND	Loop Down	NLOC
	RLS-LPBK-HDSL	LOCN/C	NEND	Loop Down	CLOC
	RLS-LPBK-HDSL	LOCN/R	FEND	Loop Down	NREM
	RLS-LPBK-HDSL	LOCN/C	FEND	Loop Down	CREM
	CONN-JACK-T1	Disconnects Loop 1 and Loop 2 from the HLU-200 for testing cable pairs			
	DISC-JACK-T1	Reconnects Loop1 and Loop 2 pairs to the HLU-200			
Administration	RMV-HDSL	Removes the AHDSL from service (OOS)			
	RST-HDSL	Restores the AHDSL to service (IS)			
	ENT-EQPT	Enter or assign a unit to a slot position			
	DLT-EQPT	Delete or unassign a unit to a slot position			
	ENT-CRS-T1	Initiate a cross connection			
	DLT-CRS-T1	Delete a cross connection			
	ED-T1 or ED-HDSL	Edits the equipment			
Monitoring	INIT-REG-HDSL	Clears the PM and sets all values to 0			
	RTRV-PM-HDSL	Retrieves PM data			
	RTRV-ALRM-HDSL	Retrieves alarms			

Table 5. *AHDSL-TL1/Litecraft Provisioning Commands*

TL1 Commands	Litecraft Parameters	Litecraft Choices	HiGain Options	HiGain Choices
ED-T1	FMT	AUTO	FRMG	AUTO [a]
ED-T1	FMT	UNFR	FRMG	UNFR
ED-T1	LINECODE	AMI	DS1	AMI[a]
ED-T1	LINECODE	B8ZS	DS1	B8ZS
ED-T1	LINECODE	AUTO	DS1	AUTO
ED HDSL	DS0BLK	24 zeros	DS0	NONE[a]
ED HDSL	DS0BLK	24 binary digits [b]	DS0	1 to 24
ED HDSL	HAIS	NO	HAIS	2LP[a]
ED HDSL	HAIS	YES	HAIS	1LP
ED HDSL	LP	SOURCE	PWRF	ENA[a]
ED HDSL	LP	SINK	PWRF	DIS
ED HDSL	LPBKACTC	000	SPLB	GNLB[a]
ED HDSL	LPBKACTC	001	SPLB	AILB
ED HDSL	LPBKACTC	010	SPLB	A2LB
ED HDSL	LPBKACTC	011	SPLB	A3LB
ED HDSL	LPBKACTC	100	SPLB	A4LB
ED HDSL	LPBKACTC	101	SPLB	A5LB
ED HDSL	LPBKACTR	YES	SAIS	ENA[a]
ED HDSL	LPBKACTR	NO	SAIS	DIS
ED HDSL	LPBKTMO	0	LBTO	NONE
ED HDSL	LPBKTMO	20	LBTO	20
ED HDSL	LPBKTMO	60	LBTO	60
ED HDSL	LPBKTMO	120	LBTO	120
ED HDSL	NIDLPBK	YES	LPBK	ENA[a]
ED HDSL	NIDLPBK	NO	LPBK	DIS
ED GOS T1	ES (daily threshold) [c]	0	ESAL (BPV)	NONE[a]
ED GOS T1	ES (daily threshold)[c]	17 > ES > 0	ESAL (BPV)	17
ED GOS T1	ES (daily threshold)[c]	170 >ES > 17	ESAL (BPV)	170
ED GOS HDSL	ES (daily threshold)[c]	0	ESAL (CRC)	NONE[a]
ED GOS HDSL	ES (daily threshold)[c]	17 > ES > 0	ESAL (CRC)	17
ED GOS HDSL	ES (daily threshold)[c]	ES > 17	ESAL (CRC)	170
ED GOS HDSL	SNR (1 day)	0 to 15	MARG	0 to 15

(a) Factory default.
(b) A sequence of 24 binary digits where each digit represents one of the 24 DS0 channels. The right-most bit is Channel 1, and the left-most bit is Channel 2. A zero in any position means that the channel is unblocked. A one in any position means that the channel is blocked.
(c) The AHDSL 17 and 170 alarms are determined by the specified ES threshold values.

Table 6. *HiGain System Option Settings*

Mode	Selection	Description
ESAL	17	Activates the alarm input signal to the Litespan microprocessor and flashes the red status LED when 17 Errored Seconds (ES) (17 HDSL CRC errors on either HDSL loop or a total of 17 BPVs and FERR) occur within a 24-hour period.
	170	Activates the alarm input signal to the Litespan microprocessor and flashes the red status LED when 170 ES (170 HDSL CRC errors on either HDSL loop or a total of 170 BPVs and FERR) occur within a 24-hour period.
	NONE[a]	Prevents generation of an 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[a]	Sets automatic cancellation of all loopback to 60 minutes after initiation.
	120	Sets automatic cancellation of all loopback to 120 minutes after initiation.
LPBK	DIS	Configures the HLU-200 to ignore the 2-in-5 SmartJack loopback command.
	ENA[a]	Enables the HLU-200 to respond to the 2-in-5 SmartJack loopback command.
SPLB	GNLB[a]	Configures the HiGain system to respond to the generic (3/4/5/6 in 7) in-band loopback codes.
	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.
PWRF	DIS	Disables powering to the HRU and/or doubler over the HDSL pairs.
	ENA[b]	Enables powering to the HRU and/or doubler over the HDSL pairs.
DS1	B8ZS	Places both the HLU and HRU into their B8ZS modes.
	AMI[a]	Places both the HLU and HRU into their AMI modes.
	AUTO	The AUTO mode is not supported. If selected, the DS1 code defaults to AMI.
FRMG	AUTO[a]	Configures HiGain 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 HiGain can also process unframed data in this AUTO mode, it is recommended that the 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 HiGain to operate in an unframed mode. This mode disables the auto framing process and forces HiGain to function as a transparent bit pipe.
HAIS	2LP[a]	Causes HiGain to transmit the AIS signal at both the HLU and HRU T1 output ports when both of the HDSL loops are not in sync (LOSW).
	1LP	Causes HiGain to transmit the AIS signal at both the HLU and HRU T1 output ports when either of the two HDSL loops is not in sync (LOSW) or if a minor alarm occurs.

Table 6. *HiGain System Option Settings (Cont.)*

Mode	Selection	Description
SAIS	ENA[a]	Causes the HRU to transmit the AIS signal towards the CI when in NREM loopback.
	DIS	Prevents the AIS signal from being transmitted to the NI and replaces it with the network test signal in the HRU List 6 and 8 or by a quiet termination (LOS) in the HRU List 7.
MARG	0 to 15 dB (3[a])	The Margin Alarm Threshold determines the minimum margin below which an alarm will occur.
DS0	Any combination of the 24 DS0 channels/NON[a]	The DS0 blocking option allows any number of the 24 DS0 channels to be blocked at both T1 output ports where they are replaced by the FF idle code.

(a) Indicates HLU-200 List 2D default factory settings.

ADMINISTRATION

The AHDSL unit can be accessed using Litecraft.

Accessing the AHDSL Unit through Litecraft

To access the AHDSL unit using Litecraft:

1 At the Litecraft Login screen (Figure 6), log in by entering an appropriate user ID, password, and communication parameters. The Network Map screen appears after a successful login (Figure 7).

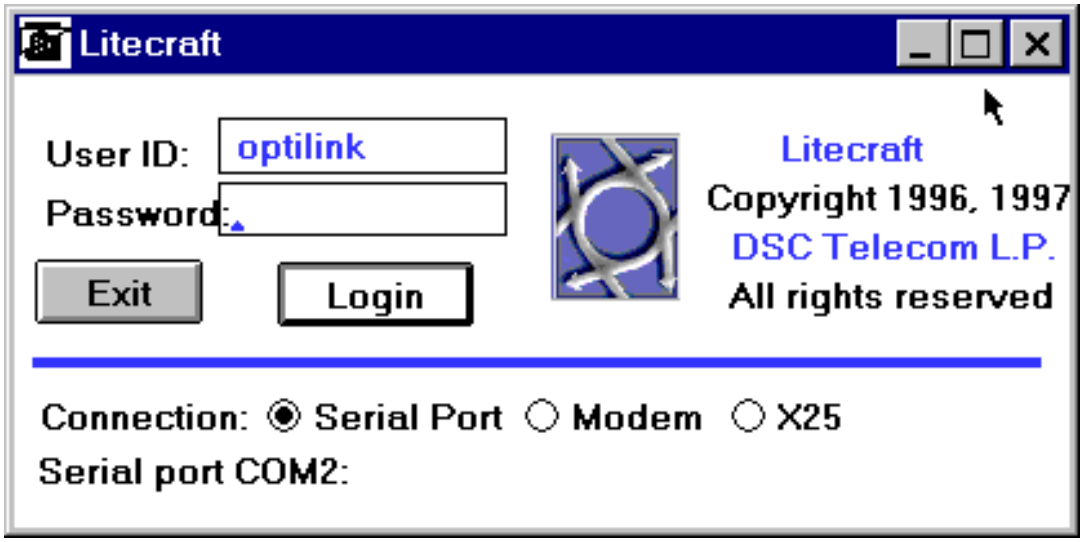


Figure 6. *Litecraft Login Screen*

2 Click on the desired network element (COT or RT). Selecting the COT causes the Node screen shown in Figure 8 to appear.

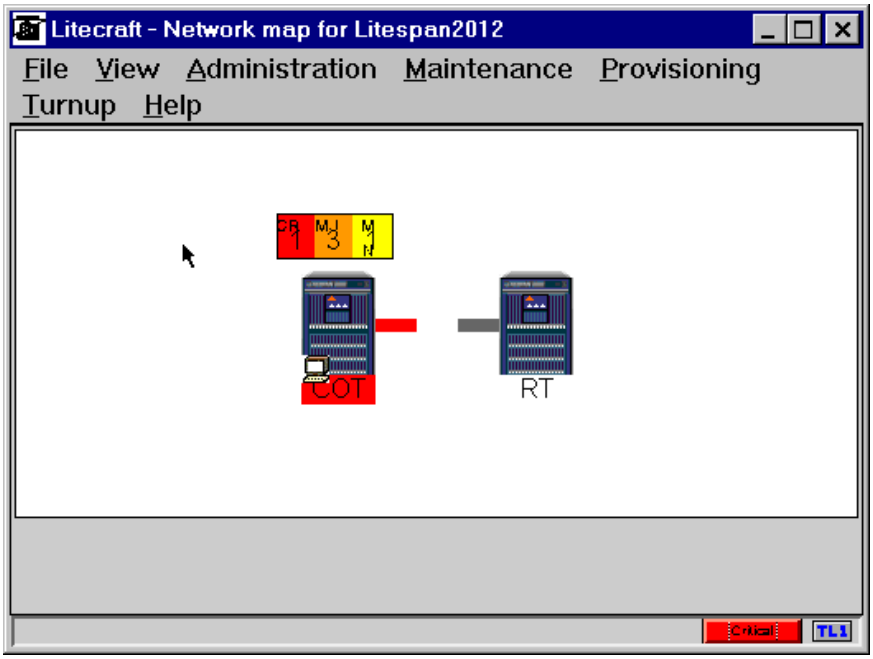


Figure 7. *Network Map Screen*

3 As shown in the Node screen (Figure 8), a Litespan 2000 system can consist of as many as nine interconnected CBAs designated as CBA-COT(RT)-1 to CBA-COT(RT)-9. Select the desired node, COT or RT, by double clicking its icon.

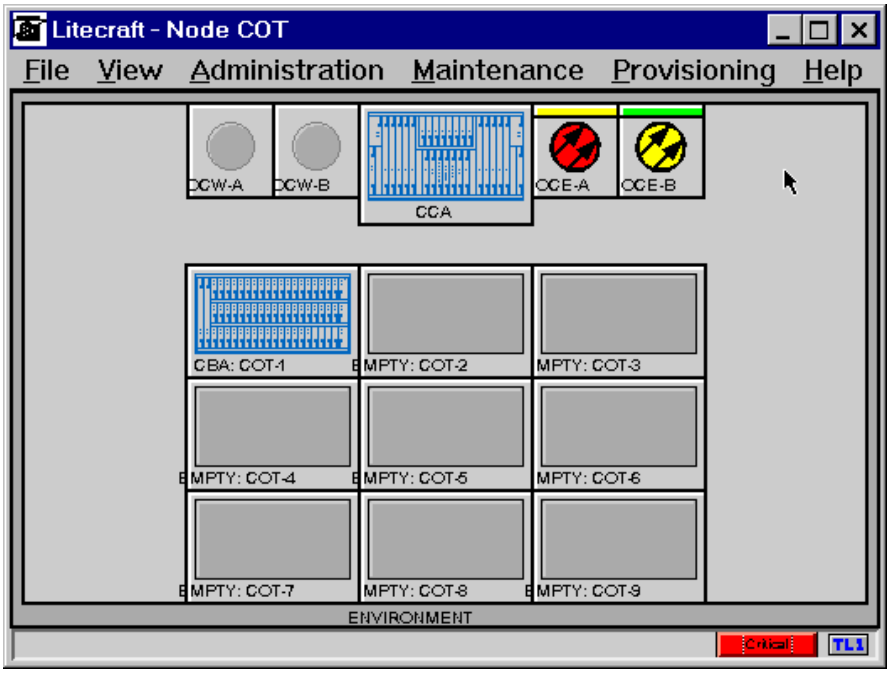


Figure 8. *Node Screen*

4 The selected Channel Bank screen appears (Figure 9 on page 15). This screen outlines all the CBA slots and displays the name of the plug that occupies each slot. The HLU-200 is identified as an AHDSL unit. Before inserting the AHDSL card into a Litespan slot, click on the slot to determine its status. The slot will be identified as being in one of the following three states.

