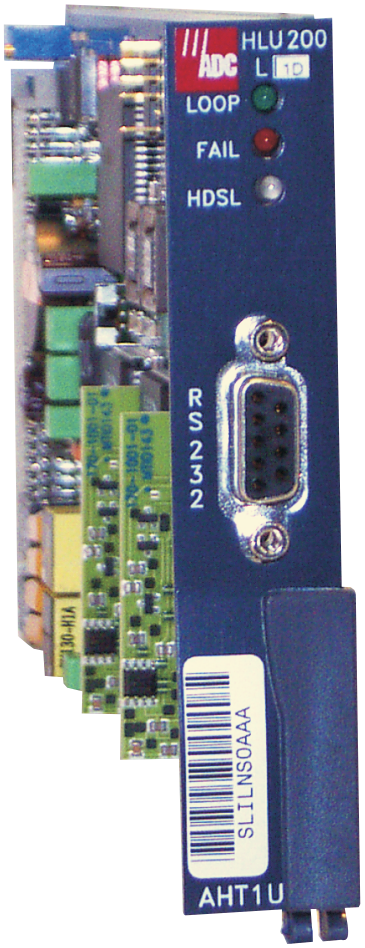
HiGain

USER MANUAL



HLU-200 List 1D Line Unit for Litespan-2000 Channel Bank
Product Catalog: HLU-200-L1D
CLEI: SLILNS0A

REVISION HISTORY OF THIS MANUAL

To order copies of this document, use document catalog number 150-200-114-03.

Issue	Release Date	Revisions Made
01	01/07/96	Initial release
02	11/22/96	Added Sections A3 and A4
03	03/08/02	ADC rebrand

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

Table of Contents

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

Product Overview

Descriptions and Features

ADC's HiGain Line Unit Model HLU-200 List 1D (AHT1U) shown in Figure 1, is an asynchronous DS1 interface unit that plugs into the Channel Bank Assembly (CBA) of a DSC Litespan-2000 optical loop carrier system to provide an HDSL interface. The AHT1U is essentially an AT1U line unit with its T1 line interface circuit replaced by an HDSL line interface circuit. When used in conjunction with an HRU-412 HiGain Remote Unit, the system provides 1.544 Mbps transmission on two unconditioned copper pairs over the full Carrier Serving Area (CSA) range. The CSA includes loops up to 12,000 feet of AWG 24 or 9,000 feet of AWG 26 wire, including bridged taps. This CSA range can be doubled with an HDU doubler and tripled with two doublers. The HiGain system uses HDSL (High-bit-rate Digital Subscriber Line) transmission technology as recommended by Bellcore TA-TSY-001210. HiGain complies with TR-TSY-000063 (Network Equipment Building System (NEBS) Generic Equipment requirements) and TR-TSY-000499 (Transport System Generic Requirements - TSGR) common requirements.

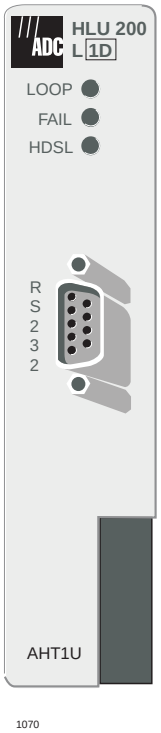


Figure 1. *HLU-200 List 1D Front Panel.*

The HLU-200 List 1D is compatible with the DSC Litespan-2000 Channel Bank version 7.1.x and 8.1.x (originally 7.2.x).

HLU-200 List 1D features:

- RS-232 maintenance port
- Lightning and power cross protection on HDSL interfaces
- 784 kbps full-duplex 2B1Q HDSL Transmission on two pairs
- Front panel status indicating LEDs
- Margin threshold alarm
- Upgradeable to HLU-200 List 2D (AHDSL) line unit
- Low power consumption
- Doubler compatible.

Applications

The HiGain system provides a cost-effective, easy-to-deploy method for delivering T1 High Capacity Digital Service (HCDS) over metallic pairs. The fiber-like quality service is deployed over two unconditioned, non-loaded copper pairs. Conventional inline T1 repeaters are not required. Cable pair conditioning, pair separation and bridged tap removal are not required. See Figure 2 for typical HLU-200 applications.

General guidelines require that each HDSL loop have less than 35 dB of loss at 196 kHz, with 135 ohms driving and terminating impedances and comply with CSA guidelines. The HiGain system operates with any number of other T1, POTS, Digital Data Service (DDS), or other HiGain systems sharing the same cable binder group. HiGain systems can be used for customers requiring DS1 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 be installed at a leisurely pace and cut-over from the installed HiGain system when convenient to do so. The installed HiGain system can then be easily removed and utilized elsewhere.

The HLU-200 operates as a channel card within a DSC Litespan-2000 Channel Bank. The Litespan-2000 system consists of a CO bank that is connected to a remote bank over an OC3 fiber link. Each bank has slots for 56 channel plug-ins. The HLU-200 List 1D is typically installed in the remote bank where it is used to transmit a T1 payload to a remote HRU-412 over two unconditioned HDSL cable pairs, with or without doublers. It is the HDSL equivalent to an AT1U channel card, which is used to transmit a T1 payload to a remote location over conventional T1 spans. The HLU-200 List 1D is compatible with software releases 7.1.x and 8.1.x and above, of the Litespan-2000 system. The List 1D is not compatible with the Litespan-2000 Management System and must be maintained, provisioned, and monitored from its front panel RS-232 port. The List 2D HLU-200 (AHDSL) line unit will provide integrated management and will be compatible with the Litespan-2000 TL1-based Network Management System and the Litecraft Management System in version 8.1. However, the List 1D has a spare Interface Control Processor (ICP) socket, see Figure 5. This holds the ICP which is required for integrating the HLU-200 LIST 1D into the Litespan-2000 Management System. This allows a List 1D unit to be returned to the factory for easy upgrading to the List 2D configuration. The HLU-200's timing is not synchronized to the Litespan bank timing, but runs asynchronously with respect to it.

The HLU-200 can be cross-connected to another HLU-200 or another asynchronous T1 channel unit within its own channel bank or in the distant channel bank. This is shown in Figure 2, where 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 to the Maintenance and Test Interface (MTI) card, which identifies the HLU-200 List 1D as an AHT1U plug. See Installation, Maintenance, and Provisioning section for more details.

Figure 2 shows both doubler and non-doubler applications. Circuit A is a non-doubler application. The HRU can be placed up to 3000 feet into the network for extra range without doublers. This requires an external Network Interface Device (NID) to be placed at the Network Interface (NI). The HRU must have its SmartJack (LB) option set to DISABLE for these external NID applications. The option is set to ENABLE when the HRU is located at the NI and performs the standard NID functions as in Circuit B and C. Circuit B is a single doubler application. The HLU-200 List 1D powers both the HDU and HRU in circuits A and B. Circuit C is a two doubler application. The HRU must be locally powered for all two doubler applications.

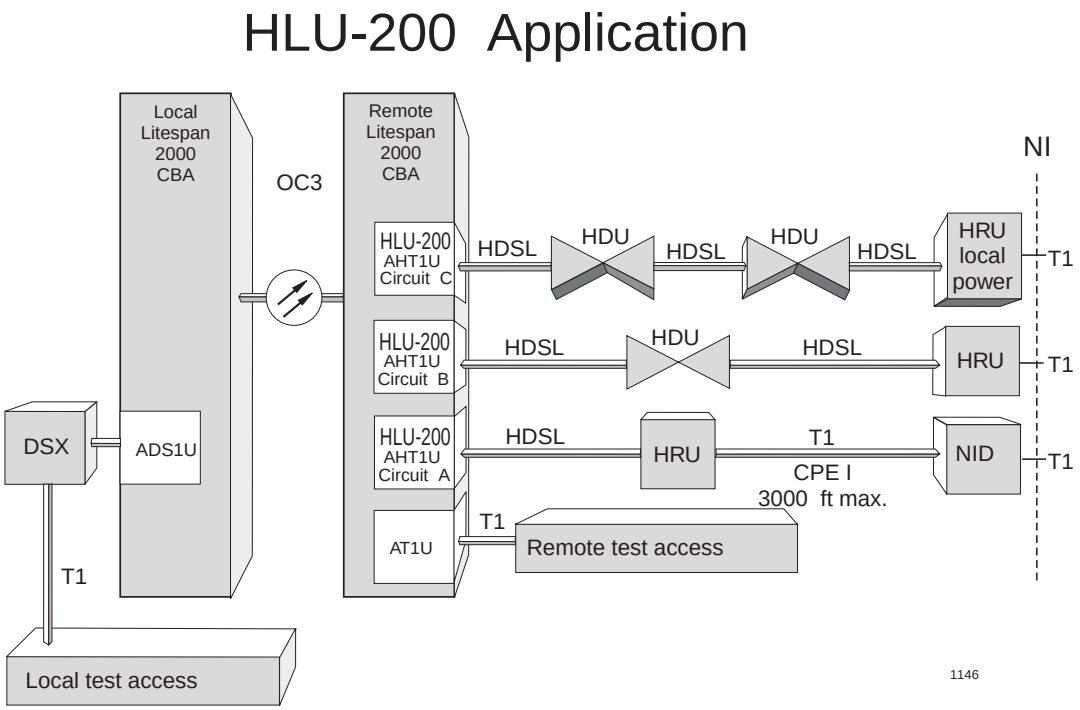


Figure 2. *HLU-200 List 1D Typical Applications*

Installation, Maintenance, and Provisioning

TL1 is the native communication language of Litespan. Access to the Litespan system is achieved by directly connecting an ASCII terminal, dial-up connection via a modem or an X.25 packet network to the RS-232 connector on either the front panel of the MTI board or to the Fuse and Alarm Panel. Refer to the TL1 Reference Practice, OSP-363-205-502, for details.

OMAPS is a user friendly software interface that provides provisioning and maintenance access to the Litespan-2000 system. OMAPS is a program that runs on an IBM PC-AT2 or equivalent computer. Refer to the OMAPS Reference Practice, OSP 363-205-501 for details.

The HLU-200 List 1D supports a limited number of the OMAPS functions that are fully supported by generic Litespan plugs, such as the AT1U. The following paragraphs list these specific OMAPS functions which the HLU-200 supports. Their equivalent TL1 commands can be found in the above mentioned TL1 practice. Each specific command is given a DLP reference number. The DLP is a Detail Level Procedure that is found in the DLP section of the Litespan-2000 OMAPS binder practice binder Series OSP 363-205-501. The DLP contains detailed information about the command's purpose, use and execution. The commands are listed in a sequence that parallels the Main OMAPS Menu that appears in TAD (Task Analysis Data)-005 of the OMAPS practice. Refer to this binder for more specific OMAPS information as needed.

Provisioning. Note that all of the HLU-200 List 1D specific user options can only be set from its front panel RS-232 maintenance port. Only one of these options, the DS1 line code (B8ZS or AMI), is sent to the Litespan-2000 system manager which reads the value and then provisions the Litespan Gate Array, shown in Figure 3, accordingly. This HLU-200 List 1D line code setting is not available from OMAPS. It must be provisioned and read from the RS-232 maintenance port mentioned above.

Channel Bank Slot Assignments**.** The HLU-200 List 1D supports the following Channel Bank Slot Assignment commands. Note that the HLU-200 List 1D's Equipment Type ID is AHT1U.

1. RETRIEVE CHANNEL UNIT SLOT ASSIGNMENTS (DLP-302)

This command retrieves and displays the following information:

a. *Access Id*. Defines the CBA and slot number, such as COT-1-45

b. *Assigned Type.* Type of channel unit assigned to the slot.

c. *Equipped Type*. Type of channel unit actually installed in the slot.

d. *Service State.* Current Service State of the specified channel unit. IS= in service, OOS= out of service. Refer to TAD 004.

e. *Status.* Current status of the specified channel unit such as CROSS CONNECTED, FAILURE, etc. refer to TAD 004.