- The slot is identified with the AHDSL gray label. This means that the slot has been assigned to accept an AHDSL card but the card has not yet been installed or equipped with an AHDSL card. If this is the case, then the AHDSL card can be inserted into the slot. Litespan will install the AHDSL unit and indicate this by coloring the slot (on the screen) light blue.
- The slot has no identifying card mnemonic. This means that no card has been assigned to the slot. In this case, simply insert the card as in Step 5 below. Litespan will automatically assign, and color the slot light blue as above.
- The slot is identified with a card ID other than AHDSL. In this case, the current card must first be deleted and the slot assigned to an AHDSL card, see Step 5 below. If the ASSIGNED card does not match the INSTALLED card, Litespan will deny normal access and use of the card.

5 Install the HLU-200 to a Litespan slot using the following steps:

a From the Channel Bank screen menu bar, select the slot then select **Provisioning | Equipment | Delete Equipment** to unassign the current plug types.

b Remove the previous unit from the slot if present.

c Insert the HLU-200 in the slot (see "Installation" on page 8). Litespan will then automatically install the HLU-200. Select **View | Refresh** to confirm installation.

d Alternately, the slot can be assigned before insertion by selecting **Provisioning | Equipment | Enter Equipment** then select the AHDSL type from the pull down menu.

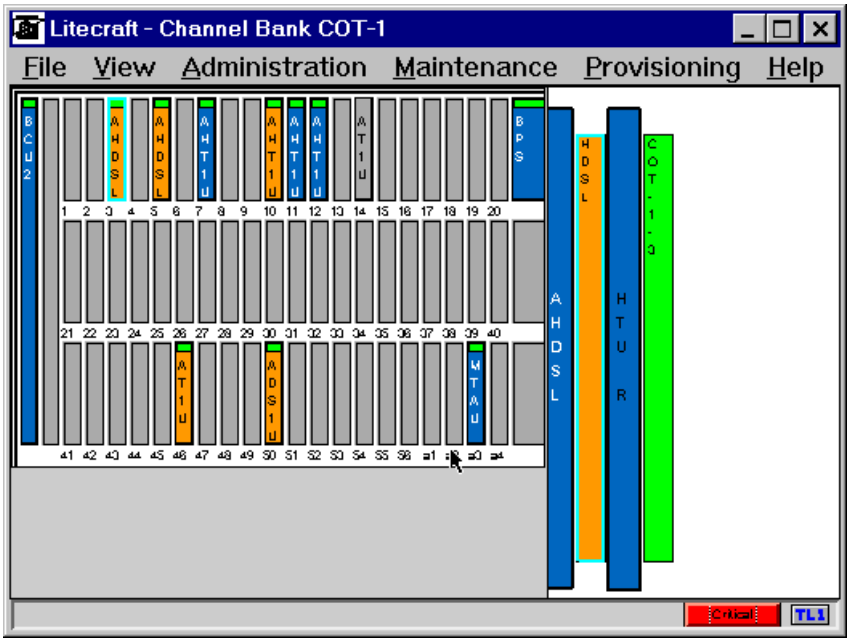


Figure 9. *Channel Bank Screen with AHDSL Circuit Selected*

6 Click the AHDSL unit icon (shown in slot 5 of Figure 9). The AHDSL circuit appears as a series of rectangles on the right half of the Channel Bank screen as shown in Figure 9 on page 15. The rectangles from left to right represent the AHDSL unit, the HDSL loops, the remote HTU, and the CBA selected. See Table 7 for the definitions of the various color codes that can appear in the Channel Bank screen of Figure 9, where OOS = Out of Service and IS = In Services.

Table 7. *Channel Bank Screen Color Codes*

Item	Gray	Gray with Card Mnemonic	Dark Blue	Green	Light Blue Outline	Orange
AHDSL-Box	OOS[a]	NA	IS/OOS[a][b]	NA	Selected	Alarm
HDSL-Box	Facilities OOS	NA	NA	Facilities IS[b]	Selected	Alarm
HTU-R-Box	HRU is missing	NA	HRU is on line	NA	Selected	NA
CBA-Box	Facilities OOS	NA	NA	Facilities IS	Selected	NA
SLOT Box	Unassigned	Assigned but, not equipped	Assigned and Equipped	NA	Selected	Alarm
Top of Slot Box	Equipment OOS	NA	NA	Equipment IS	NA	NA

(a) OOS = Out of service
(b) IS = In service

Cross Connection

An AHDSL card can be cross connected to any of the asynchronous Litespan cards that follow:

- AHDSL
- AHT1U
- AT1U
- ADS1U

The units to be connected must reside in either the same CBA or in another CBA in the same network. In either case, both ends of the connection must be identified.

To identify the connection:

1 Choose the CBA from the Network Map screen that contains the first card to be connected.

2 Highlight the card then select **Provisioning | Cross-Connect | Enter Cross-Connections**.

3 Choose the CBA and slot of the second card to be connected.

4 Click OK. This activates the cross connect.

Figure 10 on page 17 shows the CBA screen with a Cross Connection in effect between slot 4 and slot 50. To delete an existing Cross Connection, select **Provisioning | Cross Connect | Delete Cross Connect**.

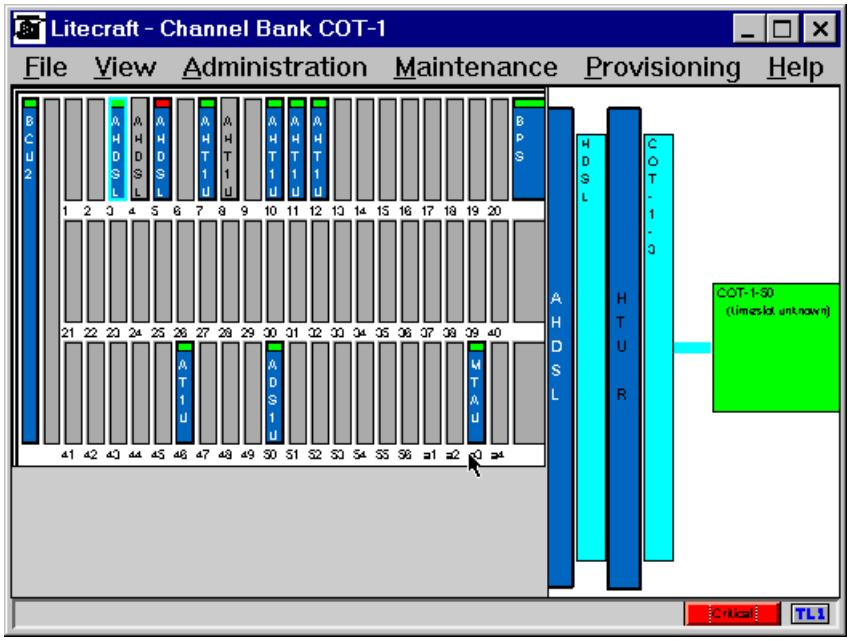


Figure 10. *Cross Connection Diagram*

In Service and Out of Service Provisioning

Litespan supports two service states for both the Equipment and Facilities (In Service [IS] or Out of Service [OOS]). The equipment designation refers to the HLU-200 unit itself. Facilities refers to either the HDL pairs or the CBA. The HLU-200 is normally placed in IS state after it has been provisioned for the intended application and is ready to provide service. If an IS unit needs to be tested, replaced or manipulated in any way that will affect its ability to carry live traffic, it should be placed in OOS state, tested, and so forth, before being returned to IS state. To change the service state of the AHDSL unit:

1 Select **Provisioning | Equipment | Edit Equipment** from Figure 10. The Litespan Equipment Edit screen in Figure 11 appears.

2 Under the PST column of Figure 11, click on the row of the card of interest. Then select **Provisioning | Edit**. A dialog box appears from which you can choose the new value.

3 Click OK and apply changes. The selected dialog box closes and the new value replaces the old value.

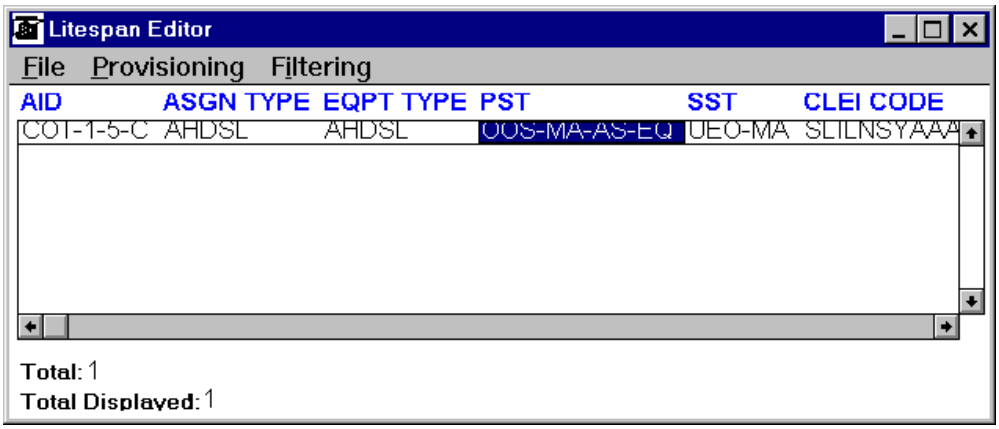


Figure 11. *Litespan Equipment Edit Screen*

To change the service state of the HLU-200's HDSL Facilities, from the Litespan Equipment Edit screen:

1 Highlight the HDSL box, in Figure 10 on page 17, and select **Provisioning | Facilities| Edit Facilities.** The Edit Facilities screen (Figure 12) appears.

2 Select **Provisioning | Edit**. A dialog box appears from which you can choose the new value.

3 Click OK and apply changes. The selected dialog box closes and the new value replaces the old value.

To change the service state of the CBA, highlight the far right CBA box in Figure 10 on page 17 and then select **Provisioning | Facilities| Edit Facilities** and proceed as stated above in Step 2.

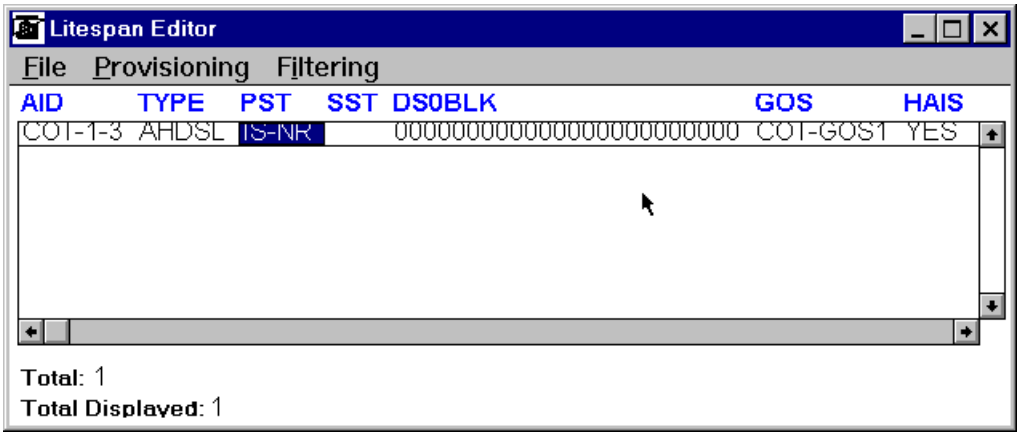


Figure 12. *Provisioning Edit Facilities Screen*

System Inventory

To access system inventory parameters, take the following steps:

1 Select **Provisioning | Equipment | Edit Equipment** from the Channel Bank screen menu bar (Figure 10 on page 17). The System Inventory screen appears (Figure 13).