2. EDIT CHANNEL UNIT SLOT ASSIGNMENTS (DLP-303)

This command allows channel units, which are not in the MT (Maintenance Test) state to be placed IS (in service) or OOS (out of service). IS indicates the unit will carry traffic when installed. OOS indicates the unit will not carry traffic when installed.

3. ENTER CHANNEL UNIT SLOT ASSIGNMENTS (DLP-304)

Use this command to assign a specific channel unit type to a specific slot. This affects the Assigned Type field mentioned in 1 above. Note this command must be executed to properly install the AHT1U into its assigned slot. The following is a step by step procedure to perform this task:

a. Delete any previous channel slot assignments from the slot into which the AHT1U is to be inserted. See step 4 below for the Delete command.

b. Insert the AHT1U into its slot. Notice that the red FAIL LED turns on and then off in a few seconds.

c. Enter the AHT1U channel unit with this ENTER command.

4. DELETE CHANNEL UNIT SLOT ASSIGNMENTS (DLP-305)

Use this command to remove a slot's previously assigned channel unit. This command should be used to remove prior slot assignments from a slot that is to be assigned an AHT1U plug.

Line Circuit Settings Option. The AHT1U supports the following Line Circuit Settings Option.

1. RETRIEVE LINE CIRCUIT SETTINGS (DLP-322)

   This retrieves the following information on a slot occupied by an AHT1U:

   a. *Access Id.* As above.

   b. *AIS.* This entry determines the type of Alarm Indicating Signal (AIS) that is sent upstream of the CBA when the AHT1U is in its alarm state. The choices are NONE, ALL 1s or ALL 0s.

   c. *Red Lined.* A Yes or No indicating a circuit's Red Lined status. A Red Lined circuit cannot have its provisioning changed without first notifying the customer served by that circuit.

   d. *Cross Connection Type.* Indicates that an AHT1U is cross connected to another T1 or DS1 line unit.

   e. *Service State.* The service state (IS or OOS) of the unit.

   f. *Status.* Indicates the status of the AHT1U: Cross Connected, OOS, MT etc.

The LINE CODE and GRADE of SERVICE settings that are supported by the AT1U are NOT supported by the AHT1U.

2. EDIT T1U CIRCUIT SETTINGS (DLP-323)

   This command allows the assigned AHT1U unit to have its AIS, Service State and Red Lined states changed.

DS1 Cross-Connections. The AHT1U supports the following DS1 Cross-Connect commands:

1. RETRIEVE DS1 CROSS-CONNECTIONS (DLP-310)

   This command allows the cross-connect status of an AHT1U to be determined.

2. PERFORM DS1 CROSS-CONNECTION (DLP-311)

   This command allows an AHT1U to be cross-connected to another AHT1U, ADS1U, or AT1U channel unit in either the same or another CBA.

The AHT1U can only be connected to another asynchronous card.

3. DISCONNECT DS1 CROSS-CONNECTION (DLP-312)

   This command allows any cross-connected AHT1U to be disconnected.

Maintenance

Alarms. The AHT1U can generate two types of alarms toward the CBA. The first is caused by unplugging the HLU **card** after it has been ENTERED. This generates a MJ (Major), SA (service affecting) Eqpt. alarm along with the "UEQ-Unequipped" message. The second is caused by various alarms within the AHT1U circuit. See the Alrams section of this manual for AHT1U Alarm details. Any of these HLU alarms cause an MJ, SA, T1 alarm with an "LOS: Loss of Signal" message. The AHT1U supports the following Alarm commands:

1. RETRIEVE STANDING ALARMS (DLP-504)

   This command retrieves the following alarm status of an AHT1U

   a. *Access ID.* As above.

   b. *Severity.* Major only.

   c. *Service Affected.* SA (service affecting) or NSA (non service affecting). Both types of AHT1U alarms are SA.

   d. *Type.* Eqpt (AHT1U UEQ unit removal) or T1 (AHT1U LOS internal alarm).

   e. *Message.* UEQ or LOS

2. RETRIEVE CONDITIONS (DLP-505)

   This command retrieves the same information as the above Retrieve Standing Alarms command, in addition to providing the Service State (IS, OOS or MT) of the AHT1U.

Performance Monitoring. The AHT1U does not support any of the main Litespan performance monitoring functions. The AHT1U conducts its own performance monitoring. Access to this performance data is provided by the AHT1U's on-board maintenance program, which is accessible from its front panel RS-232 port. See the System Maintenance Menu Screens section of this practice for more details.

Testing. The AHT1U does not support any of the Litespan initiated loopbacks. However, the AHT1U maintains a family of loopbacks that can be initiated from its RS-232 front panel maintenance port and inband codes. Although Figure 3 shows that metallic access to the HDSL loops is provided through the two narrow band test loops on pins 35 through 38 under control of two test relays, this option is not supported by the Litespan 7.1.x software. Enhanced versions of the Litespan software will support this test access. The AHT1U supports the following Testing commands:

1. REMOVE FROM SERVICE (DLP-572)

   This command allows an AHT1U that is In Service (IS) to be placed into its MT (Maintenance Test) state for generic testing. While in this state, no AHT1U alarm states are recognized by the CBA. The AHT1U can be replaced and intrusive tests can be performed without generating a CBA alarm.

2. RESTORE TO SERVICE (DLP-573)

   This command restores an AHT1U that is in its MT state to its IS state.

Resource Usage

Plug-In Equipment Detail. The AHT1U supports the following Plug-In Equipment Inventory Detail command;

1. RETRIEVE PLUG-IN EQUIPMENT DETAIL (DLP-153)

   This command retrieves the following plug-in data:

   a. *Access ID.* As above

   b. *Serial #.* This field is not supported by the AHT1U

   c. *CLEI Code.* The AHT1U's CLEI code is given as SLILNS0AAA.

   d. *H/W Version*. The AHT1U has no hardware version. Therefore the AHT1U's software version instead is displayed in this field.

   e. *Boot Version.* This is the version of the CBA Boot software.

   f. *S/W Version.* This is the software (S/W) of the Litespan operating system.

Plug-In Equipment Summary. The AHT1U supports the following Plug-In Equipment Inventory Summary command:

1. RETRIEVE PLUG-IN EQUIPMENT SUMMARY (DLP-154)

   The AHT1U's CLEI code field is listed. The AHT1U's Equipment Description column displays "Async HDSL T1 line Circuit"

Line Circuit Availability. The AHT1U supports the following Line Circuit Availability command:

1. RETRIEVE LINE CIRCUIT AVAILABILITY (DLP-158)

   This command retrieves a list of the slots that are either equipped with a channel unit (occupied slot) or Assigned (defined to accept a particular type of channel unit). For proper operation the equipped unit type must be the same as the assigned unit type. See the Resource Usage section for more information.

I/O Cabling

The HLU-200 HDSL Loop 1 and Loop 2 pairs are available at **both** the Narrowband and Wideband mass connectors of the DSC shelf it occupies. Table 1 shows the generic Loop to three (A, B, and C) DIN Connector row assignments (Figure 6).

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

Table 2 lists the Wideband cabling details for the Litespan-2000 CBA shelf. The J1 through J6 cables are normally used to access the two I/O ports (IN and OUT) 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 (J2,4 and 6) list the Slot #/HDSL Loop 1 assignments. The Pr. columns list the pairs in sequential order from 1 to 116 with pairs 97 through 100 having no connection (NC). These pair numbers can be used by LFACS or other automatic circuit assignment programs.

Narrowband cables (P1 through P9 in Table 3) 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. In an Even bank the first Narrowband cable pair (# 226) is not available. Table 3 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 4 lists the corresponding Narrowband cabling details for the Even Litespan-2000 CBA shelves.

The HLU is compatible with the DSC 24 slot Optical Network Unit 96 (ONU-96) Starspan card cage assembly. Table 5 lists the Wideband cabling/HDSL loop assignment details and Table 6 lists the Narrowband cabling details for this ONU-96 system.

The HLU is also compatible with the DSC, 12 slot, Optical Network Unit 48 (ONU-48) Starspan card cage assembly. Table 7 lists both the Wideband and Narrowband cabling/HDSL loop assignment details for this ONU-48 system.

Table 1. *Wideband and Narrowband HDSL Loop Cable Assignment*

HLU-200 Slot Connector (P1) Pin Assignments Pin Number	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		

***Table 2**. CBA Wideband Cabling/HDSL Loop Assignments*

Color Code (Base/Ink)	Pin # (T - R)		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
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	Spares Tied Off											
Vi/Or - Or/Vi	43 - 44	47 - 22												
Vi/Gr - Gr/Vi	45 - 46	48 - 23												
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														

***Table 3**. Odd CBA Narrowband Cabling (Last Pair Unassigned)/HDSL Loop Assignments*

Color Code (Base/Ink)	Pin # (T - R)		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					dead	225

L1 = HDSL Loop 1, L2 = HDSL Loop 2

***Table 4**. Even CBA Narrowband Cabling (First Pair Unassigned)/HDSL Loop Assignments)*

Color Code (Base/Ink) Tip - Ring	Pin # (T - R)		P1		P2		P3		P4		P5		P6		P7		P8		P9	
	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	dead	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

***Table 5**. ONU-96 Wideband Cabling/HDSL Loop Assignments*

Color Code (Base/Ink)	Pin # (T - R)		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 6. *ONU-96 Narrowband Cabling/HDSL Loop Assignments*

Color Code (Base/Ink)	Pin # (T - R)		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

Table 7. *ONU-48 Narrowband and Wideband Cabling/HDSL Loop Assignments*

Color Code (Base/Ink)	Pin # (T - R)	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									

Functional Operation

The HiGain system uses ADC 2-Bit 1-Quartenary (2B1Q) HDSL transceiver systems to establish two full-duplex 784 kbps data channels between the HLU-200 List 1D and a HRU-412 HiGain Remote Unit. This provides a total capacity of 1.568 Mbps between the two units.

A block diagram of the HLU-200 List 1D is shown in Figure 3. 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 8 Bit Substitution (B8ZS) coding and decoding and hands the T1 payload off to the HDSL framer.

The HLU-200 List 1D has a socket for the Interface Control Processor (ICP) which integrates the HLU-200's Management System into the Litespan CBA Management System. Factory upgrades allow the HLU-200 List 1D to be upgraded to an AHDSL List 2D unit by adding the ICP.

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 HLU-200 List 1D microprocessor also conveys its line code format (AMI/B8ZS) and Alarm Status to the Litespan microprocessor over two direct data lines between the two chips.

The TEST LOOP feature which controls the metallic test access to the two facility cable pairs is not supported by release 7.1.x but will be supported by 8.1.x.

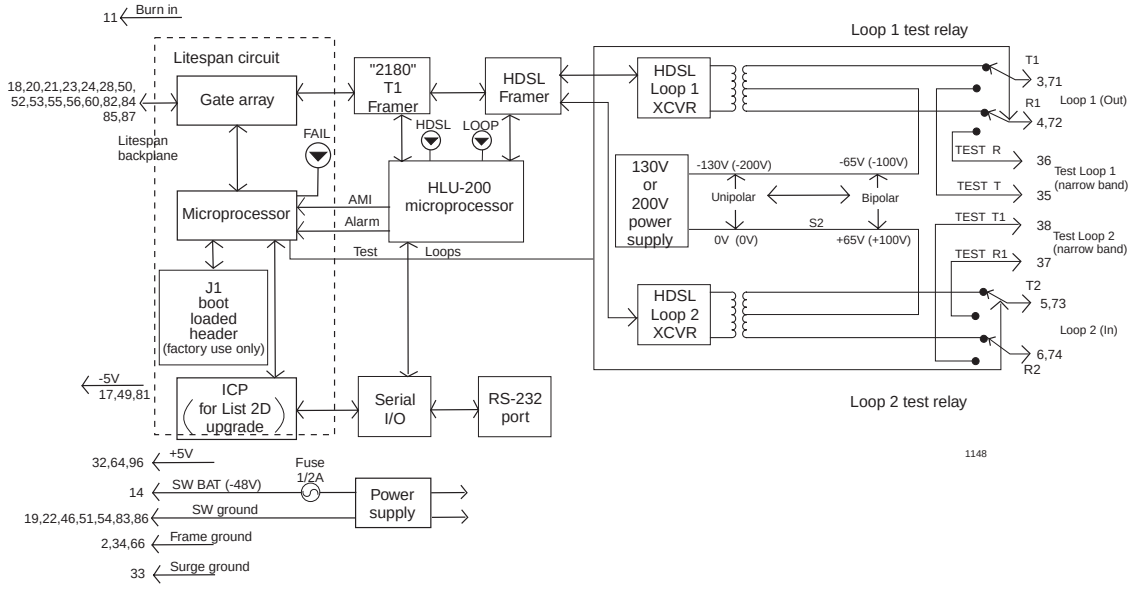


Figure 3. *HLU-200 List 1D Block Diagram.*

The HLU-200 List 1D 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 DS1 payload. The DS1 stream is separated into two parallel streams that comprise the payloads of the 2 HDSL loops. The HLU-200 List 1D allocates the DS0 time slots according to the version of HRU-412 to which it is connected. Legacy 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 DS1 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 canceller 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 DS1 stream from the payloads of the two HDSL loops. The CRC fields on the HDSL streams allow the HLU-200 List 1D 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-200and 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 DS1 clock at the exact rate received from the remote end. The HiGain system operates at DS1 rates of 1.544 Mbps with up to ±200 bps of offset.

The HLU-200 List 1D line power supply converts the -48 Vdc battery to a -130 Vdc (-200 Vdc for doublers) which provides simplex power feed on the two HDSL line interfaces.

A female 9-pin, DB-9 RS-232, is provided on the front panel connector (see Figure 4). This connector provides asynchronous access to the HiGain system maintenance, provisioning and performance monitoring firmware. The port is configured as DCE with 8 data bits, 1 stop bit and no parity. Operator interaction with the firmware is from an ASCII terminal or a personal computer with asynchronous communication software. Pressing the spacebar several times enables the HLU-200 to automatically match the terminal line baud rate, from 1200 baud to 9600 baud. Figures 9 through 16 show the menu selections available from the terminal. Table 17 defines the status menu terms. Table 18 defines the glossary of HiGain terms used in the System Status Screen.

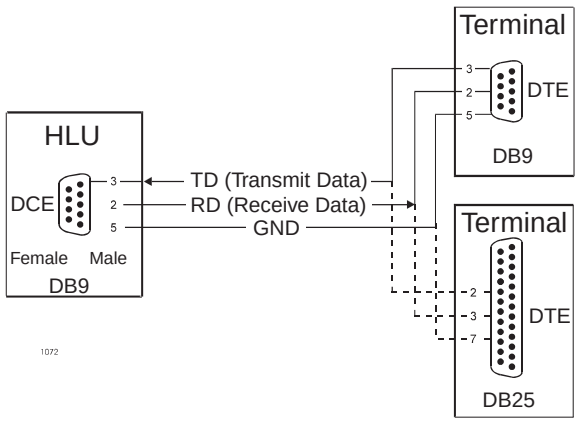


Figure 4. *DB-9 RS-232 I/O Pinouts.*

Alarms

The following alarms are detected and reported to the Litespan microprocessor via the Alarm signal from the HLU microprocessor to the Litespan processor as shown in Figure 3. They also cause the HDSL LED to flash red.

1. **ALRM LOSW:** Either of the HDSL loops lost sync
2. **ALRM RLOS:** Loss of HRU DS1 input signal

3. **ALRM 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.
4. **ALRM H1ES:** HDSL loop 1 has exceeded the 24-hour user-selected Errored Seconds CRC threshold.
5. **ALRM H2ES:** HDSL loop 2 has exceeded the 24-hour user-selected Errored Seconds CRC threshold.
6. **ALRM DS1:** The total number of bipolar violations (BPV), at the HRU DS1 input, has exceeded the 24-hour user-selected threshold.
7. **ALRM MAL1:** The margin on HDSL loop 1 has dropped below the minimum threshold value set at the maintenance terminal Margin Alarm Threshold option.
8. **ALRM MAL2:** The margin on HDSL loop 2 has dropped below the minimum threshold value set at the maintenance terminal Margin Alarm Threshold option.

The Alarm signal between the processors can be enabled or disabled by the user Alarm option described in Table 10.

The factory default setting of the ALARM option is ENABLED.

Disabling the alarm signal between the processors has no effect on the HDSL Alarm LED. It will always flash Red to indicate an HLU alarm condition.

Whenever the Alarm signal is asserted, the major alarm LED on the ACU card lights RED and remains on until the alarm condition clears. In addition, the following message is issued to the MIF terminal when this alarm occurs:

“COT X-Y; MJ, LOS, ...”

The following MTI message occurs when the alarm clears:

“COT X-Y; CL: LOS, ...”

where X-Y is the SHELF-SLOT CBA location of the HLU 200 List 1D plug.

The three HLU-200 List 1D front panel LEDs function as follows:

- **LOOP -** This is a GREEN LED that lights whenever any of the HLU-200 List 1D system loopbacks are in effect, see Loopback Operation in the Applications Without Using HiGain Doublers section.
- **FAIL -** This is a RED LED that is controlled by the bank. This LED remains lit at all times when the HLU-200 is used with revision 7.1.1 banks due to a software flaw in 7.1.1. When used with revision 7.1.2 and higher versions, it lights when the HLU-200 is first plugged into the bank and remains lit until the bank has finished its program download and handshake with the HLU-200. It also lights whenever there is a service-affecting failure within the bank.
- **HDSL -** This is a tri-colored LED that:
  - – Flashes GREEN during HDSL sync acquisition on either HDSL loop.
  - – Flashes RED for any of the alarm conditions described above.
  - – Is steady GREEN when both HDSL loops are in sync and no minor alarms exist.
  - – Is steady RED if the onboard 48V fuse opens.

Options

The HLU-200 List 1D contains a non-volatile RAM (NVRAM) which stores the system option settings. All options, except the HDSL voltage polarity option, are provisioned through the RS-232 interface. They are retained if shelf power is lost or if the HLU-200 is unplugged. Table 10 lists the HLU-200 List 1D option settings. Figure 12 illustrates the same options on the HLU-200 System Settings Menu Screens, respectively.

The HLU-200 List 1D only supports the AMI and B8ZS DS1 line code options. The AUTO code option can be selected but defaults to the AMI option setting. Thus, in order to avoid confusion, only the AMI or B8ZS options should be used. The AUTO option should never be selected. The factory default setting is AMI.

The CIRCUIT ID option is set by choosing the **H** option from the MAINTENANCE TERMINAL MAIN MENU Screen shown in Figure 9. The message:

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

follows the **H** selection. Press **Enter** after entering the chosen set of alphanumeric ID characters; choose **C** to confirm.

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

The ID appears in all HLU-200 screens as shown in Figures 9 through 16. The ID does not appear on the HRU-412 screens when the maintenance port is accessed at the remote unit. Note that the Circuit ID is not set to any default setting when the DFLT setting option is utilized.

From the MAIN MENU Screen, to set the DS0 BLOCKING option, first press **C** to select the SYSTEMS SETTINGS MAIN MENU Screen. The menu shown in Figure 12 appears. Press **B** as shown in parenthesis of the DS0 blocking selection. The DS0 channels are blocked or unblocked by entering each channel number. Multiple channels can be selected by inserting a space between each entry. After all the new settings have been made, press **E** for Exit and **C** for Confirm. The new choices are now installed. If DS0 blocking is invoked in a HiGain system that has an earlier version HRU-412 that does not support the blocking option, blocking will only occur in the upstream direction (towards the CBA) of the HLU-200 List 1D. The HRU-412 DS1 output will not be blocked. Also, all blocked channels are temporarily unblocked for all HiGain system loopback tests. This allows the standard full bandwidth T1 loopback tests to be performed.

To set the MARGIN ALARM THRESHOLD select **G** from the SYSTEM SETTINGS MAIN MENU Screen (Figure 12). Enter the desired minimum acceptable alarm threshold from the 0 dB to 15 dB range. This causes a minor alarm to occur if either the margin on HDSL loop 1 (MAL1) or loop 2 (MAL2) drops below the selected threshold value. Since the margin can never drop below 0, choosing **0** for the margin threshold turns the margin alarm off.

Other system settings are set from the terminal in a similar manner. Enter the key represented by the letter in parenthesis of the parameter to be changed. Each entry of this letter scrolls the parameter to its next value. After all selections have been made, press **E** for Exit and **C** for Confirm. This activates the new choices and returns control to the MAIN MENU Screen.

The HAIS option provides two selections for the T1 transmit outputs at the HRU-412 for HDSL loss of sync conditions. The 1LP selection causes the AIS pattern to be transmitted at the T1 outputs at both ends when either of the two HDSL loops experience an out of sync (LOSW) condition or when a margin alarm occurs. This choice causes the 12 channels on the surviving loop to be lost as they are replaced by the AIS pattern.

However it does allow both down and upstream equipment to be made aware of the loss of one HDSL loop or a loop with low margin. This is the preferred setting to be able 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 196 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 dB to 10 dB. Thus if the Margin alarm is set 5 dB below the normal margin at turn-up, when one conductor does open, a minor alarm occurs and causes the AIS condition. This alerts the maintenance personnel of the problem. The 2LP choice requires both HDSL loops to be out of sync (LOSW) before the AIS signal is transmitted. This choice preserves the integrity of the 12 surviving channels when just one loop is lost.

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 5.

The factory default setting is UNI (-). It sets the HDSL line voltage to 0V on loop 2 and to either -30V (for non-doubler circuits) or -200V (for doubler circuits) 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 (+100V for doubler circuits) on loop 2 and -65V (-100V for doubler circuits) 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 200k ohms. 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 S1's setting.

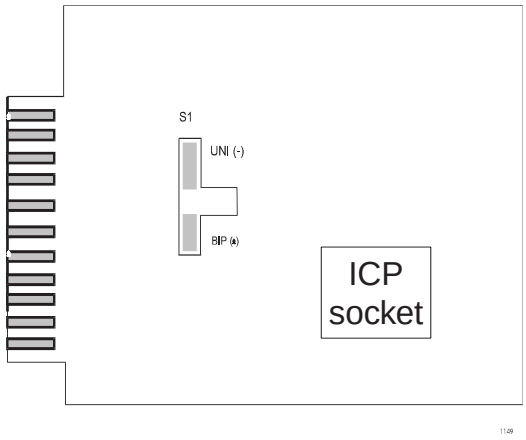


Figure 5. *HDSL Line Voltage Switch S1 and ICP Socket locations.*

Installation

Upon receipt of the equipment, visually inspect it for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to ADC.

The HLU-200 List 1D mounts in a Litespan-2000 channel bank. The HLU-200 List 1D slot pinouts are shown in Figure 6.

The HLU-200 is compatible with Release 7.1 and higher of the Litespan-2000 system. The HLU-200 List 1D must always be provisioned from the front panel RS-232 port as described in the Option section of this manual.

Upon initial insertion into a Release 7.1.1 bank, the FAIL LED lights and remains lit. When plugged into a Release 7.1.2 or higher version, the FAIL LED lights until the handshake between the bank and HLU-200 is complete. If the HLU-200 List 1D is connected to an HRU-412, the HDSL LED will flash GREEN until the two units sync. Then it will light solid GREEN, indicating a stable online condition.

If the HLU-200 List 1D is removed from a slot, it must not be reinserted for at least 15 seconds. Reinserting it sooner may temporarily lock the HLU-200 into an unstable state.