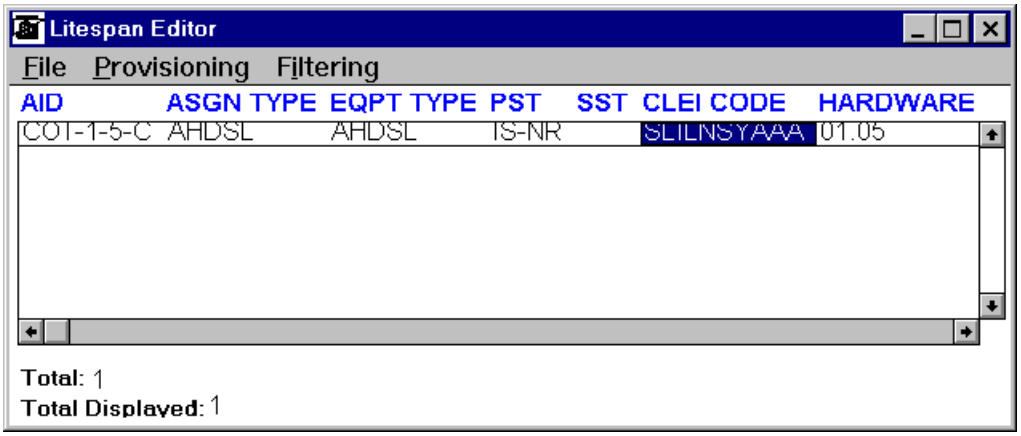


Figure 13. *System Inventory Screen*

2 Make sure the plug names for ASGN TYPE and EQPT TYPE agree.

3 Make sure the correct Common Language Equipment Identifier (CLEI) code has been entered. The correct CLEI code for the AHDSL unit is SLILNSYAAA.

Other parameters (HARDWARE, SOFTWARE, BOOTCODE VRSN, and SERIAL NO) identify the Litespan system; they are unrelated to the AHDSL unit.

PROVISIONING

All the user options in the HLU-200 List 2D can be set during provisioning.

Setting User Options

TL1 and Litecraft support standard HiGain user options with the following exceptions:

- Two HiGain options not supported are Zero-Byte Timeslot Interchange (ZBTS) and ALRM (permanently set to OFF and ENA, respectively). See Table 6 on page 12 for a list of the HiGain options supported by the HLU-200 List 2D.
- Standard HiGain screens such as Span Status, Set Clock, Loopback, Performance Data, Performance History, Alarm History, and Circuit ID are not available. These items are replaced by a set of TL1 commands and the Litecraft Graphical User Interface (GUI) screens.
- TL1 and Version 2.0 of Litecraft only support non-doubler applications.

In addition, TL1 and Litecraft can initiate all four loopbacks: NLOC, NREM, CLOC, and CREM.

To provision the AHDSL user options:

In the Channel Bank screen (Figure 10 on page 17) highlight the HTU-R box and select **Provisioning | Facilities | Edit Facilities**. The continuous Provisioning screen appears (Figure 14 through Figure 17 display the continuous screen as four smaller screens).

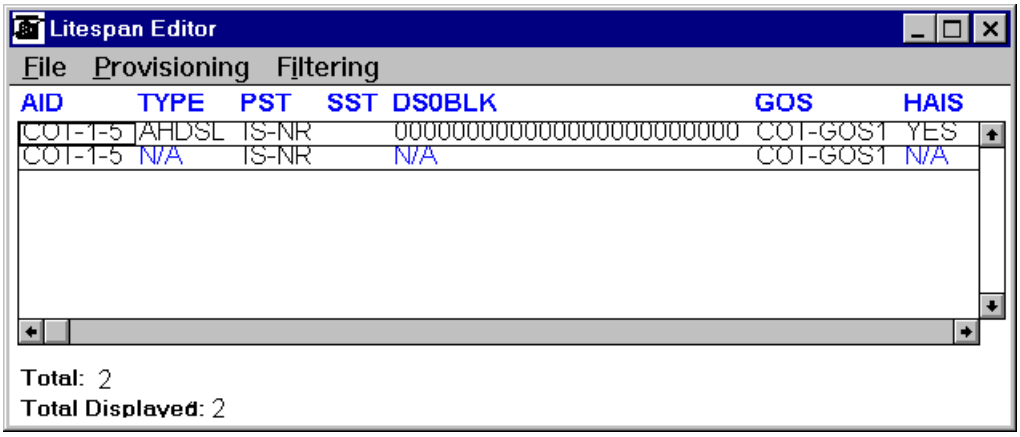


Figure 14. *HDSL/T1 Provisioning Screen 1*

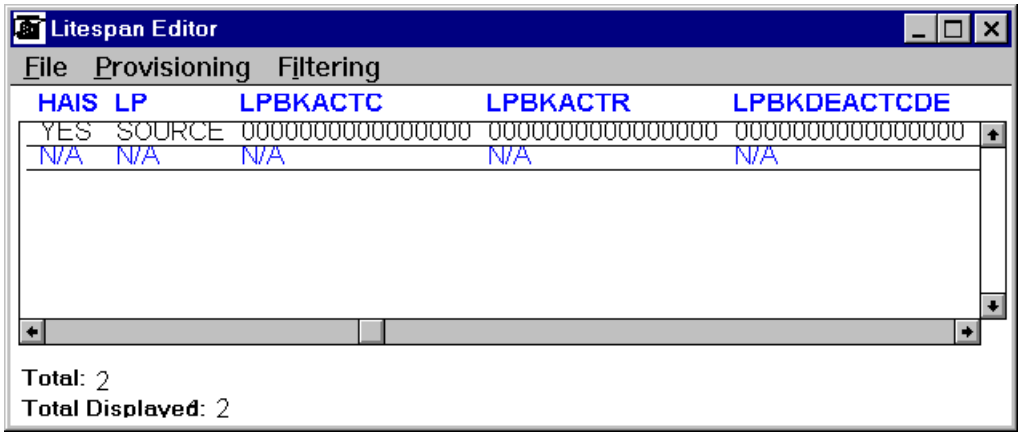


Figure 15. *HDSL/T1 Provisioning Screen 2*

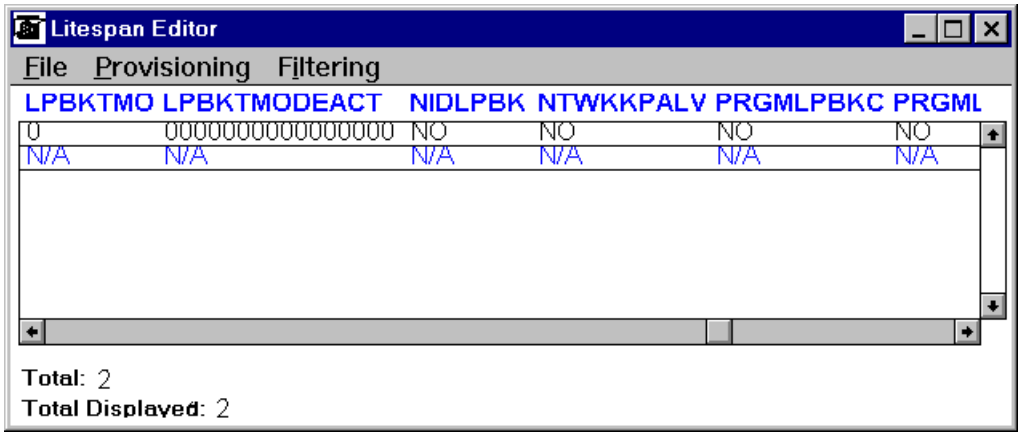


Figure 16. *HDSL/T1 Provisioning Screen 3*

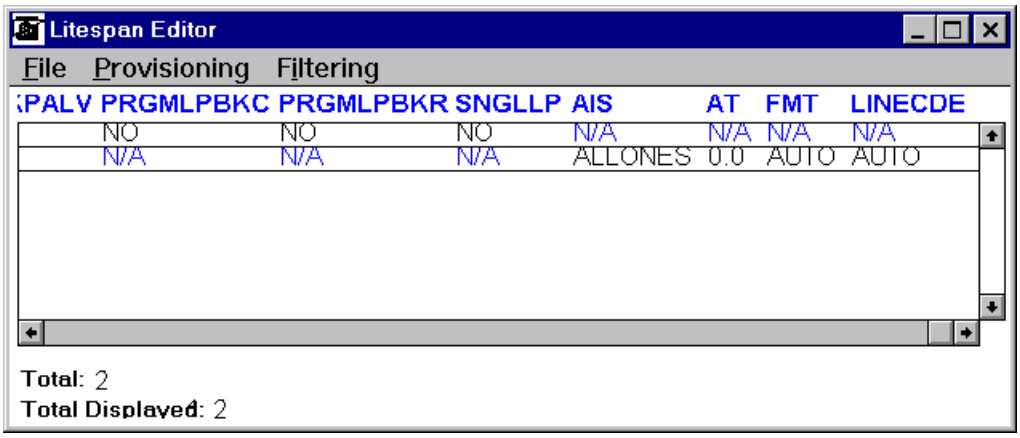


Figure 17. *HDSL/T1 Provisioning Screen 4*

An example of setting the DSO Blocking option follows:

1 At the top of Figure 14 on page 19, locate the DS0BLK parameter and its corresponding setting.

2 Check the possible settings (Litecraft Choices) for the DS0BLK parameter in Table 5 on page 11.

3 To change the setting, left click current value, then right click and follow the instructions.

4 Repeat Steps 2 to 4 to provision the following options: HAIS, LP, LPBKACTC, LPBKACTR, LPBKTMO, NIDLPBK, FMT and LINECODE.

5 Do not change any other parameters in the AHDSL Provisioning screen.

6 Click on the Apply Changes box to activate the new selections.

Parameter Threshold

The AHDSL has two parameter thresholds, **Errored Seconds Threshold** and **Margin Threshold**, described below.

The standard 17 or 170 **Errored Seconds Thresholds** are determined by setting either the T1 or HDSL Errored Seconds parameters to the value shown in Table 4 on page 10. Selecting a value from 1 to 16 sets the Errored Seconds threshold to 17. Selecting a value from 17 to 170 sets the threshold to 170.

To set the **T1 Errored Seconds threshold** to 17 or 170 per day, set the T1 Daily thresholds using Table 5 on page 11 and doing the following step:

1 Highlight the COT box from the Channel Bank screen (Figure 9 on page 15). Then select **Maintenance | Grades of Service | Edit GOS Table**. The T1 Errored Seconds Threshold screen, Figure 18, appears.

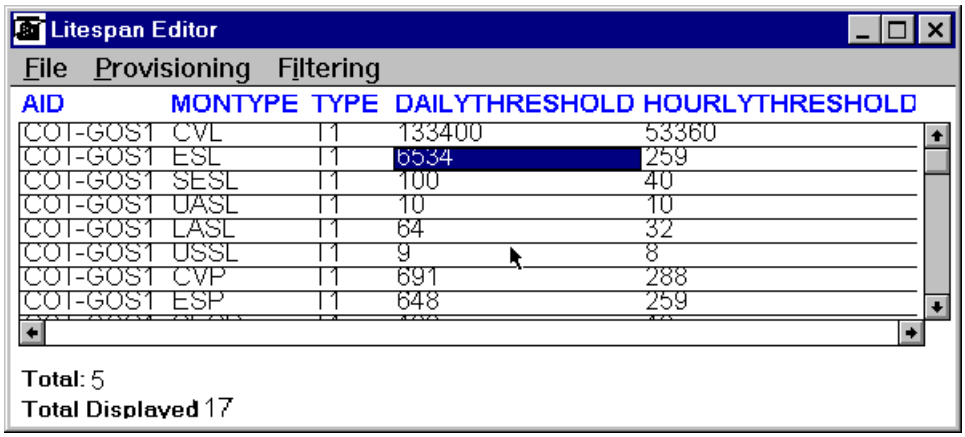


Figure 18. *T1 ES Threshold Screen*

2 To set the T1 Daily Threshold, do the following:

- **a** Highlight the ESL number in the DAILYTHRESH column. Right click or enter **Provisioning | Edit**.
- **b** Enter a number from 0 to 170 in the DAILYTHRESH column. This number sets the ES threshold as defined in Table 4 on page 10.
- **c** Ignore all other rows and columns.
- **d** Click on Apply Changes to install the new selection.
- **e** Select **File | Close** or click the X box to return to the Channel Bank screen.

To set the **HDSL Errored Seconds Threshold**, highlight the HDSL box from the Channel Bank screen (Figure 9 on page 15) and repeat Step 1 and Step 2 used above for the T1 Errored Seconds Threshold. Figure 19 displays the HDSL Errored Seconds Threshold.