The unstable 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 3 consecutive polling inquiries before it declares the slot empty. If the unit is removed and re-inserted before 3 po1ling 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. Note this dormant state is easy to detect since a dormant unit's FAIL LED remains lit and does not change it's state within 15 seconds after insertion as a normal unit does.

Refer to Installation, Maintenance, and Provisioning section for information relating to installing the HLU with the Litespan operating system.

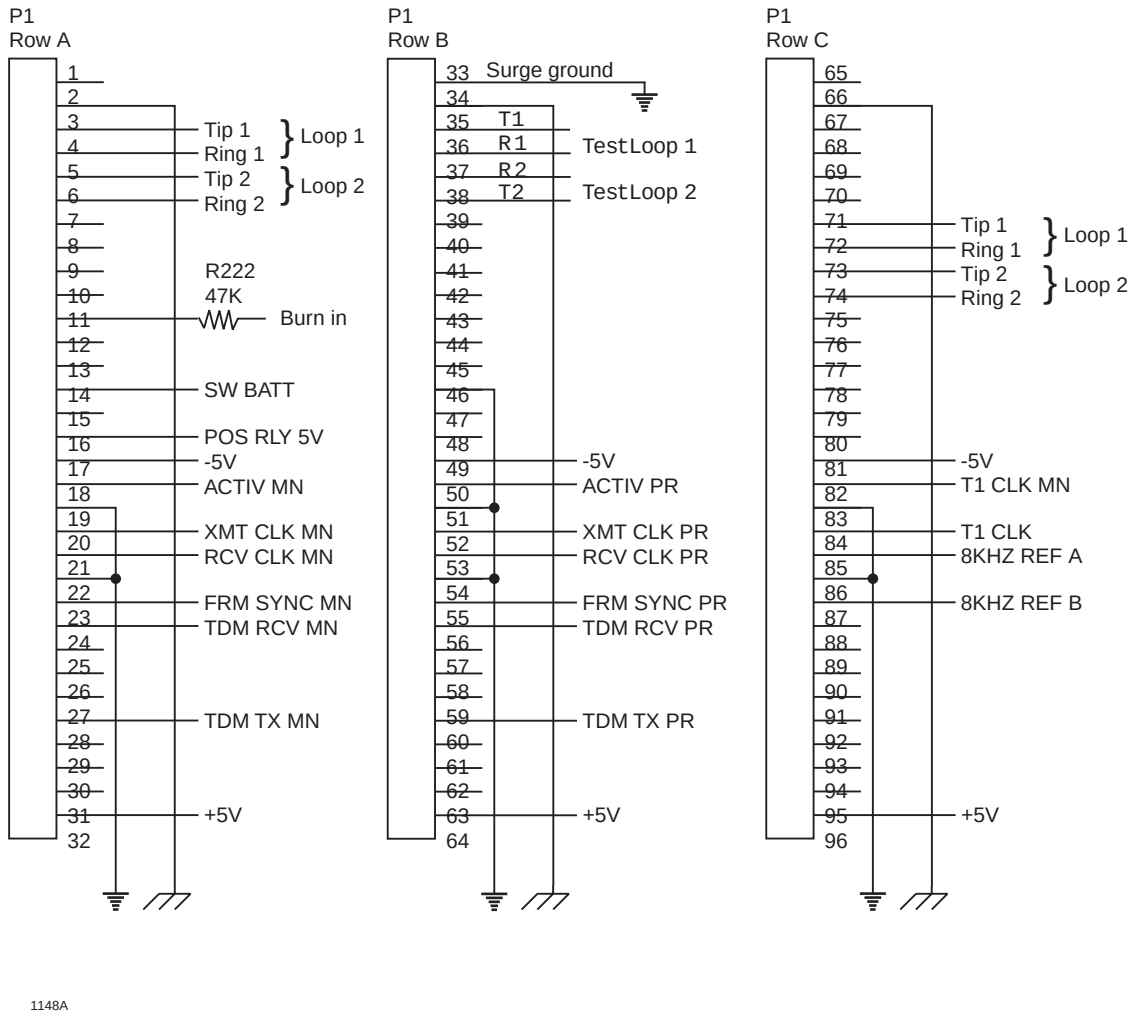


Figure 6. *HLU-200 List 1D Card-Edge Connectors*

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 (HLU to HRU/HRU to HLU)	<220 microseconds per span
DS1 Equivalent Rate	1.544 Mbps ±200 bps
DS1 Format	AMI, B8ZS, or ZBTSI
DS1 Frame Format	ESF, SF or UNFR/CLR
Maximum Power Consumption	13W non-doubler, 20W doubler
Maximum Heat Dissipation	5W non-doubler, 6.3W doubler
HDSL Span Voltage	-130 Vdc to -200 Vdc
Electrical Protection	Secondary surge protection and power cross protection on HDSL ports
Operating Temperature	-40°F to +149°F (-40°C to +65°C)
Operating Humidity	5% to 95% (non-condensing)
Mounting	Litespan-2000 CBA/ONU-48, 96
Dimensions	
Height:	4.42 in. (11.22 cm)
Width:	0.84 in. (2.13 cm)
Depth:	10.2 in. (25.9 cm)
Weight:	1 lb. (0.45 kg)

Applications Without Using HiGain Doublers

General

This section addresses HLU-200 List 1D operation when used without doublers. For applications without doublers, the HLU-200 is directly connected to the HRU-412 by the two cable pairs.

Power Parameters

Table 8 lists the non-doubler HLU-200 List 1D's current drain on the 4 CBA's power supplies, its power consumption, and 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 1D consumes or draws from the CBA's power buses. This parameter is needed when the Litespan-2000 is battery powered. It determines the battery capacity required to maintain an 8-hour stand-by battery reserve for emergency situations.

Loopback Operation

The HiGain system has a family of loopback options. The most important of these is the SmartJack loopback which enables the HRU-412 to respond to the standard (2/3-in-5) SmartJack inband loopback codes and thus emulate the functions of a standard Network Interface Device (NID). This option can be enabled or disabled from the terminal SYSTEM SETTINGS MENU (Figure 12).

In addition to the SmartJack loopback, the HiGain system can be configured for one of five special inband loopback (SPLB) command sequences. These are selected from the SPLB user option shown in Table 10 and Figure 12. The non-Doubler loopback locations are shown in Figure 7.

GNLB is the HiGain system Generic loopback code. The GNLB allows inband 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 inband codes issued to the HRU to loop-up the HLU/CREM (6-in-7) or HRU/CLOC (5-in-7) towards the CI. Either loop-up condition is terminated (looped-down) with the 3-in-5 loop-down code. Both inband codes must be present for 5 seconds before the HiGain system responds. Table 11 lists the test procedures that apply when using the GNLB mode.

The A1LB loopback selection, Table 12, 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 inband 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 13 through 16 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)

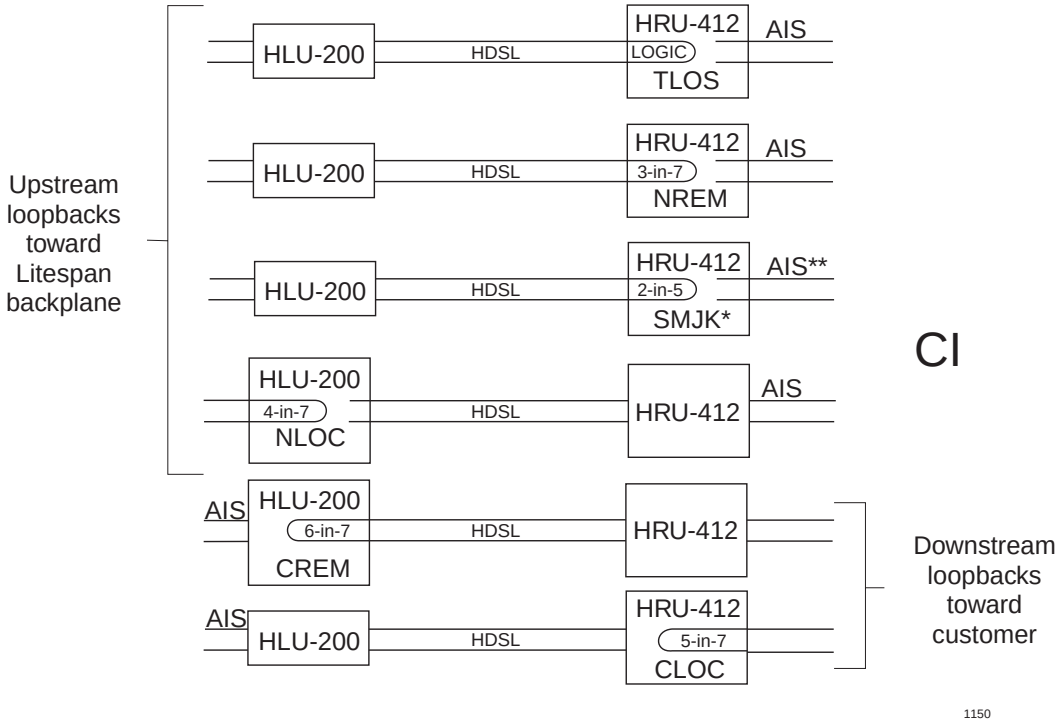
A5LB differs from A2LB in that A5LB does not block the arming code from exiting the HLU-200 List 1D toward the CBA. A2LB can be configured to either block this arming code after two seconds, and replace it with the AIS code, or to unblock it by executing the FAR-END ACTIVATE code. Since A5LB never blocks the arming code from exiting the HLU-200 List 1D, 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.

Testing

Tables 11 through 16 provide step-by-step test procedures for the HLU-200 List 1D as a function of the loopback option selected. These procedures allow verification of the integrity of the HDSL channels at every module location as well as the DS1 channels to the customer and the remote/local T1 interface.

If trouble is encountered on the HLU-200 List 1D Litespan-2000 Interface, verify that the HLU-200 List 1D is making a positive connection to the CBA backplane.



* The SmartJack loopback is a metallic loopback in the HRU list 6,7, and 8. It is a logic loopback in all HRU of lists 1-5.

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

Figure 7. *HLU-200 List 1D Non-Doubler GNLB Loopback Configurations*

Table 8. *HLU-200 List 1D Power Parameters for Non-Doubler Applications*

Power Bus	HLU-200 CPE-I* Off	HLU-200 CPE I 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 Batt.	133 mA	200 mA	0 mA	60 mA	0 mA
-48V Talk Batt.	0 mA	0 mA	0 mA	0 mA	109 mA
Power Consumption	9.33W	12.6W	2.9W	3.6W	7W
Power Dissipation	4.23W	4.88W	2.9W	3.6W	6.3W
*CPE-I = Customer Premise Equipment (Current option in HRU)					

Applications Using HiGain Doublers

General

One or two doublers may be used in the HDSL loops between the HLU and the HRU-412. When using two doublers in an HDSL loop, the HRU-412 must be locally powered. This section addresses HLU operation with the HDU-451, List 3 and 4 or the HDU-439 and 437, List 1 mini doublers. The HLU-200 List 1D must not be used with the older, higher power HDU-451 List 1 or 2 doublers. The HDU 451 List 3, 4 and both mini doublers are low power doublers which consume 40% less power than either List 1 or 2.

Power Parameters

Table 9 lists the doubler HLU-200 List 1D's current drain on the 4 CBA's power supplies, the unit's power consumption, and dissipation. The same parameters are shown for two other common CBA plugs, the AT1U and REBS, for comparison. As can be seen, the power consumption and dissipation (per slot) of the HLU-200 List 1D are comparable to those of the two common CBA plugs.

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 consumes or draws from the CBA's power buses. This parameter is needed when the Litespan-2000 is battery powered. It determines the battery capacity required to maintain an 8-hour stand-by battery reserve for emergency situations.