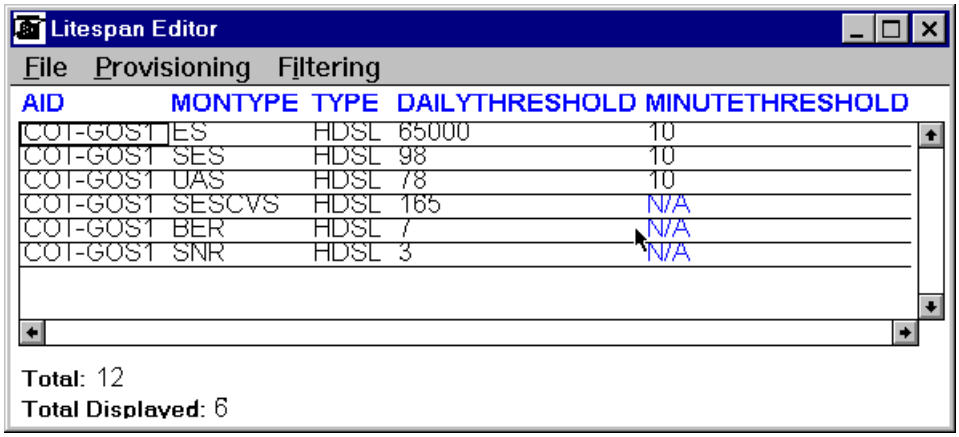


Figure 19. *HDSL ES Threshold Screen*

The T1 and HDSL screens are identical except for the designation *T1* or *HDSL* in the Type column. Unlike Litespan error thresholds, HiGain only has one error threshold value for both the HDSL CRC error and the T1 BPV error. Litecraft allows this one threshold value to be set from either the T1 or HDSL command. The last command issued applies.

To set the **Margin or SNR Threshold** to the desired value between 0 and 15. Repeat Step 1 on page 22 except select the HDSL box from the Channel bank screen (Figure 9 on page 15). When Figure 19 on page 22 displays, select the SNR value under the Daily Threshold column. Edit as before in Step 2 on page 22, with the exception of setting the SNR threshold.

Version 2.0 of Litecraft does not allow the margin to be changed from its .3dB factory default value.

MONITORING

T1 Performance Monitoring

To view the T1 Performance Monitoring (PM) statistics:

1 Select (highlight) the CBA box furthest to the right.

2 Select **Maintenance | Performance Monitoring** from the Channel Bank screen menu bar (shown on page 15).

The T1 PM screen Figure 20 appears.

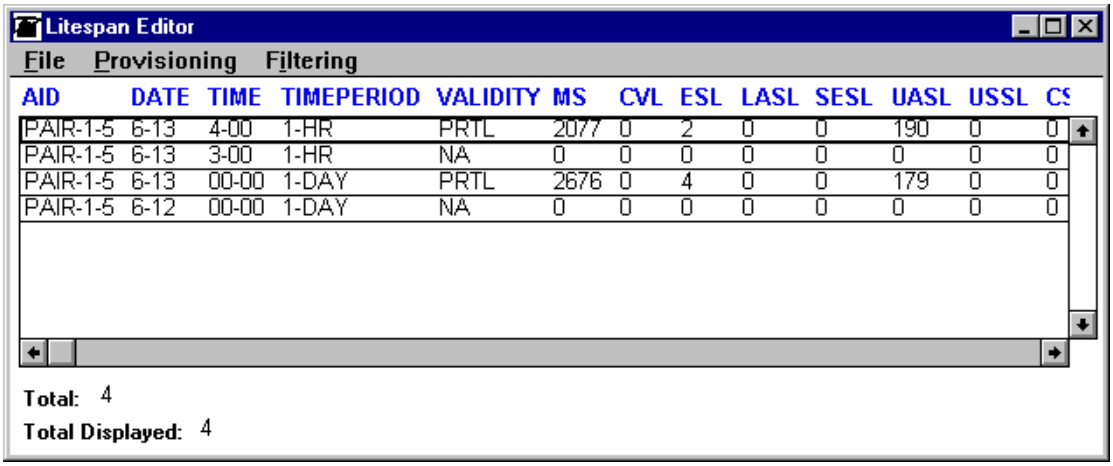


Figure 20. *T1 PM Screen*

In the T1 PM screen, the 1-HR and 1_DAY ES (Bipolar Violations [BPVs]) and Unavailable Seconds (UAS) (Loss of Signal [LOS]) events are listed in the ESL and UASL columns respectively.

Graphs

The data can also be displayed in a graph that accompanies the T1 PM screen (Figure 21).

The graph is selected by:

- The UASL or ESL choice from the Monitored Types Pull-down menu

The desired hour is selected from:

- The Times Pull-down menu

The time interval is selected from:

- The Time Periods Pull-down menu

All selections are done from the graph screen by selecting the Graph button.

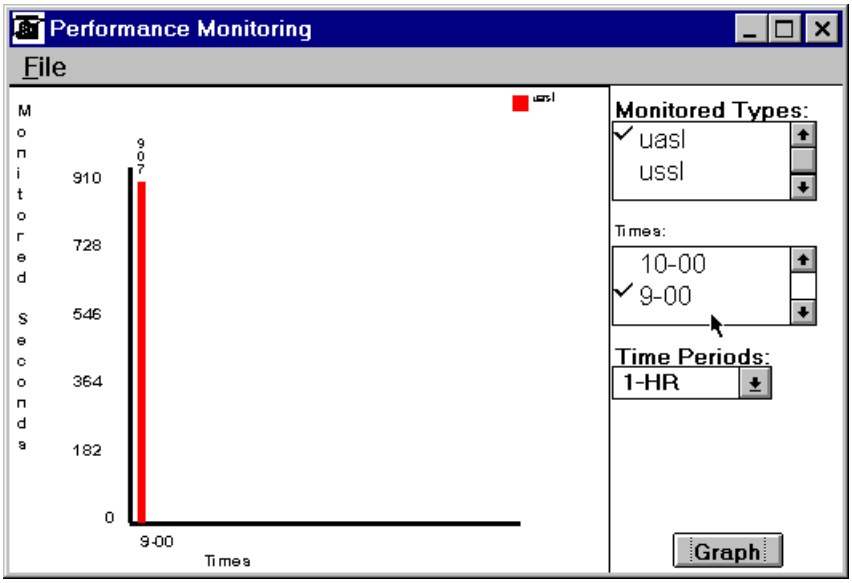


Figure 21. *T1 UASL Graph*

The T1 PM date can be cleared by doing the following:

1 Select the right box

2 Choose **Maintenance | Initialize PM Registers**

3 Select the appropriate register, 1-HR or 1-DAY, to be cleared

HDSL Performance Monitoring

To view the HDSL Performance Monitoring statistics:

1 Select (highlight) the HDSL box.

2 Select **Maintenance | Performance Monitoring** from the Channel Bank screen menu box, shown on page 15.

The HDSL PM screen Figure 22 on page 25, appears along with its graph screen which is activated by the procedure described explain in "Graphs" on page 24. The HDSL PMs can also be cleared in the following way:

1 Select the HDSL box

2 Select **Maintenance | Initialize PM Registers** and select the appropriate register, 15-Min on 1-Day, to be cleared.

3 Select the appropriate register, 15-Min on 1-Day, to be cleared.

When the HDSL PMs are requested, Version 2.0 of Litecraft mistakenly responds with the following message (at least once and sometimes with succession): "LITESPAN REQUEST DENIED. INVALID MONITORED TIME SPECIFICATION." When this message occurs, simply click on it and proceed.

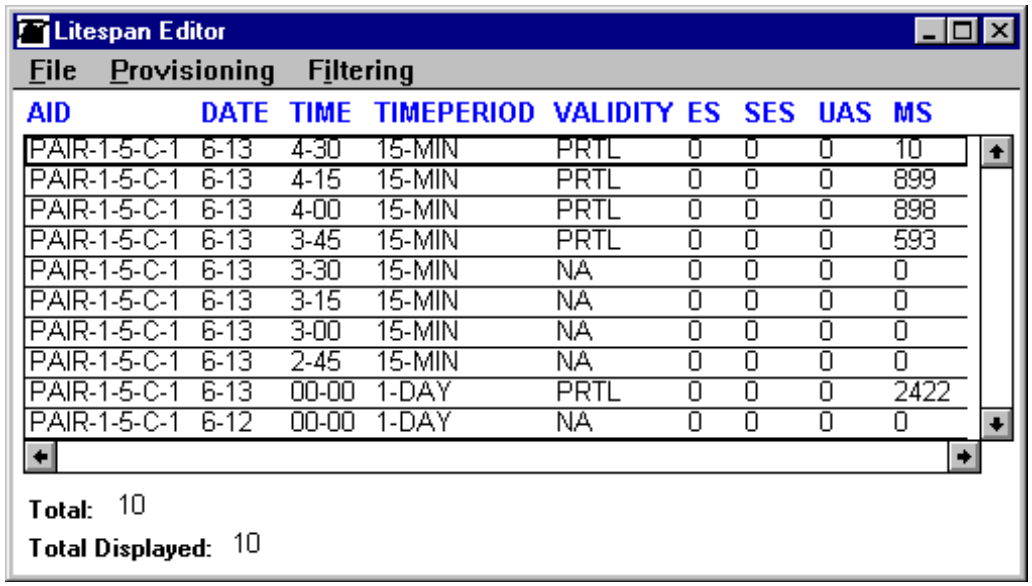


Figure 22. *HDSL PM Screen*

In the HDSL PM screen, the 15-MIN and 1_DAY ES (CRCs) and UAS (LOF) events are listed in the ES and UAS columns respectively. The 32 15-MIN and 7 1-DAY statistics are listed.

The HDSL PM date can be cleared by doing the following:

1 Select the right box

2 Select **Maintenance | Initialize PM Registers**

3 Select the appropriate register, 1-HR or 1-DAY, to be cleared.

Only the current 1-HR and current 1-DAY registers are cleared.

Alarms

The AHDSL alarms listed in Table 8 are detected and reported to the Litespan microprocessor through the "Alarm" signal from the HLU microprocessor to the Litespan processor as shown in Figure 3 on page 6. They also cause the HDSL LED to flash red.

To retrieve the alarm status of a CBA, click on the red CRITICAL alarm key located at the lower right hand corner of the CBA screen shown in Figure 9 on page 15. The alarm screen shown in Figure 23 appears. The alarm type is listed in the CONDTYPE column. These are related to the standard AHDSL alarms listed in Table 8 on page 26.

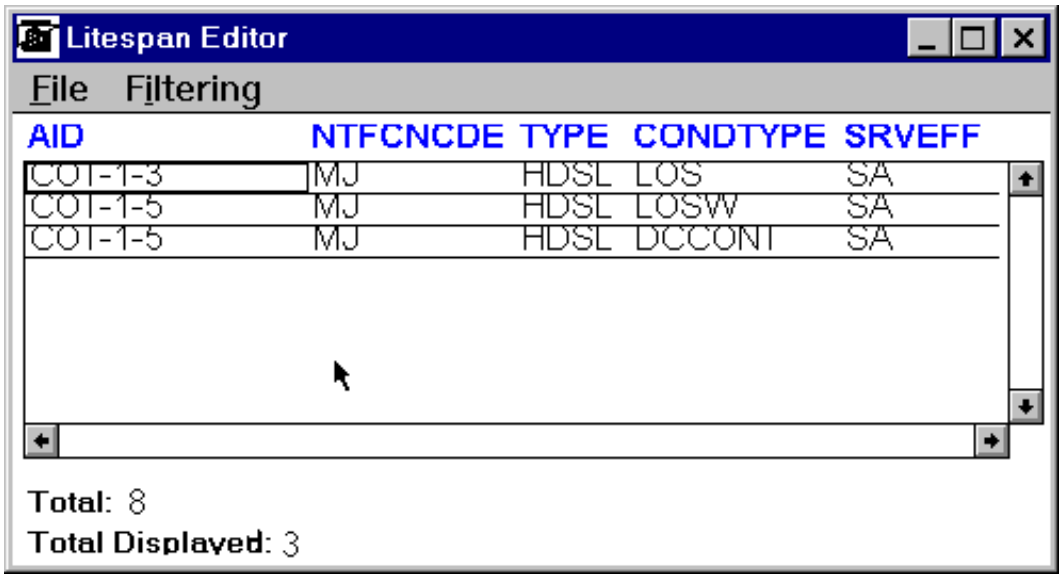


Figure 23. *AHDSL Alarm Screen*

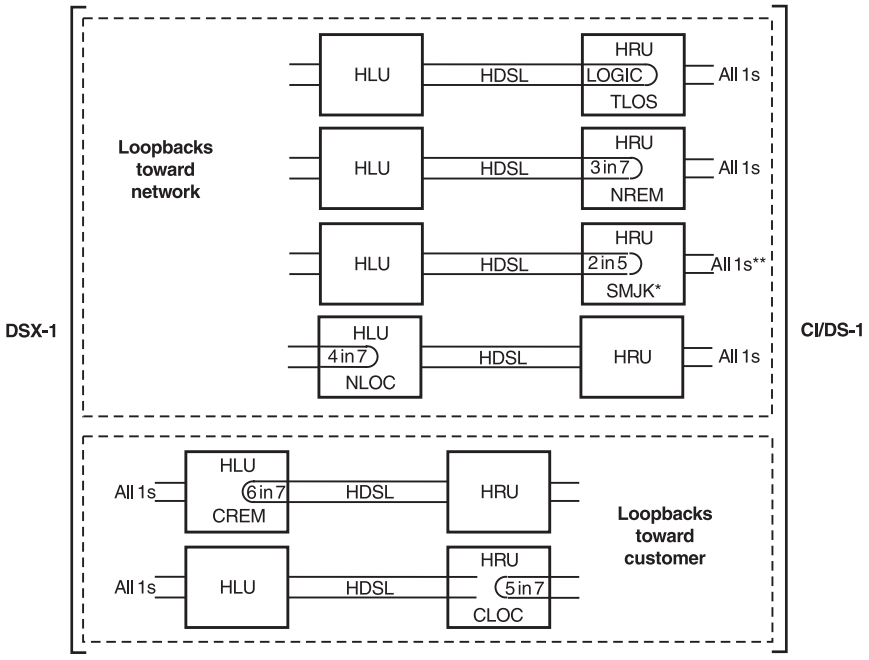
Table 8. *HLU-200 List 2D Alarms to Litespan Processor*