1. **The HLU-200 List 1D does not support single doubler applications that require the line powered HRU remote unit to provide 60 mA of CPE current to power an external NID. Such applications exceed the maximum allowed 48V slot current of 360 mA.**

2. **All single doubler applications with line powered HRU remote units and all 2 doubler applications with locally powered HRU remote units require 2 CBA slots to be reserved (one empty slot per circuit) to keep the CBA's per slot power dissipation and consumption within limits.**

Loopback Operation

The HiGain system has a family of loopback options. The most important of these is the SmartJack loopback which enables the HRU-412 to respond to the standard (2/3-in-5) SmartJack inband loopback codes. This option can be enabled or disabled from the terminal SYSTEM SETTINGS Menu Screen (Figure 12).

In addition to the SmartJack loopback, the HiGain system can be configured for one of five special inband loopback (SPLB) command sequences. These are selected from the SPLB user options shown in Table 10. The loopback locations are shown in Figure 8.

GNLB is the HiGain system Generic loopback code. The GNLB allows inband codes issued to the HLU from the CBA to loop-up either the HLU/NLOC (4-in-7) or HRU/ NREM (3-in-7) towards the CBA. In addition, it allows inband codes from the Customer Interface (CI) to loop-up the HLU/CREM (6-in-7) or HRU/CLOC (5-in-7) towards the customer. For Doubler applications it permits looping Doubler #1 towards the network NDU1 (2-in-6) or towards the customer CDU1
(4-in-6). Doubler #2 is looped towards the network with NDU2 (3-in-6) or towards the customer with CDU2 (5-in-6). Either loop-up condition is terminated (looped-down) with the (3-in-5) loop-down code. All messages must be present for five seconds before the HiGain system will respond. Table 19 lists the test procedures that apply when using the GNLB mode.

The A1LB loopback selection, Table 12 complies with that proposed for HDSL systems in the T1/E-1.4/92 recommendation with the following additions:

- Query loopback
- IOR power-down
- Three loopback time-out choices
- Initiation from either end
- Repeating bit error signatures
- Alternate query loopback.

These additions make A1LB identical to the 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 inband loopback functions that are supported by the HLU-200 List 1D HiGain system. These loopbacks provide the HiGain system with sophisticated maintenance and troubleshooting tools. Tables 13 through 16 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 1D into the network. 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 1D, it does not need this FAR-END ACTIVATE code. A3LB differs from A4LB in that A3LB supports the additional (1-in-6) SmartJack loopback command.

Two additional loopback points are added for each HDU-451 doubler that is used as shown in Figure 8. NDU1 and NDU2 are executed towards the network. CDU1 and CDU2 are towards the customer. All four loopbacks can be initiated by the 16 bit inband commands in SPLB states A1LB, A2LB and A3LB as described in Tables 12 through 14. NDU1 and NDU2, along with the rest of the loopbacks towards the network, can be issued from the Loopback Menu shown in Figure 24. The simplest HiGain system includes two loopback locations: The HLU-200 List 1D and the HRU-412. The most complex HiGain system application includes the HLU-200 List 1D, HRU-412 and two inline HDU-451 Doublers. Refer to the ADC HiGain Intelligent Repeater Application Note #910, Part #325-910-100, for more SPLB details.

Table 9. *HLU-200 List 1D Power Parameters for Doubler Applications*

Power Buses	HLU-200 1 Dub† CPE I Off or 2 Dub	HLU-200 1 Dub† CPE I On*	HLU-200 1 Dub 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 Batt.	351 mA	443 mA	133 mA	60 mA	0 mA
-48V Talk Batt.	0 mA	0 mA	0 mA	0 mA	109 mA
Power Consumption	19.8W total 8.2W per slot	24.2W total 12.1W per slot	9.33W	3.6 W	7W
Power Dissipation	6.32W total 3.16W per slot	7.2W total 3.6W per slot	4.23W	3.6W	6.3W

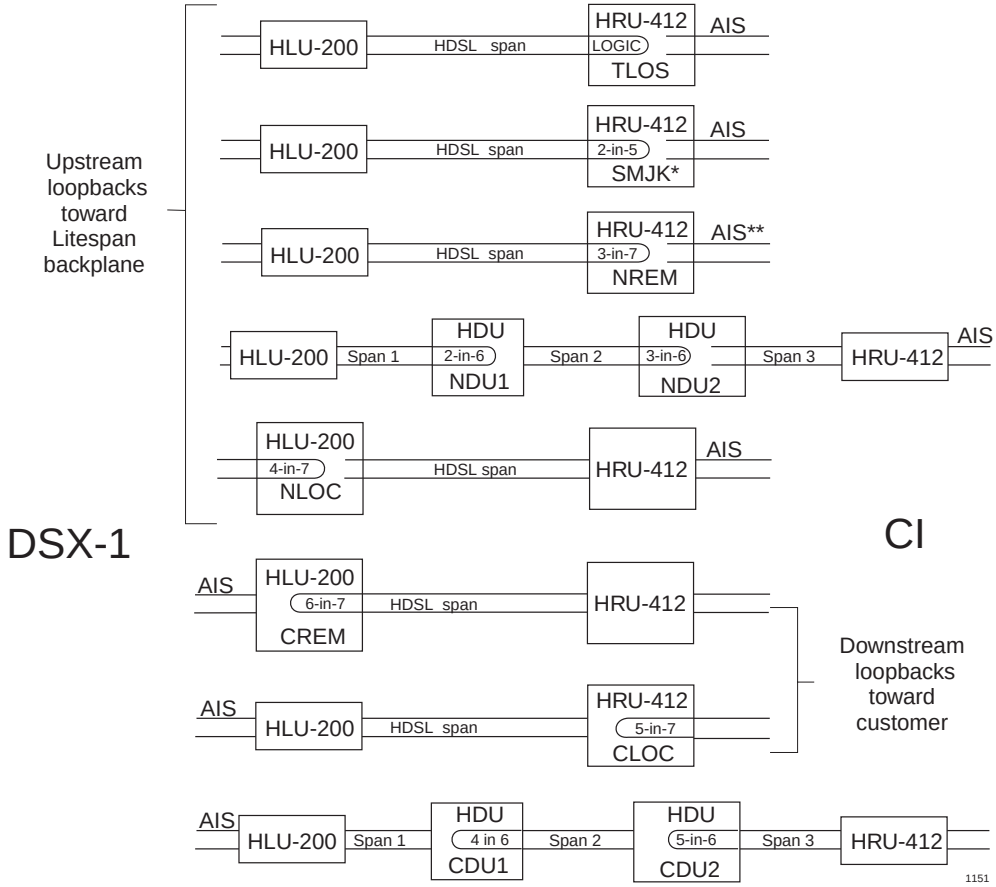
*Not Supported Exceeds 360 mA max 48V current per slot.

† Must reserve 2 slots for these doubler applications

Testing

Table 19 and Tables 12 through 16 provide step-by-step test procedures for the HLU-200 List 1D as a function of the loopback option selected. These procedures allow verification of the integrity of the HDSL channels at every module location as well as the DS1 channels to the customer and the remote/local T1 interface.

If trouble is encountered on the HLU-200 List 1D Litespan-2000 Interface, verify that the HLU-200 List 1D is making a positive connection with the CBA backplane.



Use the 3-in-5 code to loop down any of these loopbacks

* The SmartJack loopback is a metallic loopback in the HRU list 6,7, and 8. It is a logic loopback in all HRU of lists 1-5.

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

Figure 8. *HLU-200 List 1D Doubler GNLB Loopback Configuration*

Tables

***Table 10**. System Option Settings*

Mode	Selection	Description
ZBTS	ON	Tells HiGain that the ESF frame is operating in its ZBTSI mode.
	OFF*	Tells HiGain that the ESF frame is operating in its normal non-ZBTSI mode.
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*	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*	Sets automatic cancellation of all loopback to 60 minutes after initiation.
	120	Sets automatic cancellation of all loopback to 120 minutes after initiation.
ALM	DIS	Disables assertion of the Alarm input signal to the Litespan processor from the HLU processor. Note the HDSL LED still flashes Red for an alarm condition even when the ALM DIS option is chosen.
	ENA*	Enables assertion of the Alarm input signal to the Litespan processor from the HLU processor.
LPBK	DIS	Configures the HLU-200 to ignore the 2 in 5 SmartJack loopback command.
	ENA*	Enables the HLU-200 to respond to the 2 in 5 SmartJack loopback command.
SPLB	GNLB*	Configures the HiGain system to respond to the generic (3/4/5/6-in-7) inband loopback codes.
	A1LB and A2LB	Configures the HiGain system to respond to the Teltrend addressable repeater inband loopback codes.
	A3LB	Configures the HiGain system to respond to the Wescom addressable repeater inband loopback codes.
	A4LB	Configures the HiGain system to respond to the Wescom Mod 1 addressable repeater inband loopback codes.
	A5LB	Configures the HiGain system to respond to the Teltrend Mod 1 addressable repeater inband loopback codes.
PWRF	DIS	Disables powering to the HRU-412 and/or doubler over the HDSL pairs.
	ENA*	Enables powering to the HRU-412 and/or doubler over the HDSL pairs.
DS1	B8ZS	Places both the HLU and HRU into their B8ZS modes.
	AMI*	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.

Continued

***Table 10**. System Option Settings (Continued)*

Mode	Selection	Description
FRMG	AUTO*	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*	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.
SAIS	ENA*	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 (4*)	The Margin Alarm Threshold determines the minimum allowable margin below which an alarm will occur.
DS0	Any combination of the 24 DS0 channels/NONE*	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.

* Indicates HLU-200 List 1D factory settings.

Table 11. *HLU-200 GNLB Test Procedures Without HiGain Doublers*

Step	Action
1	Have the CO tester send the HRU-412 (3-in-7) inband loop-up code for five seconds. Observe that an HRU NREM loopback is in effect (see Figure 7 for non-doubler loopback configurations, Figure 8 for 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 List 1D 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) inband loop-down code.
4	Have the CO tester send the HLU-200 List 1D (4-in-7) inband loop-up for five seconds. Observe that a NLOC HLU-200 List 1D 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.
6	The HLU-200 List 1D can be looped-up from the remote location (CREM) by issuing the (6-in-7) command at the HRU-412 DS1 input port.
7	The HRU-412 can be looped-up from the remote location (CLOC) by issuing the (5-in-7) command at the HRU-412 DS1 input port.

Table 12. *HLU-200 A1LB Test Procedures*

Step	Action
1	Send into the HLU-200 List 1D the inband ARMING and NI LPBK code 11000 for at least five seconds.
2	Monitor the output of the HLU-200 List 1D for the return of the pattern. Return of pattern indicates that either the HRU-412 has looped-up (if the SMART-JACK LOOPBACK option is ENABLED) or that an external NI has looped up (if the SMART-JACK LOOPBACK option is DISABLED) and that the HLU-200 List 1D and HRU-412 units have been ARMED. Verify, if possible, that the LOOPBACK LED of the HRU-412 is flashing, indicating that the HRU-412 is armed or that it lights steadily, indicating that it is both armed and in loopback.
3	Once armed the HLU-200 List 1D can be looped back (see NLOC in Figure 7 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: • Two seconds of AIS (all ones), followed by: • Five seconds of returning data pattern, followed by: • 231 logic errors (including the frame bit) occur in the returned pattern [10 errors if ILR-1 (Doubler 1) was sent, 200 errors if ILR-20 (Doubler 2) was sent, and 20 errors if ILR-2 (HRU) was sent], followed by: • Normal looped data. Note that this error pattern will repeat 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. The HiGain Line Unit is now in Logic back (NLOC in Figure 7 for non-doubler loopback configuration.) The Loopback Time-out option, which is user settable to NONE, 20, 60 or 120 minutes, determines the duration of this loopback unless it is overridden by the TIME-OUT OVERRIDE command or a loop down command is sent. If the Time-out Override code 1101 0101 1101 0110 (D5D6) is received, the activation sequence described in 3 above is repeated and the automatic timed expiration of the loopback is inhibited. If this Time-out Override is sent, then the only way to loop the HLU-200 List 1D down is to issue the IR (Intelligent Repeater) LPDN (loop-down) code 1001 0011 1001 0011 (9393) or to issue the NI LPDN and Disarm code 11100. The automatic time-out timer is restored during subsequent loopback sessions.
4	Upon completion, the tester sends IOR LPDN code 1001 0011 1001 0011 (9393) to loop-down the HLU-200 List 1D. The unit remains armed however, as indicated by the flashing of the HRU-412 LOOPBACK LED.

Continued

***Table 12**. HLU-200 A1LB Test Procedures (Continued)*

Step	Action		
5	Using the following codes, a network tester can activate loopbacks NLOC or NREM or SMJK if enabled (shown in Figure 7 for non-doubler loopback configurations.) A tester at the CI can activate loopbacks CLOC or CREM.		
	ADDRESSABLE 1 (A1LB) REPEATER LOOPBACK COMMANDS		
	ARMING or NI LPBK (inband)	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 (inband)	Disarming code	11100 11100 ...
	DISARM (ESF Data Link)	Disarming code	1111(F)1111(F)0010(2)0100(4)
	IOR LPBK (NLOC and CREM 231 errors)	HLU Loop up	1101(D)0011(3)1101(D)0011(3)
	ILR-1 LPBK (NDU1 and CDU1 10-bit errors)	*Doubler 1 Loop-up*	*1100 0111 0100 0001 (C741)*
	ILR-20 LPBK (NDU2 and CDU2 200-bit errors)	*Doubler 2 Loop-up*	*1100 0111 0101 0100 (C754)*
	ILR-2 LPBK (NREM and CLOC 20 bit errors)	HRU Loop up	1100(C)0111(7)0100(4)0010(2)
	IR LPDN	Loop down (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	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)
	Note: The leftmost 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.		
6	After testing is complete, send the universal loopdown [IR (Intelligent Repeater) LPDN] code if the system is to loopdown but remain ARMED. Send the disarm code 11100 if all the equipment is to be looped down, disarmed and returned to normal operation. Note that the ARMED mode has an automatic time-out of 120 minutes.		
7	**Note: Doubler specific information is shown in italics.**		

Table 13. *HLU-200 A2LB Test Procedures*

Step	Action
1	Send into the HLU-200 List 1D the inband ARMING and NI LPBK code 11000 for at least five seconds.
2	Monitor the output of the HLU-200 List 1D for the return of the pattern. Return of pattern indicates that either the HRU-412 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 1D and HRU-412 units have been ARMED. Verify, if possible, that the LOOPBACK LED of the HRU-412 is flashing, indicating that the HRU-412 is armed or that it lights steadily, indicating that it is both armed and in loopback.
3	Once armed the HLU-200 List 1D can be looped back (NLOC in Figure 7 for non-doubler loopback configuration) by sending IOR LPBK activation code 1101 0011 1101 0011(D3D3) for at least five seconds. The tester observes the following activation response: • Two seconds of AIS (all ones), followed by: • Five seconds of returning data pattern, followed by: • 231 logic errors (including the frame bit) occur in the returned pattern [10 errors if ILR-1 (Doubler 1) was sent, 200 errors if ILR-20 (Doubler 2) was sent, and 20 errors if ILR-2 (HRU) was sent], followed by: • Normal looped data. Note that this error pattern will repeat 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. The HiGain Line Unit is now in Logic Loopback (NLOC in Figure 7 for non-doubler loopback configuration.) The Loopback Time-out option, which is user settable to NONE, 20, 60 or 120 minutes, determines the duration of this loopback unless it is overridden by the TIME-OUT OVERRIDE command or a loop down command is sent. If the Time-out Override code 1101 0101 1101 0110 (D5D6) is received, the activation sequence described in 3 above is repeated and the automatic timed expiration of the loopback is inhibited. If this Time-out Override is sent, then the only way to loop the HLU-200 List 1D down is to issue the IR (Intelligent Repeater) LPDN (loop-down) code 1001 0011 1001 0011 (9393) or to issue the NI LPDN and Disarm code 11100. The automatic time-out timer is restored during subsequent loopback sessions.
4	Upon completion, the tester sends IOR LPDN code 1001 0011 1001 0011 (9393) to loop-down the HLU-200 List 1D. The unit remains armed however, as indicated by the flashing of the HRU-412 LOOPBACK LED.

Continued

Table 13. *HLU-200 A2LB Test Procedures (Continued)*

Step	Action		
5	Using the following codes, a network tester can activate loopbacks NLOC or NREM or SMJK if enabled (shown in Figure 7 for non-doubler loopback configurations and Figure 16 for doubler loopback configurations.) A tester at the CI can activate loopbacks CLOC or CREM.		
	ADDRESSABLE 2 (A2LB) REPEATER LOOPBACK COMMANDS		
	ARMING or NI LPBK (inband)	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 (inband)	Disarming code	11100 11100 ...
	DISARM (ESF Data Link)	Disarming code	1111(F)1111(F)0010(2)0100(4)
	IOR LPBK (NLOC and CREM 231 errors)	HLU Loop up	1101(D)0011(3)1101(D)0011(3)
	ILR-1 LPBK *(NDU1 and CDU1 10 bit errors)*	*Doubler 1* *Loop-up*	*1100 0111 0100 0001 (C741)*
	ILR-20 LPBK *(NDU2 and CDU2 200 bit errors)*	*Doubler 2* *Loop-up*	*1100 0111 0101 0100 (C754)*
	ILR-2 LPBK (NREM and CLOC 20 bit errors)	HRU Loop up	1100(C)0111(7)0100(4)0010(2)
	IR LPDN	Loop down (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	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)
	Note: The left most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} Bit Error Ratio (BER) on the facility. The IOR POWER DOWN code must remain present for the duration of the power down mode. When this code is removed, the HiGain 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.		
6	After testing is complete, send the universal loopdown [IR (Intelligent Repeater) LPDN] code if the system is to loopdown but remain ARMED. Send the disarm code 11100 if all the equipment is to be looped down, disarmed and returned to normal operation. Note that the ARMED mode has an automatic time-out of 120 minutes.		
7	**Note: Doubler specific information is shown in italics.**		

Table 14. *HLU-200 A3LB Test Procedures*

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>The HiGain Line Unit can be looped back (NLOC in Figure 7 for non-doubler loopback configuration, NLOC in Figure 8 for doubler loopback configuration) 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-200 List 1D to enter its NLOC state. The Loopback Time-out option, which is user settable to NONE, 20, 60 or 120 minutes, determines the duration of this loopback unless it is overridden by the reception of a second identical 16-bit loop-up command before the timer expires. When this time-out override state exists, the only way to loop the HLU-200 List 1D 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.</td></tr>
<tr><td>2</td><td>The following list summarizes the codes required to execute all the HiGain loopbacks shown in Figure 7 and Figure 8. Note that all code sequences must be present for at least five seconds.
ABBREVIATIONS USED BELOW:
LU = LoopUp
LD = LoopDown
NI = Network Interface
CI = Customer Interface
ESF-DL = Extended Super Frame Data Link
ADDRESSABLE 3 (A3LB) REPEATER LOOPBACK COMMANDS
<table>
<tr><th>Position</th><th>Name</th><th>Code</th></tr>
<tr><td>HLU-200 LU FROM NI</td><td>NLOC</td><td>1111(F)*1111(F)0001(1)1110(E)</td></tr>
<tr><td>HLU-200 LU FROM CI</td><td>CREM</td><td>0011(3)1111(F)0001(1)1110(E)</td></tr>
<tr><td>HDU-451 DOUBLER 1 from NI</td><td>NDU1</td><td>1111 1111 0000 0100 (FF04)</td></tr>
<tr><td>HDU-451 DOUBLER 1 from CI</td><td>CDU1</td><td>0011 1111 0000 0100 (3F04)</td></tr>
<tr><td>HDU-451 DOUBLER 2 from NI</td><td>NDU2</td><td>1111 1111 0000 0110 (FF06)</td></tr>
<tr><td>HDU-451 DOUBLER 2 from CI</td><td>CDU2</td><td>0011 1111 0000 0110 (3F06)</td></tr>
<tr><td>HRU-412 LU FROM NI</td><td>NREM</td><td>1111(F)1111(F)0000(0)0010(2)</td></tr>
<tr><td>HRU-412 LU FROM CI</td><td>CLOC</td><td>0011(3)1111(F)0000(0)0010(2)</td></tr>
<tr><td>HRU-412 LU FROM NI</td><td>SMJK</td><td>11000 11000 11000 ...</td></tr>
<tr><td>HRU-412 LU FROM NI</td><td>SMJK</td><td>100000 100000 100000 ...</td></tr>
<tr><td>HRU-412 LU FROM NI (ESF-DL)</td><td>SMJK</td><td>1111(F)1111(F)0100(4)1000(8)</td></tr>
<tr><td>HLU and HRU LD FROM NI OR CI</td><td>Loop Down</td><td>11100 11100 11100 ...</td></tr>
<tr><td>HLU and HRU LD FROM NI OR CI</td><td>Loop Down</td><td>100 100 100 ...</td></tr>
<tr><td>HLU and HRU LD FROM NI OR CI (ESF-DL)</td><td>Loop Down</td><td>1111(F)1111(F)0010(2)0100(4)</td></tr>
</table>
Note: The left most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} Bit Error Ratio (BER) on the facility. 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.</td></tr>
<tr><td>3</td><td>Note: Doubler specific information is shown in italics.</td></tr>
</table>

Table 15. *HLU-200 A4LB Test Procedures*

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>The HiGain Line Unit can be looped back (NLOC in Figure 7 for non-doubler loopback configuration, NLOC in Figure 8 for doubler loopback configuration) 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-200 List 1D to enter its NLOC state. The Loopback Time-out option, which is user settable to NONE, 20, 60 or 120 minutes, determines the duration of this loopback unless it is overridden by the reception of a second identical 16-bit loop-up command before the timer expires. When this time-out override state exists, the only way to loop the HLU, List 6D down is to issue one of the three loop-down commands listed in Step 2. The automatic time-out mode is restored during subsequent loopback sessions.</td></tr>
<tr><td>2</td><td>The following list summarizes the codes required to execute all the HiGain system loopbacks shown in Figure 7 and Figure 8. Note that all code sequences must be present for at least five seconds.
ABBREVIATIONS USED BELOW:
LU = LoopUp
LD = LoopDown
NI = Network Interface
CI = Customer Interface
ESF-DL = Extended Super Frame Data Link
ADDRESSABLE 4 (A4LB) REPEATER LOOPBACK COMMANDS
<table>
<tr><th>Position</th><th>Name</th><th>Code</th></tr>
<tr><td>HLU-200 LU FROM NI</td><td>NLOC</td><td>1111(F)*1111(F)0001(1)1110(E)</td></tr>
<tr><td>HLU-200 LU FROM CI</td><td>CREM</td><td>0011(3)1111(F)0001(1)1110(E)</td></tr>
<tr><td>HDU-451 DOUBLER 1 from NI</td><td>NDU1</td><td>1111 1111 0000 0100 (FF04)</td></tr>
<tr><td>HDU-451 DOUBLER 1 from CI</td><td>CDU1</td><td>0011 1111 0000 0100 (3F04)</td></tr>
<tr><td>HDU-451 DOUBLER 2 from NI</td><td>NDU2</td><td>1111 1111 0000 0110 (FF06)</td></tr>
<tr><td>HDU-451 DOUBLER 2 from CI</td><td>CDU2</td><td>0011 1111 0000 0110 (3F06)</td></tr>
<tr><td>HRU-412 LU FROM NI</td><td>NREM</td><td>1111(F)1111(F)0000(0)0010(2)</td></tr>
<tr><td>HRU-412 LU FROM CI</td><td>CLOC</td><td>0011(3)1111(F)0000(0)0010(2)</td></tr>
<tr><td>HRU-412 LU FROM NI</td><td>SMJK</td><td>11000 11000 11000 ...</td></tr>
<tr><td>HRU-412 LU FROM NI (ESF-DL)</td><td>SMJK</td><td>1111(F)1111(F)0100(4)1000(8)</td></tr>
<tr><td>HLU and HRU LD FROM NI OR CI</td><td>Loop Down</td><td>11100 11100 11100 ...</td></tr>
<tr><td>HLU and HRU LD FROM NI OR CI</td><td>Loop Down</td><td>100 100 100 ...</td></tr>
<tr><td>HLU and HRU LD FROM NI OR CI (ESF-DL)</td><td>Loop Down</td><td>1111(F)1111(F)0010(2)0100(4)</td></tr>
</table>
Note: The left most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} Bit Error Ratio (BER) on the facility. 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.</td></tr>
<tr><td>3</td><td>Note: Doubler specific information is shown in italics.</td></tr>
</table>