CONDTYPE	Alarm	Description
LOSW	LOSW	Either of the HDSL loops lost sync
LOS	RLOS	Loss of HRU DS1 input signal
	TLOS	A user option that causes the loss of the HRU DS1 input from the CI to initiate a logic loopback state in the HRU.
ESTH	H1ES	HDSL loop 1 has exceeded the 24-hour user-selected Errored Seconds CRC threshold.
	H2ES	HDSL loop 2 has exceeded the 24-hour user-selected Errored Seconds CRC threshold.
	DS-1	The total number of bipolar violations (BPV), at the HRU DS1 input, has exceeded the 24-hour user-selected threshold.
SNRL	MAL1	The margin on HDSL loop 1 has dropped below the minimum threshold value set at the maintenance terminal Margin Alarm Threshold option.
	MAL2	The margin on HDSL loop 2 has dropped below the minimum threshold value set at the maintenance terminal Margin Alarm Threshold option.
DCCONT	POWER FEED OPEN	The HLU-200 has detected an open circuit in one of the two HDSL loops causing a DC continuity DCCONT alarm.

LOOPBACK OPERATION

The HiGain system has a family of loopback options. The most important of these is the SmartJack (SMJK) loopback which enables the HRU to respond to the standard (2/3 in 5) SmartJack in-band loopback codes and thus emulate the functions of a standard NID. This option can be enabled or disabled from the NIDLPBK option in the HDSL Provisioning screen (see Figure 14 through Figure 17).

In addition to the SMJK loopback, the HiGain system can be configured for one of five Special Loopback (SPLB) command sequences. These are selected from the LPBKACTC user option shown in Figure 15 on page 20. The loopback locations are shown in Figure 24.



* The SmartJack loopback is a metallic loopback in the HRU Lists 6 and 7. It is a logic loopback in HRU Lists 1 through 5.

** Set the SAIS option to ENA to send the AIS pattern to the CI during SmartJack Loopback.

Figure 24. *HLU-200 List 2D Non-doubler Loopback Configuration*

The Generic Loopback (GNLB) allows in-band codes issued to the HLU to loop-up either the HLU/NLOC (4 in 7) or HRU/NREM (3 in 7) towards the CBA. In addition, it allows in-band codes issued to the HRU to loop-up the HLU/CREM (6 in 7) or HRU/CLOC (5 in 7) towards the Customer Interface (CI). 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 system responds.

The A1LB loopback selection complies with that proposed for HDSL systems in the T1E1.4/92 recommendation 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 described below. It is given a separate identity to allow future T1/E1 enhancements to be added without affecting A2LB.

A2LB through A5LB are four special addressable repeater in-band loopback functions which are supported by the HLU-200 HiGain system. These loopbacks provide the HiGain system with sophisticated maintenance and trouble shooting tools. Tables 10 and 11 list the details of these 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 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-200 List 2D toward the CBA. A2LB can be configured to either 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-200 List 2D, it does not support this FAR-END ACTIVATE code. A3LB differs from A4LB in that A3LB supports the additional (1 in 6) SmartJack loopback command.

The green Loop LED on the HLU front panel lights whenever any of the circuit modules (HLU, HDU or HRU) is in a loopback state.

Although the following loopback section describes, HLU, HRU and HDU (doubler) loopbacks commands, the HLU-200, List 2D when managed by the current version of Litecraft, does not support doubler applications.

TESTING LOOPBACKS

To access the System Loopback screen:

1 Highlight the HRU-R box for loopbacks toward the customer (CLOC-CREM), or the CBA box for loopbacks toward the network (NLOC-NREM)

2 Select **Maintenance | Facilities | Operate Loopback Test** from the Channel Bank.

3 Select Near End (NEND) or Far End (FEND) per Table 9 on page 29.

Figure 25 shows a loopback option box and Table 9 on page 29 shows the relationship between HiGain standard loopback mnemonics and Litecraft mnemonics.

Figure 25. *System Loopback Screen*

Table 9. *Loopback Mnemonics*

HiGain Mnemonic	Litecraft Equivalent
NLOC	HTU (R) Network Loopback (NEND)
CREM	HTU (C) Customer Loopback (FEND)
NREM	HTU (R) Network Loopback (FEND)
CLOC	HTU (C) Customer Loopback (NEND)

Litecraft Version 2.0 supports the HDSL loop up (Operate Loopback Test) but not the loopdown (Release Loopback Test) command. This loopup command should only be issued with extra caution. If issued, the only way to loop the circuit down is to issue the following TL1 loopdown command: RLS-LPBK-T1.

TEST LOOP ACCESS

The HLU-200, List 2D supports the same Test Loop function that most other Litespan channel units support. The block diagram of this function is shown in Figure 3 on page 6. Each of the two HDSL loops (Loop 1 and Loop 2) from the outside cable pairs pass through a set of relay contacts before they are connected to the HLU-200. This allows each of the two incoming loops to be disconnected from the HLU-200 whenever these relays are energized by Litecraft or TL1 commands. The energized relays then route the outside cable pairs over the Narrow Band Test Loops 1 and 2 bus to the MTAU unit which can then perform standard cable pair tests on each of the two loops. The Litecraft/TL1 commands that initiate this test access are listed in Table 4 on page 10 below.

To access the test loop commands:

1 Highlight either the HTU-R or the CBA boxes in the Channel Bank screen of Figure 9 on page 15.

2 Select either **Maintenance | MTAU | Connect to MTAU** to connect the HDSL pairs to the MTAU or **Maintenance | MTAU | Disconnect from MTAU** to reconnect the HDSL pairs to the AHDSL unit.

Use this test loop command with caution since it opens the HDSL pairs and forces the circuit completely out of service. Also, to avoid undue stress on the relay contacts, and unwanted voltage on the cable pairs whose slow decay may cause misleading test measurements, remove the HDSL voltage from the two loops prior to initiating the test loop command. This is done by issuing the ED HDSL LP SINK command listed in Table 5 on page 11. To restore the HDSL voltage after the tests are finished and the Test Off command has been sent, issue the ED HDSL LP SOURCE command listed in Table 5 on page 11. This restores the HDSL voltage to the cable pairs.

Version 2.0 of Litecraft only supports the CONN to MTAU command. The DISC command is not available. Therefore the CONN command should never be issued. If the CONN command is inadvertently issued, the HLU-200 List 2D must be unplugged from its slot, reseated and reinstalled to reconnect HDSL pairs and restore the HLU to its normal operating state.

GNLB LOOPBACK TEST PROCEDURES

Testing allows verification of the integrity of the HDSL channels at every module location as well as the DS-1 channels to the customer and the remote/local T1 interface. If trouble is encountered on the HLU-200 List 2D Litespan 2000 Interface, verify that the HLU-200 List 2D is making a positive connection to the CBA backplane.

To perform the GNLB loopback test procedure:

1 Have the CO tester send the HRU (3 in 7) in-band loop-up code for five seconds. Observe that an HRU “NREM” loopback is in effect (see Figure 24 on page 27 for non-doubler loopback configurations). The loopback state is indicated by the GREEN LOOP LED on the front panel and is also displayed in the Span Status screen.

2 Have the CO tester transmit a T1 test signal into the HLU-200 and verify that the returned (looped) signal is error free.

3 If the above test fails, have the CO tester transmit the (3 in 5) in-band loop-down code.

4 Have the CO tester send the HLU-200 List 2D (4 in 7) in-band loop-up for five seconds. Observe that a "NLOC" HLU-200 List 2D loopback is in effect. The loopback state is indicated by the GREEN LOOP LED on the front panel and is also displayed in the Span Status screen.

5 Repeat Step 2. If the test passes, the problem is in the downstream direction. If it fails, the problem is in the upstream direction.

NOTES ON NON-DOUBLER GNLB LOOPBACK TEST PROCEDURES:

- The HLU-200 List 2D can be looped-up from the remote location (CREM) by issuing the (6 in 7) command at the HRU DS1 input port.
- The HRU 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 A1LB, A2LB, and the A5LB test procedures:

1 Send into the HLU-200 List 2D the in-band ARMING and NI LPBK code 11000 for at least five seconds.

2 Monitor the output of the HLU-200 for the return of the pattern. Return of pattern indicates that:

- either the HRU has looped-up (if the SMARTJACK LOOPBACK option is ENABLED)
- or that an external NI has looped up (if the SMARTJACK LOOPBACK option is DISABLED) and that the HLU-200 List 2D and HRU units have been ARMED.

3 Verify, if possible, that the HRU LOOPBACK LED is flashing, indicating that the HRU is armed or lights steadily, indicating that it is both armed and in loopback.

4 Once armed the HLU-200 can be looped back (see NLOC in Figure 24 on page 27 for non-doubler loopback configurations) 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 presented:

a Two seconds of all ones pattern

b Five seconds of returning data pattern

c 231 logic errors (including the frame bit) occurring in the returned pattern comprising:

- 10 errors if ILR-1 (Doubler 1) was sent
- 200 errors if ILR-20 (Doubler 2) was sent
- 20 errors if ILR-2 (HRU) was sent
- normal looped data

This error pattern will repeat every 20 seconds as long as the IOR loopback pattern is being sent. This also applies to ILR, Time-Out Override and Query commands.

Some Intelligent Repeater (IR) test sets do not count frame errors as bit errors when the test pattern is framed and the HLU-200 is set to the AUTO framing mode. To improve compatibility with those test sets, the HLU-200 generates 201 (NDU2) and 232 (NLOC) ID bit errors. As a result, the HLU-200 may indicate one more or one less bit error, depending on the test set type and the number of frame bits contained in the block of errored bits. To avoid this uncertainty, ADC recommends sending the IR commands unframed.

The HLU is now in Logic Loopback. The Loopback Time-out option can be set by the user to:

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

These selections determine 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 4, above, is repeated and the automatic timed expiration of the loopback is inhibited. If this Time-out Override is sent, then the only two ways to loop the HLU-200 down are to:

- Issue the IR (Intelligent Repeater) LPDN (loop-down) code 1001 0011 1001 0011 (9393)
- Issue 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 loop down but remain ARMED, send the IR (Intelligent Repeater) LPDN code (universal loop down).
- If all the equipment is to be looped down, disarmed and returned to normal operation, send the disarm code 11100.

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

- **Loopback terminates (manually or time-out),**
- **Query**
- **Alternate query**
- **Far end activate**
- **Another ARM command.**

Using the codes listed in Table 10, a network tester can activate loopbacks NLOC or NREM or SMJK (if enabled). A customer tester can activate loopbacks CLOC or CREM.

Table 10. *Addressable 1, 2, 5 (A1LB, A2LB, A5LB) Repeater Loopback Commands*

Name	Description	Code [a]
ARMING or NI LPBK (in-band)	Arming code	11000 11000 …
ARMING or NI LPBK (ESF Data Link)	Arming code	1111(F) [b] 1111(F)0100(4)1000(8)
IR LPDN or DISARM (in-band)	Disarming code	11100 11100 …
DISARM (ESF Data Link)	Disarming code	1111(F)1111(F)0010(2)0100(4)
IOR LPBK (NLOC and CREM 229-231 bit errors) [c]	HLU Loopup	1101(D)0011(3)1101(D)0011(3)
ILR-1 LPBK (NDU1 and CDU1 10 bit errors) [d]	**DOUBLER-1 Loop up**	**1100(C)0111(7)0100(4)0001(1)**
LR-20 LPBK (NDU2 and CDU2 200 bit errors)	**DOUBLER-2 Loop up**	**1100(C)0111(7)0101(5)0100(4)**
ILR-2 LPBK (NREM and CLOC 20 bit errors)	**HRU Loop up**	**1100(C)0111(7)0100(4)0010(2)**
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)
TIME-OUT OVERRIDE	Loopback Time-out Override	1101(D)0101(5)1101(D)0110(6)
FAR END NI ACTIVATE [e]	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)

(a) 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.