Table 16. *HLU-200 A5LB Test Procedures (Continued)*

Step	Action
1	Send into the HLU-200 List 1D the inband ARMING and NI (Network Interface) LPBK code 11000 for at least five seconds, or at least four repetitions of the 16-bit ESF Data Link ARMING code 1111 1111 0100 1000 (FF48). (Left bit arrive first)
2	Monitor the output of the HLU-200 List 1D for the return of the pattern. Return of pattern indicates that either the HRU-412 has looped-up (if the SMART-JACK LOOPBACK option is ENABLED) or that an external NI has looped up (if the SMART-JACK LOOPBACK option is DISABLED) and that the HLU-200 List 1D and HRU-412 units have been ARMED. Verify, if possible, that the LOOPBACK LED of the HRU-412 is flashing, indicating that the HRU-412 is armed or that it lights steadily, indicating that it is both armed and in loopback.
3	Once armed the HLU-200 List 1D can be looped back (NLOC in Figure 7 for non-doubler loopback configuration, NLOC in Figure 8 for doubler loopback configuration) by sending IOR (Intelligent Office Repeater) LPBK activation code 1101 0011 1101 0011 (D3D3) for at least five seconds. The tester observes the following activation response: • Two seconds of AIS (all ones), followed by: • Five seconds of returning data pattern, followed by: • 231 logic errors (including the frame bits) occur in the returned pattern [10 errors if ILR-1 (Doubler 1) was sent, 200 errors if ILR-20 (Doubler 2) was sent, and 20 errors if ILR-2 (HRU) was sent], followed by: • Normal looped data. Note that this error pattern will repeat 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.) The HiGain Line Unit is now in Logic Loopback (NLOC in Figure 7 for non-doubler loopback configuration, NLOC in Figure 16 for doubler loopback configuration). The Loopback Time-out option, which is user settable to NONE, 20, 60 or 120 minutes, determines the duration of this loopback unless it is overridden by the TIME-OUT OVERRIDE command or a loop down command is sent. If the Time-out Override code 1101 0101 1101 0110 (D5D6) is received, the activation sequence described in 3 above is repeated and the automatic timed expiration of the loopback is inhibited. If this Time-out Override is sent, then the only way to loop the HLU-200 down is to issue the IR (Intelligent Repeater) LPDN (loopdown) code 1001 0011 1001 0011 (9393) or to issue the NI (Network Interface) LPDN and Disarm code 11100. The automatic time-out timer is restored during subsequent loopback sessions.
4	Upon completion, the tester sends IOR LPDN code 1001 0011 1001 0011 (9393) to loop-down the HLU-200 List 1D. The unit remains armed however, as indicated by the flashing of the HRU-412 LOOPBACK LED.

Continued

Table 16. *HLU-200 A5LB Test Procedures (Continued)*

Step	Action		
5	Using the following codes, a network tester can activate loopbacks NLOC or NREM or SMJK if enabled (see Figure 7 for non-doubler loopback configurations, Figure 8 for doubler loopback configurations.) A tester at the CI can activate loopbacks CLOC or CREM.		
	ADDRESSABLE 5 (A5LB) REPEATER LOOPBACKS		
	ARMING or NI LPBK (inband)	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 (inband)	Disarming code	11100 11100 ...
	DISARM (ESF Data Link)	Disarming code	1111(F)1111(F)0010(2)0100(4)
	IOR LPBK (NLOC and CREM 231 errors)	HLU Loop up	1101(D)0011(3)1101(D)0011(3)
	ILR-1 LPBK (NDU1 and CDU1 10-bit errors)	*Doubler 1 Loop-up*	*1100 0111 0100 0001 (C741)*
	ILR-20 LPBK (NDU2 and CDU2 200-bit errors)	*Doubler 2 Loop-up*	*1100 0111 0101 0100 (C754)*
	ILR-2 LPBK (NREM and CLOC 20-bit errors)	HRU Loop up	1100(C)0111(7)0100(4)0010(2)
	IR LPDN	Loop down (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)
	IOR POWER DOWN (HLU)	Removes HDSL line power	0110(6)0111(7)0110(6)0111(7)
	Note: The left most bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} Bit Error Ratio (BER) on the facility. The IOR POWER DOWN code must remain present for the duration of the power down mode. When this code is removed, the HiGain 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.		
6	After testing is complete, send the universal IR loop-down [IR (Intelligent Repeater) LPDN] code if the system is to loop-down but remain ARMED. Send the disarm code 11100 if all the equipment is to be looped down, disarmed and returned to normal operation. Note that the ARMED mode has an automatic time-out of 120 minutes.		
7	**Note: Doubler specific information is shown in italics.**		

Table 17. *HLU-200 Status Menu Messages*

Type	Message	Full Name	Description
ALARMS:	NONE	No Alarms	
	RLOS	Remote Loss of Signal	No signal from HRU-412 remote T1 interface.
	LOSW1(2)	Loss of Sync Word 1 or 2	HDSL loop 1 or 2 has lost sync.
	H1ES	HDSL Loop 1 Errored Second	Loop 1 CRC's have exceeded the user selected ES threshold.
	H2ES	HDSL Loop 2 Errored Second	Loop 2 CRC's have exceeded the user selected ES threshold.
	DS1	Digital Service 1	DS1 input BPVs at the HRU-412 have exceeded the user selected ES threshold.
	RAIS	Remote Alarm Indicating Signal	Indicates an AIS (all 1s) pattern is being transmitted from the remote or T1 output port.
	MAL1	Margin Alarm 1	The margin on HDSL loop 1 has dropped below the threshold (1 dB to 15 dB) set by the user.
	MAL2	Margin Alarm 2	The margin on HDSL loop 2 has dropped below the threshold (1 dB to 15 dB) set by the user.
	CHREV	Channels Reversed	The Loop 1 and 2 HDSL pairs are reversed at the HRU-412 input port. Loop 1 is specified to carry the (-) simplex DC voltage, and Loop 2 is specified to carry the (+) simplex DC voltage.
LOOPBACKS: (Doublers and Non-Doublers)	SMJK	SmartJack Loopback	Loopback at HRU-412 (remote) toward the CBA initiated by either the (2 in 5) inband loopback code or the out-of-band ESF data link code (Figure 7).
	NREM	Network Remote Loopback	Loopback at HRU-412 (remote) toward the CBA initiated by upstream inband codes or from the maintenance terminal (Figure 7).
	NLOC	Network Local Loopback	Loopback at HLU-200, (local) toward the CBA initiated by upstream inband codes or from the maintenance terminal (Figure 7).
	CLOC	Customer Local Loopback	Loopback at HRU-412 (local) toward CI initiated from CPE (customer) by inband codes or from the maintenance terminal (Figure 7).
	CREM	Customer Remote Loopback	Loopback at HLU-200, (remote) toward customer initiated from CPE (customer) by inband codes or from the maintenance terminal (Figure 7).
	TLOS	Transmit Loss of Signal (Loopback)	HRU-412 is in a logic loopback state caused by a loss of its T1 input from the CI, if enabled at the HRU-412, List 6, 7 or List 8, via its TLOS switch option.

Continued

Table 17. *HLU-200 Status Menu Messages (Continued)*

Type	Message	Full Name	Description
LOOPBACKS: (Doublers Only)	NDU1	Network Doubler 1 Loopback	The loopback at doubler 1 toward the CBA (Figure 8) initiated by inband codes, or the maintenance terminal.
	NDU2	Network Doubler 2 Loopback	The loopback at doubler 2 toward the CBA (Figure 8) initiated by inband codes or the maintenance terminal.
	CDU1	Customer Doubler 1 Loopback	The loopback at doubler 1 toward CI (Figure 8) initiated by inband codes or the maintenance terminal.
	CDU2	Customer Doubler 2 Loopback	The loopback at doubler 2 toward CI (Figure 8) initiated by inband codes or the maintenance terminal.

Table 18. *Glossary of HiGain Terms*

Term	Definition
MARGINS	Indicates the excess signal to noise ratio, at the HRU, HDU, or HLU HDSL ports, relative to a 10^{-7} BER. 1st value is current margin, 2nd value is minimum margin since (C)leared last, 3rd value is maximum value since cleared. NA means Not Available (loop is not in sync). The normal range of a typical margin is from 22 dB to 6 dB.
PULSE ATTENUATION	Indicates the attenuation of the 2B1Q pulse from the distant end. The HiGain system operates with pulse attenuations in excess of 30 dB. This value is related to the cable pair's 196 kHz loss. The pulse attenuation is a more direct indication of the loop attenuation to the 2B1Q signal than the 196 kHz loss. The normal range of pulse attenuation is from 1 dB to 28 dB.
PPM	Indicates the relative offset of the crystal oscillator in the HRU-412 from the HLU-200 List 1D crystal oscillator. Any value between -100 and +100 is adequate. Values outside this range indicate out of tolerance components or excessive temperature drift in critical components.
HDSL 24 Hour ES (Errored Seconds)	The number of 1 second intervals that contained at least 1 CRC error. This value is a running total of the last 24 Hours.
HDSL 24 Hour UAS (Unavailable Seconds)	The number of seconds the HDSL loop was out of sync.
DS1 BPV Seconds (ES)	The number of seconds in which at least 1 BPV was detected at the HRU DS1 input.
DS1 UAS Count	The number of seconds during which the HRU DS1 input signal was absent (125 or more consecutive 0).
Frame type	Type of DS1 framing used on the HRU input stream (SF, ESF, Unframed or No Activity).
Code type	Type of DS1 line coding (AMI, B8ZS, AMI : ZBTSI or B8ZS : ZBTSI). The latter two conditions indicate the code type that is being received when the HiGain system is set to its ZBTS mode. In either the AMI or B8ZS DS1 code mode, the Code type displays the selected code as opposed to the code type that is actually being received, which is what is displayed when set to AUTO code mode.
HLU/Ver w.x-y	“w.x” = software version number of the HLU “y” = list # of HLU
HRU/Ver a.b-c	“a.b” = software version number of the HRU “c” = list # of HRU
HDU1/Ver s.t-u	“s.t.” = the software version number of the HDU #1 “u” = List number of the HDU #1.
HDU2/Ver f.g-h	“f.g.” = the software version number of the HDU #2. “h” = List number of the HDU #2.

***Table 19**. HLU-200 GNLB Test Procedures Using HiGain Doublers*

Step	Action
1	Have the CO tester send the HRU-412 (3-in-7) inband loop-up code for five seconds. Observe that an HRU NREM loopback is in effect (Figure 8). The loopback state is indicated in the Span Status display screen, and by the Green Loop LED on the front panel.
2	Have the CO tester transmit a T1 test signal into the HLU-200 List 1D 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) inband loop-down code.
4	Have the CO tester send the HLU-200 List 1D (4-in-7) inband loop-up for five seconds. Observe that a NLOC HLU-200 List 1D loopback is in effect. The green front panel Loop LED should light.
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.
6	The HLU-200 List 1D can be looped-up from the remote location (CREM) by issuing the (6-in-7) command at the HRU-412 DS1 input port.
7	The HRU-412 can be looped-up from the remote location (CLOC) by issuing the (5-in-7) command at the HRU-412 DS1 input port.
8	Doubler #1 can be looped toward the CI from the remote location (CDU1) by issuing the (4-in-6) loopback command at the HRU-412 DS1 input port.
9	Doubler #1 can be looped toward the CBA from the HLU location (NDU1) by issuing the (2-in-6) loopback command at the HLU-200 List 1D DS1 input port.
10	Doubler #2 can be looped toward the CI from the remote location (CDU2) by issuing the (5-in-6) loopback command at the HRU-412 DS1 input port.
11	Doubler #2 can be looped toward the CBA from the HLU location (NDU2) by issuing the (3-in-6) loopback command at the HLU-200 List 1D DS1 input port.