(b) This is the HEX number for the 4-bit group.

(c) 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.

(d) 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.

(e) Not supported by A5LB.

Information found in bold in Table 10 and Table 11, "Addressable 3 and 4 (A3LB and A4LB) Repeater Loopback Commands," on page 34 is specific to HiGain doublers.

A3LB AND A4LB TEST PROCEDURES

The HLU-200 can be looped back by sending the Addressable Office Repeater (AOR) LPBK activation code 1111(F) 1111(F) 0001(1) 1110(E) for at least 5 seconds. This causes the HLU-200 to enter the NLOC state. The Loopback Time-out option can be set by the user to:

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

These selections determine 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-200 down is to issue one of the three loopdown commands listed in Step 2. The automatic time-out mode is restored during subsequent loopback sessions.

Table 11, "Addressable 3 and 4 (A3LB and A4LB) Repeater Loopback Commands," on page 34 summarizes the codes required to execute Addressable 3 and 4 (A3LB and A4LB) repeater loopback commands. All code sequences must be present for at least 5 seconds. The abbreviations used in Table 11 are as follows:

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

Table 11. *Addressable 3 and 4 (A3LB and A4LB) Repeater Loopback Commands*

Position	Name	Code [a]
HLU-200 LU FROM NI	NLOC	1111(F) [b] 1111(F)0001(1)1110(E)
HLU-200 LU from CI	CREM	0011(3)1111(F)0001(1)1110(E)
HDU DOUBLER 1 FROM NI	**NDU1**	**1111 1111 0000 0100 (FF04)**
HDU DOUBLER 1 FROM CI	**CDU1**	**0011 1111 0000 0100 (3F04)**
HDU DOUBLER 2 FROM NI	**NDU2**	**1111 1111 0000 0110 (FF06)**
HDU DOUBLER 2 FROM CI	**CDU2**	**0011 1111 0000 0110 (3F06)**
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)

(a) 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 entire arming and loopback sequence can be initiated at the remote HRU location.

(b) This is the HEX number for the 4-bit group.

APPENDIX A - TECHNICAL SPECIFICATIONS

HDSL

Line Code	784 kbps, 2B1Q
Output	+13.5 dBm ±0.5 dB at 135Ω
Line Impedance	135Ω
Span Voltage	-130 V to ± 200 V dc
Start-up Time (per span)	30 seconds (typical), 60 seconds (maximum) per span

DS-1

Line rate	1.544 Mbps ± 200 bps
Line format	AMI, B8ZS, or ZBTSI
Frame format	ESF, SF or unframed/CRC

Line Clock Rate

Internal Stratum 4 clock

One-way DS-1 Delay

<220 µs per span

Maximum Provisioning Loss

35 dB @ 196 kHz, 135Ω

Maximum Heat Dissipation

5W (without doubler), 6.3W (with doubler) typical

Mounting

Litespan 2000 CBA/ONU-48, 96

Electrical Protection

Secondary surge and power cross protection on all HDSL ports.

Environmental

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

Dimensions and Weight

Height	4.42 in. (11.22 cm)
Width	0.84 in. (2.13 cm)
Depth	10.2 in. (25.9 cm)
Weight	1 lb. (.45 kg)

APPENDIX B - CONNECTOR & HDSL CABLE LOOPBACK ASSIGNMENT

The HLU-200 List 2D mounts in a Litespan 2000 channel bank.

CARD-EDGE CONNECTOR

The HLU-200 List 2 D slot pinouts are shown in Figure 26.

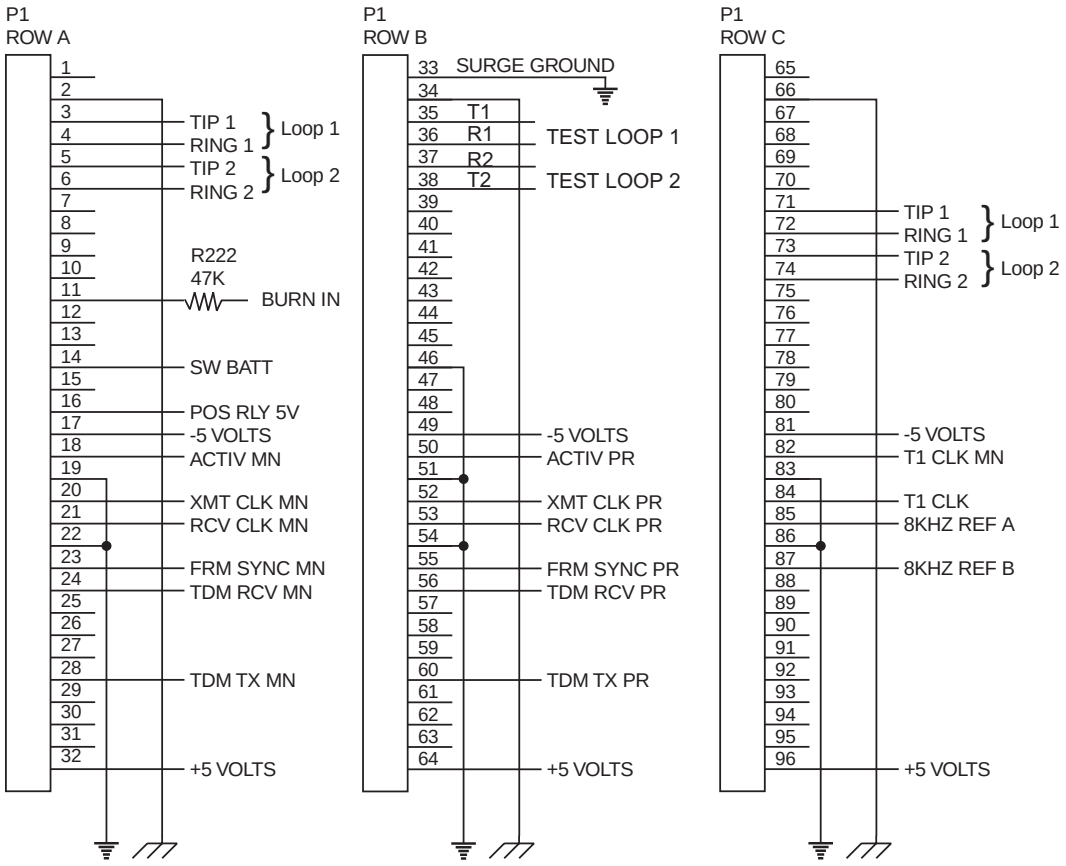


Figure 26. *HLU-200 List 2D Card-Edge Connectors*

INPUT/OUTPUT CABLING

The HLU-200 List 2D HDSL Loop 1 and Loop 2 pairs are available at both the Narrowband and Wideband mass connectors of the Alcatel shelf it occupies as shown in Table 12. Figure 26 shows the generic Loop to three (A, B, and C) Pin Connector row assignments. Table 13 on page 37 lists the Wideband cabling details for the Litespan 2000 CBA shelf.

Table 12. *Wideband and Narrowband HDSL Loop Cable Assignment*

HLU-200 Slot Connector (P1) Pin Assignments	Function	Wideband Cabling	Narrowband Cabling
3 (A3) and 71 (C7)	HDSL Loop1 - Tip	OUT Pair	Circuit 1
4 (A4) and 72 (C8)	HDSL Loop1 - Ring		
5 (A5) and 73 (C9)	HDSL Loop2 - Tip	IN Pair	Circuit 2
6 (A6) and 74 (C10)	HDSL Loop2 - Ring		

Providing this dual connector access to each HDSL cable pair makes it imperative that no connection be made to the connector that is not used.

Table 13 lists the Wideband cabling details for the Litespan 2000 CBA shelf.

Table 13. *CBA Wideband Cabling/HDSL Loop Assignments*

Color Code (Base/Ink)	Pin # (Tip - Ring)		J1		J2		J3		J4		J5		J6	
Tip - Ring	710 or 3M	AMP	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.
Wh/Bl - Bl/Wh	1 - 2	26 - 1	1 - L2	1	1 - L1	21	21 - L2	41	21 - L1	61	41 - L2	81	41 - L1	101
Wh/Or - Or/Wh	3 - 4	27 - 2	2 - L2	2	2 - L1	22	22 - L2	42	22 - L1	62	42 - L2	82	42 - L1	102
Wh/Gr - Gr/Wh	5 - 6	28 - 3	3 - L2	3	3 - L1	23	23 - L2	43	23 - L1	63	43 - L2	83	43 - L1	103
Wh/Br - Br/Wh	7 - 8	29 - 4	4 - L2	4	4 - L1	24	24 - L2	44	24 - L1	64	44 - L2	84	44 - L1	104
Wh/Sl - Sl/Wh	9 - 10	30 - 5	5 - L2	5	5 - L1	25	25 - L2	45	25 - L1	65	45 - L2	85	45 - L1	105
Rd/Bl - Bl/Rd	11 - 12	31 - 6	6 - L2	6	6 - L1	26	26 - L2	46	26 - L1	66	46 - L2	86	46 - L1	106
Rd/Or - Or/Rd	13 - 14	32 - 7	7 - L2	7	7 - L1	27	27 - L2	47	27 - L1	67	47 - L2	87	47 - L1	107
Rd/Gr - Gr/Rd	15 - 16	33 - 8	8 - L2	8	8 - L1	28	28 - L2	48	28 - L1	68	48 - L2	88	48 - L1	108
Rd/Br - Br/Rd	17 - 18	34 - 9	9 - L2	9	9 - L1	29	29 - L2	49	29 - L1	69	49 - L2	89	49 - L1	109
Rd/Sl - Sl/Rd	19 - 20	35 - 10	10 - L2	10	10 - L1	30	30 - L2	50	30 - L1	70	50 - L2	90	50 - L1	110
Bk/Bl - Bl/Bk	21 - 22	36 - 11	11 - L2	11	11 - L1	31	31 - L2	51	31 - L1	71	51 - L2	91	51 - L1	111
Bk/Or - Or/Bk	23 - 24	37 - 12	12 - L2	12	12 - L1	32	32 - L2	52	32 - L1	72	52 - L2	92	52 - L1	112
Bk/Gr - Gr/Bk	25 - 26	38 - 13	13 - L2	13	13 - L1	33	33 - L2	53	33 - L1	73	53 - L2	93	53 - L1	113
Bk/Br - Br/Bk	27 - 28	39 - 14	14 - L2	14	14 - L1	34	34 - L2	54	34 - L1	74	54 - L2	94	54 - L1	114
Bk/Sl - Sl/Bk	29 - 30	40 - 15	15 - L2	15	15 - L1	35	35 - L2	55	35 - L1	75	55 - L2	95	55 - L1	115
Yl/Bl - Bl/Yl	31 - 32	41 - 16	16 - L2	16	16 - L1	36	36 - L2	56	36 - L1	76	56 - L2	96	56 - L1	116
Yl/Or - Or/Yl	33 - 34	42 - 17	17 - L2	17	17 - L1	37	37 - L2	57	37 - L1	77	N/C	97	N/C	117
Yl/Gr - Gr/Yl	35 - 36	43 - 18	18 - L2	18	18 - L1	38	38 - L2	58	38 - L1	78	N/C	98	N/C	118
Yl/Br - Br/Yl	37 - 38	44 - 19	19 - L2	19	19 - L1	39	39 - L2	59	39 - L1	79	N/C	99	N/C	119

Table 13. *CBA Wideband Cabling/HDSL Loop Assignments (Cont.)*

Color Code (Base/Ink)	Pin # (Tip - Ring)		J1		J2		J3		J4		J5		J6	
Tip - Ring	710 or 3M	AMP	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.
Yl/Sl - Sl/Yl	39 - 40	45 - 20	20 - L2	20	20 - L1	40	40 - L2	60	40 - L1	80	N/C	100	N/C	120
Vi/Bl - Bl/Vi	41 - 42	46 - 21												
Vi/Or - Or/Vi	43 - 44	47 - 22												
Vi/Gr - Gr/Vi	45 - 46	48 - 23	Spares Tied Off											
Vi/Br - Br/Vi	47 - 48	49 - 24												
Vi/Sl	49	50												
Sl/Vi	N/C	N/C												
Drain Wire	50	25	Frame Ground											
L1 = HDSL Loop 1, L2 = HDSL Loop 2														

The J1 through J6 cables are normally used to access the two Input/Output (I/O) ports from slots that contain standard T1 channel units. Column 1 lists the color code ID of each pair. Columns 2 and 3 list the pin numbers of either the 710 or AMP cables that are provided by the CBA. The odd numbered cable columns (J1,3 and 5) list the Slot #/HDSL Loop 2 assignments. The even numbered cable columns (J2, J4, and J6) list the Slot #/HDSL Loop 1 assignments. The Pr. columns list the pairs in sequential order from 1 to 120 with pairs 77 through 100 having No Connection (N/C). These pair numbers can be used by LFACS or other automatic circuit assignment programs.

Narrowband cables (P1 through P9 in Table 14) are normally used to access the four I/O ports from various DS0 channel units. When more than 1 CBA shelf is associated with a common control assembly (nine maximum), both even and odd CBA shelves must be used. The odd shelves (1, 3, 5 and 7) have slightly different Narrowband I/O cable assignments than the even shelves. This is done to facilitate LFACS pair assignment with minimum loss of cable pairs. In an odd bank the last Narrowband cable pair (# 225) is not available. Table 14 lists the Narrowband cabling details for the odd Litespan 2000 CBA shelves. HDSL Loop 1 (L1) is assigned to the conventional Circuit 1 of each slot and is shown in the Slot/circuit column as X-L1. HDSL Loop 2 (L2) is assigned to the conventional Circuit 2 of each slot and is shown in the Slot/circuit column as X-L2. Where X= Slot #. The HLU-200 has no connection to the narrowband ports normally assigned to Circuits 3 and 4 of each narrowband cable.

Table 14. *Odd CBA Narrowband Cabling (Last Pair Unassigned)/ HDSL Loop Assignments*

Color Code (Base /Ink)	Pin # (Tip - Ring)		P1		P2		P3		P4		P5		P6		P7		P8		P9	
Tip - Ring	710 or 3M	AMP	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.
Wh/Bl - Bl/Wh	1 - 2	26 - 1	1 - L1	1	7 - L2	26					26 - L1	101	32 - L2	126					51 - L1	201
Wh/Or - Or/Wh	3 - 4	27 - 2	1 - L2	2					20 - L1	77	26 - L2	102					45 - L1	177	51 - L2	202
Wh/Gr - Gr/Wh	5 - 6	28 - 3					14 - L1	53	20 - L2	78					39 - L1	153	45 - L2	178		
Wh/Br - Br/Wh	7 - 8	29 - 4			8 - L1	29	14 - L2	54					33 - L1	129	39 - L2	154				
Wh/Sl - Sl/Wh	9 - 10	30 - 5	2 - L1	5	8 - L2	30					27 - L1	105	33 - L2	130					52 - L1	205
Rd/Bl - Bl/Rd	11 - 12	31 - 6	2 - L2	6					21 - L1	81	27 - L2	106					46 - L1	181	52 - L2	206
Rd/Or - Or/Rd	13 - 14	32 - 7					15 - L1	57	21 - L2	82					40 - L1	157	46 - L2	182		
Rd/Gr - Gr/Rd	15 - 16	33 - 8			9 - L1	33	15 - L2	58					34 - L1	133	40 - L2	158				
Rd/Br - Br/Rd	17 - 18	34 - 9	3 - L1	9	9 - L2	34					28 - L1	109	34 - L2	134					53 - L1	209
Rd/Sl - Sl/Rd	19 - 20	35 - 10	3 - L2	10					22 - L1	85	28 - L2	110					47 - L1	185	53 - L2	210
Bk/Bl - Bl/Bk	21 - 22	36 - 11					16 - L1	61	22 - L2	86					41 - L1	161	47 - L2	186		
Bk/Or - Or/Bk	23 - 24	37 - 12			10 - L1	37	16 - L2	62					35 - L1	137	41 - L2	162				
Bk/Gr - Gr/Bk	25 - 26	38 - 13	4 - L1	13	10 - L2	38					29 - L1	113	35 - L2	138					54 - L1	213
Bk/Br - Br/Bk	27 - 28	39 - 14	4 - L2	14					23 - L1	89	29 - L2	114					48 - L1	189	54 - L2	214
Bk/Sl - Sl/Bk	29 - 30	40 - 15					17 - L1	65	23 - L2	90					42 - L1	165	48 - L2	190		
Yl/Bl - Bl/Yl	31 - 32	41 - 16			11 - L1	41	17 - L2	66					36 - L1	141	42 - L2	166				
Yl/Or - Or/Yl	33 - 34	42 - 17	5 - L1	17	11 - L2	42					30 - L1	117	36 - L2	142					55 - L1	217
Yl/Gr - Gr/Yl	35 - 36	43 - 18	5 - L2	18					24 - L1	93	30 - L2	118					49 - L1	193	55 - L2	218
Yl/Br - Br/Yl	37 - 38	44 - 19					18 - L1	69	24 - L2	94					43 - L1	169	49 - L2	194		
Yl/Sl - Sl/Yl	39 - 40	45 - 20			12 - L1	45	18 - L2	70					37 - L1	145	43 - L2	170				
Vi/Bl - Bl/Vi	41 - 42	46 - 21	6 - L1	21	12 - L2	46					31 - L1	121	37 - L2	146					56 - L1	221
Vi/Or - Or/Vi	43 - 44	47 - 22	6 - L2	22					25 - L1	97	31 - L2	122					50 - L1	197	56 - L2	222
Vi/Gr - Gr/Vi	45 - 46	48 - 23					19 - L1	73	25 - L2	98					44 - L1	173	50 - L2	198		
Vi/Br - Br/Vi	47 - 48	49 - 24			13 - L1	49	19 - L2	74					38 - L1	149	44 - L2	174				
Vi/Sl - Sl/Vi	49 - 50	50 - 25	7 - L1	25	13 - L2	50					32 - L1	125	38 - L2	150					NA	225
L1 = HDSL Loop 1, L2 = HDSL Loop 2																				

In an Even bank the first Narrowband cable pair (# 226) is not available. Table 15 lists the corresponding Narrowband cabling details for the Even Litespan 2000 CBA shelves.

Table 15. *Even CBA Narrowband Cabling (First Pair Unassigned)/HDSL Loop Assignments*

Base/ Ink Color Code	Pin # (Tip - Ring)		P1		P2		P3		P4		P5		P6		P7		P8		P9	
Tip - Ring	710 or 3M	AMP	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.	Slot - Loop	Pr.
wh/bl-bl/wh	1 - 2	26 - 1	NA	226	7 - L1	251	13 - L2	276					32 - L1	351	38 - L2	376				
wh/or - or/wh	3 - 4	27 - 2	1 - L1	227	7 - L2	252					26 - L1	327	32 - L2	352					51 - L1	427
wh/gr - gr/wh	5 - 6	28 - 3	1 - L2	228					20 - L1	303	26 - L2	328					45 - L1	403	51 - L2	428
wh/br - br/wh	7 - 8	29 - 4					14 - L1	279	20 - L2	304					39 - L1	379	45 - L2	404		
wh/sl-sl/wh	9 - 10	30 - 5			8 - L1	255	14 - L2	280					33 - L1	355	39 - L2	380				
rd/bl-bl/rd	11 - 12	31 - 6	2 - L1	231	8 - L2	256					27 - L1	331	33 - L2	356					52 - L1	431
rd/or-or/rd	13 - 14	32 - 7	2 - L2	232					21 - L1	307	27 - L2	332					46 - L1	407	52 - L2	432
rd/gr-gr/rd	15 - 16	33 - 8					15 - L1	283	21 - L2	308					40 - L1	383	46 - L2	408		
rd/br-br/rd	17 - 18	34 - 9			9 - L1	259	15 - L2	284					34 - L1	359	40 - L2	384				
rd/sl-sl/rd	19 - 20	35 - 10	3 - L1	235	9 - L2	260					28 - L1	335	34 - L2	360					53 - L1	435
bk/bl-bl/bk	21 - 22	36 - 11	3 - L2	236					22 - L1	311	28 - L2	336					47 - L1	411	53 - L2	436
bk/or-or/bk	23 - 24	37 - 12					16 - L1	287	22 - L2	312					41 - L1	387	47 - L2	412		
bk/gr-gr/bk	25 - 26	38 - 13			10 - L1	263	16 - L2	288					35 - L1	363	41 - L2	388				
bk/br-br/bk	27 - 28	39 - 14	4 - L1	239	10 - L2	264					29 - L1	339	35 - L2	364					54 - L1	439
bk/sl-sl/bk	29 - 30	40 - 15	4 - L2	240					23 - L1	315	29 - L2	340					48 - L1	415	54 - L2	440
yl/bl-bl/yl	31 - 32	41 - 16					17 - L1	291	23 - L2	316					42 - L1	391	48 - L2	416		
yl/or-or/yl	33 - 34	42 - 17			11 - L1	267	17 - L2	292					36 - L1	367	42 - L2	392				
yl/gr-gr/yl	35 - 36	43 - 18	5 - L1	243	11 - L2	268					30 - L1	343	36 - L2	368					55 - L1	443
yl/br-br/yl	37 - 38	44 - 19	5 - L2	244					24 - L1	319	30 - L2	344					49 - L1	419	55 - L2	444
yl/sl-sl/yl	39 - 40	45 - 20					18 - L1	295	24 - L2	320					43 - L1	395	49 - L2	420		
vi/bl-bl/vi	41 - 42	46 - 21			12 - L1	271	18 - L2	296					37 - L1	371	43 - L2	396				
vi/or-or/vi	43 - 44	47 - 22	6 - L1	247	12 - L2	272					31 - L1	347	37 - L2	372					56 - L1	447
vi/gr-gr/vi	45 - 46	48 - 23	6 - L2	248					25 - L1	323	31 - L2	348					50 - L1	423	56 - L2	448
vi/br-br/vi	47 - 48	49 - 24					19 - L1	299	25 - L2	324					44 - L1	399	50 - L2	424		
vi/sl - sl/vi	49 - 50	50 - 25			13 - L1	275	19 - L2	300					38 - L1	375	44 - L2	400				

L1 = HDSL Loop 1, L2 = HDSL Loop 2

The HLU is compatible with the Alcatel 24 slot Optical Network Unit 96 (ONU-96) Starspan card cage assembly. Table 16 lists the Wideband cabling/HDSL loop assignment details.

Table 16. *ONU-96 Wideband Cabling/HDSL Loop Assignments*

Color Code (Base/Ink)	Pin # (Tip - Ring)		J1		J2		J3		J4	
Tip - Ring	710 or 3M	AMP	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.	Slot - Pair	Pr.
Wh/Bl - Bl/Wh	1 - 2	26 - 1	N/C	1	N/C	26	N/C	51	N/C	76
Wh/Or - Or/Wh	3 - 4	27 - 2	N/C	2	N/C	27	N/C	52	N/C	77
Wh/Gr - Gr/Wh	5 - 6	28 - 3	1 - L1	3	7 - L1	28	13 - L1	53	19 - L1	78
Wh/Br - Br/Wh	7 - 8	29 - 4	1 - L2	4	7 - L2	29	13 - L2	54	19 - L2	79
Wh/Sl - Sl/Wh	9 - 10	30 - 5	N/C	5	N/C	30	N/C	55	N/C	80
Rd/Bl - Bl/Rd	11 - 12	31 - 6	N/C	6	N/C	31	N/C	56	N/C	81
Rd/Or - Or/Rd	13 - 14	32 - 7	2 - L1	7	8 - L1	32	14 - L1	57	20 - L1	82
Rd/Gr - Gr/Rd	15 - 16	33 - 8	2 - L2	8	8 - L2	33	14 - L2	58	20 - L2	83
Rd/Br - Br/Rd	17 - 18	34 - 9	N/C	9	N/C	34	N/C	59	N/C	84
Rd/Sl - Sl/Rd	19 - 20	35 - 10	N/C	10	N/C	35	N/C	60	N/C	85
Bk/Bl - Bl/Bk	21 - 22	36 - 11	3 - L1	11	9 - L1	36	15 - L1	61	21 - L1	86
Bk/Or - Or/Bk	23 - 24	37 - 12	3 - L2	12	9 - L2	37	15 - L2	62	21 - L2	87
Bk/Gr - Gr/Bk	25 - 26	38 - 13	N/C	13	N/C	38	N/C	63	N/C	88
Bk/Br - Br/Bk	27 - 28	39 - 14	N/C	14	N/C	39	N/C	64	N/C	89
Bk/Sl - Sl/Bk	29 - 30	40 - 15	4 - L1	15	10 - L1	40	16 - L1	65	22 - L1	90
Yl/Bl - Bl/Yl	31 - 32	41 - 16	4 - L2	16	10 - L2	41	16 - L2	66	22 - L2	91
Yl/Or - Or/Yl	33 - 34	42 - 17	N/C	17	N/C	42	N/C	67	N/C	92
Yl/Gr - Gr/Yl	35 - 36	43 - 18	N/C	18	N/C	43	N/C	68	N/C	93
Yl/Br - Br/Yl	37 - 38	44 - 19	5 - L1	19	11 - L1	44	17 - L1	69	23 - L1	94
Yl/Sl - Sl/Yl	39 - 40	45 - 20	5 - L2	20	11 - L2	45	17 - L2	70	23 - L2	95
Vi/Bl - Bl/Vi	41 - 42	46 - 21	N/C	21	N/C	46	N/C	71	N/C	96
Vi/Or - Or/Vi	43 - 44	47 - 22	N/C	22	N/C	47	N/C	72	N/C	97
Vi/Gr - Gr/Vi	45 - 46	48 - 23	6 - L1	23	12 - L1	48	18 - L1	73	24 - L1	98
Vi/Br - Br/Vi	47 - 48	49 - 24	6 - L2	24	12 - L2	49	18 - L2	74	24 - L2	99
Vi/Sl - Sl/Vi	49 - 50	50 - 25	N/C Drain	25	N/C Drain	50	N/C Drain	75	N/C Drain	100
L1 = HDSL Loop 1, L2 = HDSL Loop 2										

Table 17 lists the Narrowband cabling details for this ONU-96 system.

Table 17. *ONU-96 Narrowband Cabling/HDSL Loop Assignments*

Color Code (Base/Ink)	**Pin # (Tip - Ring)**		**P1**		**P2**		**P3**		**P4**	
Tip - Ring	**710 or 3M**	**AMP**	**Slot - Circuit**	**Pr.**	**Slot - Circuit**	**Pr.**	**Slot - Circuit**	**Pr.**	**Slot - Circuit**	**Pr.**
Wh/Bl - Bl/Wh	1 - 2	26 - 1	1 - L1	1	7 - L2	26				
Wh/Or - Or/Wh	3 - 4	27 - 2	1 - L2	2					20 - L1	77
Wh/Gr - Gr/Wh	5 - 6	28 - 3					14 - L1	53	20 - L2	78
Wh/Br - Br/Wh	7 - 8	29 - 4			8 - L1	29	14 - L2	54		
Wh/Sl - Sl/Wh	9 - 10	30 - 5	2 - L1	5	8 - L2	30				
Rd/Bl - Bl/Rd	11 - 12	31 - 6	2 - L2	6					21 - L1	81
Rd/Or - Or/Rd	13 - 14	32 - 7					15 - L1	57	21 - L2	82
Rd/Gr - Gr/Rd	15 - 16	33 - 8			9 - L1	33	15 - L2	58		
Rd/Br - Br/Rd	17 - 18	34 - 9	3 - L1	9	9 - L2	34				
Rd/Sl - Sl/Rd	19 - 20	35 - 10	3 - L2	10					22 - L1	85
Bk/Bl - Bl/Bk	21 - 22	36 - 11					16 - L1	61	22 - L2	86
Bk/Or - Or/Bk	23 - 24	37 - 12			10 - L1	37	16 - L2	62		
Bk/Gr - Gr/Bk	25 - 26	38 - 13	4 - L1	13	10 - L2	38				
Bk/Br - Br/Bk	27 - 28	39 - 14	4 - L2	14					23 - L1	89
Bk/Sl - Sl/Bk	29 - 30	40 - 15					17 - L1	65	23 - L2	90
Yl/Bl - Bl/Yl	31 - 32	41 - 16			11 - L1	41	17 - L2	66		
Yl/Or - Or/Yl	33 - 34	42 - 17	5 - L1	17	11 - L2	42				
Yl/Gr - Gr/Yl	35 - 36	43 - 18	5 - L2	18					24 - L1	93
Yl/Br - Br/Yl	37 - 38	44 - 19					18 - L1	69	24 - L2	94
Yl/Sl - Sl/Yl	39 - 40	45 - 20			12 - L1	45	18 - L2	70		
Vi/Bl - Bl/Vi	41 - 42	46 - 21	6 - L1	21	12 - L2	46				
Vi/Or - Or/Vi	43 - 44	47 - 22	6 - L2	22						97
Vi/Gr - Gr/Vi	45 - 46	48 - 23					19 - L1	73	N/C	98
Vi/Br - Br/Vi	47 - 48	49 - 24			13 - L1	49	19 - L2	74		99
Vi/Sl - Sl/Vi	49 - 50	50 - 25	7 - L1	25	13 - L2	50				100
L1 = HDSL Loop 1, L2 = HDSL Loop 2										

The HLU is also compatible with the Alcatel, 12 slot, Optical Network Unit 48 (ONU-48) Starspan card cage assembly. Table 18 lists both the Wideband and Narrowband cabling/HDSL loop assignment details for this ONU-48 system.

Table 18. *ONU-48 Wideband and Narrowband Cabling/HDSL Loop Assignments*

Color Code (Base/Ink)	**Pin # (Tip - Ring)**	**P1**	**P2**	**J1**	**J2**				
Tip - Ring	**710 or 3M**	**Slot - Circuit**	**Pr.**	**Slot - Circuit**	**Pr.**	**Slot - Pair**	**Pr.**	**Slot - Pair**	**Pr.**
Wh/Bl - Bl/Wh	1 - 2	1 - L1	1	7 - L1	26	1 - L1	1		26
Wh/Or - Or/Wh	3 - 4	1 - L2	2	7 - L2	27	1 - L2	2		27
Wh/Gr - Gr/Wh	5 - 6					2 - L1	3	8 - L1	28
Wh/Br - Br/Wh	7 - 8					2 - L2	4	8 - L2	29
Wh/Sl - Sl/Wh	9 - 10	2 - L1	5	8 - L1	30	3 - L1	5	9 - L1	30
Rd/Bl - Bl/Rd	11 - 12	2 - L2	6	8 - L2	31	3 - L2	6	9 - L2	31
Rd/Or - Or/Rd	13 - 14					4 - L1	7	10 - L1	32
Rd/Gr - Gr/Rd	15 - 16					4 - L2	8	10 - L2	33
Rd/Br - Br/Rd	17 - 18	3 - L1	9	9 - L1	34	5 - L1	9	11 - L1	34
Rd/Sl - Sl/Rd	19 - 20	3 - L2	10	9 - L2	35	5 - L2	10	11 - L2	35
Bk/Bl - Bl/Bk	21 - 22					6 - L1	11	12 - L1	36
Bk/Or - Or/Bk	23 - 24					6 - L2	12	12 - L2	37
Bk/Gr - Gr/Bk	25 - 26	4 - L1	13	10 - L1	38	N/C	13	N/C	38
Bk/Br - Br/Bk	27 - 28	4 - L2	14	10 - L2	39	N/C	14	N/C	39
Bk/Sl - Sl/Bk	29 - 30					N/C	15	N/C	40
Yl/Bl - Bl/Yl	31 - 32					N/C	16	N/C	41
Yl/Or - Or/Yl	33 - 34	5 - L1	17	11 - L1	42	N/C	17	N/C	42
Yl/Gr - Gr/Yl	35 - 36	5 - L2	18	11 - L2	43	N/C	18	N/C	43
Yl/Br - Br/Yl	37 - 38					N/C	19	N/C	44
Yl/Sl - Sl/Yl	39 - 40					N/C	20	N/C	45
Vi/Bl - Bl/Vi	41 - 42	6 - L1	21	12 - L1	46	N/C	21	N/C	46
Vi/Or - Or/Vi	43 - 44	6 - L2	22	12 - L2	47	N/C	22	N/C	47
Vi/Gr - Gr/Vi	45 - 46					N/C	23	N/C	48
Vi/Br - Br/Vi	47 - 48					N/C	24	N/C	49
Vi/Sl - Sl/Vi	49 - 50	N/C	25	N/C	50	N/C Drain	25	N/C Drain	50
L1 = HDSL Loop 1, L2 = HDSL Loop 2									

APPENDIX C - PRODUCT SUPPORT

ADC Customer Service Group provides expert pre-sales and post-sales support and training for all its products.

Technical support is available 24 hours a day, 7 days a week by contacting the ADC Technical Assistance Center.

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

APPENDIX D - ABBREVIATIONS

2B1Q	2 Binary,1 Quaternary
ACO	Alarm Cut Off
AIS	Alarm Indicator Signal
AMI	Alternate Mark Inversion
AWG	American Wire Gauge
B8ZS	Bipolar with 8-zero Substitution
BBS	Bulletin Board System
BER	Bit Error Rate
BPV	Bipolar Violation
BRG	Bridge
CBA	Channel Bank Assembly
CI	Customer Installation
CLEI	Common Language Equipment Identifier
CLOC	Customer Local Loopback
CO	Central Office
CPE	Customer Premises Equipment
CRC	Cyclic Redundancy Check
CREM	Customer Remote Loopback
CSA	Carrier Service Area
CSU	Channel Service Unit
DCE	Data Circuit-Terminating Equipment
DDS	Digital Data Service
DIS	Disabled
DLC	Digital Loop Carrier
DS-1	Digital Signal, Level 1
DSX-1	DS1 Cross-connect Frame
ECI	Equipment Catalog Item
ENA	Enabled
ENFT	Enable Fractional T1
ES	Errored Seconds
ESF	Extended SuperFrame
ESF DL	Extended SuperFrame Data Link
FEND	Far End
HCDS	High Capacity Digital Service
HCS	HiGain Central Office Shelf
HDSL	High-bit-rate Digital Subscriber Line
HDU	HiGain Doubler Unit
HG	HiGain
HLU	HiGain Line Unit
HMS	HiGain Management Shelf
HMU	HiGain Management Unit
HRE	HiGain Remote Enclosure
HRU	HiGain Remote Unit
I-CPE	Interface-Customer Premises Equipment
IOR	Intelligent Office Repeater
LED	Light Emitting Diodes
LOS	Loss of Signal
LOSW	Loss of Sync Word
NEBS	Network Equipment Building System
NEC	National Electric Code
NEND	Near End
NI	Network Interface
NID	Network Interface Device
NIU	Network Interface Unit
NLOC	Network Local Loopback
NMA	Network Management and Administration
NREM	Network Remote Loopback
NVRAM	Non-Volatile Random Access Memory

PCS	Personal Communication Services
PL	Payload
POTS	Plain Old Telephone Service
PWRF	Power Feed
RCV	Receive
RDA	Remote DS-1 Alarm
RLOS	Remote Loss of Signal
RMA	Return Material Authorization
SAIS	SmartJack AIS
SF	Super Frame
SNR	Signal-to-Noise Ratio
SPLB	Special Loopback
STS	Span Terminating Shelf
TLOS-LB	Transmit Loss of Signal-Loopback
TSGR	Transport System Generic Requirements
UAS	Unavailable Seconds
XMT	Transmit
ZBTSI	Zero-Byte Timeslot Interchange

CERTIFICATION AND WARRANTY

FCC COMPLIANCE

This unit complies with the limits for Class A digital devices pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, can cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Refer to the installation section of this manual for guidance on:

Cabling

Correct connections

Grounding

LIMITED WARRANTY

ADC DSL Systems, Incorporated (“ADC”) warrants that, for a period of sixty (60) months from the date of shipment, the hardware portion of its products will be free of material defects and faulty workmanship under normal use. ADC's obligation, under this warranty, is limited to replacing or repairing, at ADC's option, any such hardware product which is returned during the 60-month warranty period per ADC's instructions and which product is confirmed by ADC not to comply with the foregoing warranty.

ADC warrants that, for a period of 90 days from the date of purchase, the software furnished with its products will operate substantially in accordance with the ADC published specifications and documentation for such software. ADC’s entire liability for software that does not comply with the foregoing warranty and is reported to ADC during the 90-day warranty period is, at ADC’s option, either (a) return of the price paid or (b) repair or replace of the software. ADC also warrants that, for a period of thirty (30) days from the date of purchase, the media on which software is stored will be free from material defects under normal use. ADC will replace defective media at no charge if it is returned to ADC during the 30-day warranty period along with proof of the date of shipment.

The transportation charges for shipment of returned products to ADC will be prepaid by the Buyer. ADC will pay transportation charges for shipment of replacement products to Buyer, unless no trouble is found (NTF), in which case the Buyer will pay transportation charges.

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

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

ADC DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WITH RESPECT TO ITS PRODUCTS AND ANY ACCOMPANYING WRITTEN MATERIALS. FURTHER, ADC DOES NOT WARRANT THAT SOFTWARE WILL BE FREE FROM BUGS OR THAT ITS USE WILL BE UNINTERRUPTED OR REGARDING THE USE, OR THE RESULTS OF THE USE, OF THE SOFTWARE IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY OR OTHERWISE.

MODIFICATIONS

Any changes or modifications made to this device that are not expressly approved by ADC voids the user's warranty.

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

STANDARDS COMPLIANCE

The HLU-200 List 2D has been tested and verified to comply with the applicable sections of the following standards.

- GR 63-CORE - Network Equipment-Building System (NEBS) Requirements
- GR 1089-CORE - Electromagnetic Compatibility and Electrical Safety

To comply with the intrabuilding wiring requirements of GR-1089-CORE, section 4.5.9, the shields of the ABAM-type cables that connect the HLU-200 List 2D DSX-1 output ports to the cross-connect panel must be grounded at both ends.

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