System Maintenance Menu Screens

Non-Doublers

Figure 9 is the Maintenance Terminal MAIN MENU Screen. Its eight sub-menus provide many useful provisioning, test and monitoring tools. Figure 10 shows the HLU-200 List 1D SPAN STATUS Screen. The DS1 STATUS fields in the HLU column are not supported and should be ignored.

Figure 11 shows the SET CLOCK menu. Both the Time and Date are set with this menu. Set the hours and minutes, using the military (24-hour) convention. Setting the seconds is optional. Enter the date in the sequence and format shown. HRU-412 units using software versions 6.4 and above, and all List 6, List 7 HRU-412 units can also be set to the same time and date as the HLU-200 List 1D by entering a U to the "Update Remote" query. All time information is lost when power is removed. The last date, however, is retained in NVRAM and reappears when power is restored.

Figure 12 shows the SYSTEM SETTINGS Screen. All 13 user options can be set from this screen. To change any option, enter its character key that is shown inside the parenthesis within each parameter description. This causes the screen to refresh with the new parameter. After all parameters have been selected, press E (Exit) then C (Confirm). The newly selected parameters are now activated.

Figure 13 shows the LOOPBACK MENU Screen. Loopbacks NLOC, NREM, CLOC and CREM are available.

Figure 14 shows the PERFORMANCE DATA screen. Both the Errored and Unavailable Seconds for both HDSL loops and the remote DS1 input are listed at 15-minute intervals over a four hour time interval. Earlier and later data, in four-hour chunks on six different screens, can be accessed by pressing P (Previous) or N (Next) respectively. All of the counters can be set to zero by pressing C (Clear) from the HLU-200 List 1D SPAN STATUS Screen shown in Figure 10. Note that since the HLU-200 List 1D is considered the master module, this clears all performance data screens at both the HLU-200 List 1D and the HRU-412. The RS-232 terminal interface at the HRU-412 does not allow the counters to be cleared.

Figure 15 shows the 7-DAY PERFORMANCE HISTORY Screen. The "Errored Seconds" and "Unavailable Seconds" for both HDSL loops and the remote DS1 input are listed for the current and previous seven days. All of the counters can be set to zero by pressing C (Clear) on the HLU-200 List 1D SPAN STATUS Screen (Figure 10). Note that since the HLU-200 is considered the master module, this clears all performance data screens at both the HLU-200 and the HRU-412. The RS-232 terminal interface at the HRU-412 does not allow the counters to be cleared.

Figure 16 shows the ALARM HISTORY Screen. The alarms are defined in the Alarms section. The "First" and "Last" columns contain the time and date stamp of the first and last occurrence of each alarm. The "Current" column shows the status of each alarm. The "Count" column lists the number of times each alarm occurred. All the data can be cleared by pressing C (Clear). The maximum non-overflowing count is 999.

Selection **H** from the main menu allows the Circuit ID # to be set. It is limited to 24 alphanumeric characters. It, like the system settings, is stored in NVRAM and thus remains when power is lost. Note that the Circuit ID # is not available at the HRU-412 Maintenance Port.

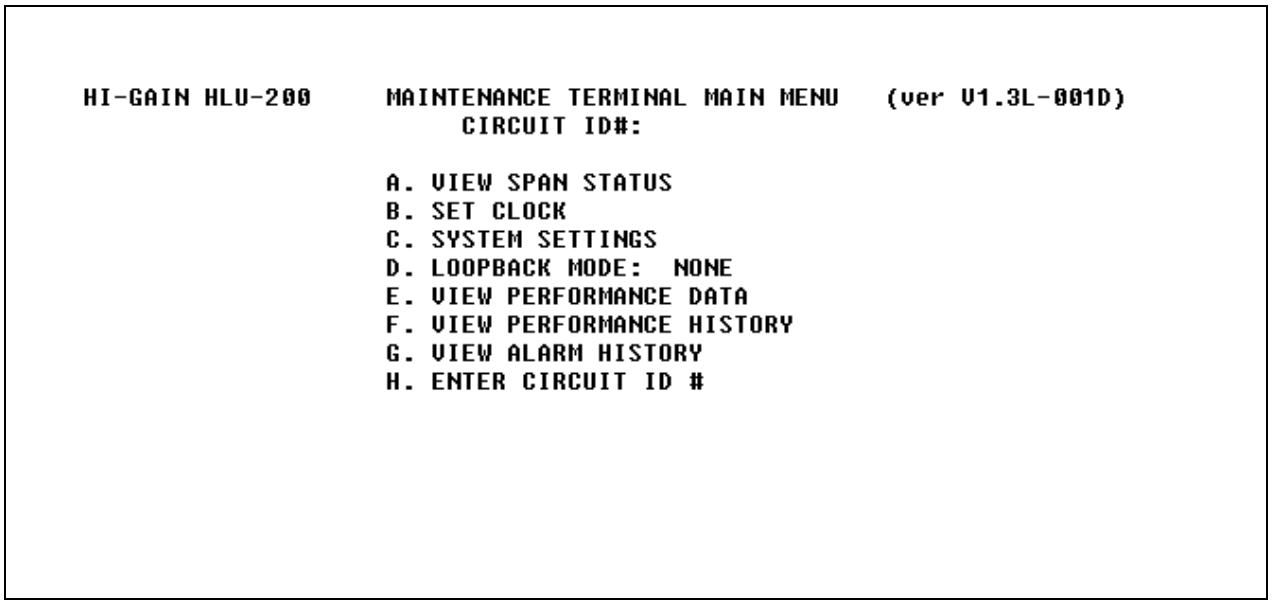


***Figure 9**. HLU-200 List 1D Terminal Main Menu*

```
                          SPAN STATUS
                ( HLU/ver1.3-001D: HRU/ver2.6-0008)
TIME: 00:38:00
DATE: 07/13/96                    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:          13/12/14     11/10/11     16/14/16     16/14/16 dB
PULSE ATTN:        29           29           27           27     dB
PPM OFFSET:        00           00          -12          -12     ppm
24 HOUR ES:      00001        00000        00002        00002   seconds
24 HOUR UAS:     00013        00015        00000        00001   seconds

                                DS1 STATUS
                              HLU                  HRU
24 HOUR BPV Seconds:          N/A                00003
24 HOUR UAS Count:            N/A                00013
Frame type:                   ESF                  ESF
Code type:                    N/A                  AMI

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

***Figure 10**. HLU-200 List 1D Span Status Menu (Non-Doubler Applications)*

```
                              SET CLOCK

TIME: 00:05:57
DATE: 02/17/96
CIRCUIT ID#:


Format: HH:MM
        MM/DD/YY









NEW TIME:
```

Figure 11. *HLU-200 List 1D Set Clock Menu*

```
                            SYSTEM SETTINGS

 TIME: 00:07:42
 DATE: 02/17/96                    CIRCUIT ID#:


 SMART-JACK (L)B:    DISABLE
 (S)PECIAL LPBK:     GNLB
 (P)OWER:            ENABLE
 (Z)BTSI:            OFF
 ES ALARM TH(R)ES:   NONE
 LOOPBACK (T)IMEOUT: 60
 (A)LARM:            ENABLE
 (D)S1 LINE CODE:    AMI
 (F)RAMING:          AUTO
 AIS ON (H)DSL LOSW: 2 LOOPS
 AIS ON S(M)JK/NREM: DISABLE
 MAR(G)IN ALM THRES: 4
 DS0 (B)LOCKING: xx - Blocked Channels
 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

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

Figure 12. *HLU-200 List 1D Terminal System Settings Main Menu*

```
                              LOOPBACK MENU

TIME: 00:08:43
DATE: 02/17/96
CIRCUIT ID#:


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









                                  (E)xit
```

Figure 13. *HLU-200 List 1D Terminal Loopback Menu*

```
Date: 02/17/96              PERFORMANCE DATA
CIRCUIT ID#:
                    ERRORED SECONDS/UNAVAILABLE SECONDS

            DS1             HDSL-1              HDSL-2
           HRU       HLU       HRU       HLU       HRU       HLU       HRU
20:15    000/000   000/000   000/000   000/000   000/000
20:30    000/000   000/000   000/000   000/000   000/000
20:45    000/000   000/000   000/000   000/000   000/000
21:00    000/000   000/000   000/000   000/000   000/000
21:15    000/000   000/000   000/000   000/000   000/000
21:30    000/000   000/000   000/000   000/000   000/000
21:45    000/000   000/000   000/000   000/000   000/000
22:00    000/000   000/000   000/000   000/000   000/000
22:15    000/000   000/000   000/000   000/000   000/000
22:30    000/000   000/000   000/000   000/000   000/000
22:45    000/000   000/000   000/000   000/000   000/000
23:00    000/000   000/000   000/000   000/000   000/000
23:15    000/000   000/000   000/000   000/000   000/000
23:30    000/000   000/000   000/000   000/000   000/000
23:45    000/000   000/000   000/000   000/000   000/000
00:00    000/000   000/000   000/000   000/000   000/000

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

Figure 14. *HLU-200 List 1D Terminal Performance Data*

```
Time: 00:11:39                    7 DAY HISTORY
CIRCUIT ID#:

                        ERRORED SECONDS/UNAVAILABLE SECONDS

            DS1              HDSL-1              HDSL-2
           HRU         HLU         HRU         HLU         HRU
02/10   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
02/11   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
02/12   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
02/13   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
02/14   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
02/15   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
02/16   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000

                                    (E)xit
```

Figure 15. *HLU-200 List 1D 7-Day Performance Data History*

```
                              ALARM HISTORY

TIME: 00:12:57
DATE: 02/17/96
CIRCUIT ID#:

Type              First               Last                Current        Count
LOS, DS1-HLU                                              OK             000
LOS, DS1-HRU                                              OK             000
LOSW, HDSL1       02/17/96-00:00      02/17/96-00:00      OK             001
LOSW, HDSL2       02/17/96-00:00      02/17/96-00:00      OK             001
ES, HDSL1                                                 OK             000
ES, HDSL2                                                 OK             000
MARGIN L1                                                 OK             000
MARGIN L2                                                 OK             000
PWR-OPEN                                                  OK             000
PWR-SHRT          02/17/96-00:00      02/17/96-00:00      OK             001

LAST CLEARED:  NONE

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

Figure 16*. HLU-200 List 1D Alarm History*

Doublers

Figure 17 is the Maintenance Terminal MAIN MENU Screen. Its eight sub-menus provide many useful provisioning, test and monitoring tools.

Selection "H" from the MAIN MENU Screen allows the Circuit ID# to be set. It is limited to 24 alphanumeric characters. It, like the system settings, is stored in NVRAM and thus remains when power is lost. Note that the Circuit ID# is not available at the HRU-412 Maintenance Port.

Figures 18 through 21 show the HLU-200 List 1D SPAN STATUS screens for Twin Doubler applications. The SPAN 1 Screen contains data on the two HDSL loops between the HLU-200 List 1D and the first Doubler. The SPAN 2 Screen refers to the loops between the first Doubler and the HRU-412 for single-Doubler circuits or between the first and second Doublers for two-Doubler circuits. The SPAN 3 screen refers to the loops between the second Doubler and the HRU-412 for two-Doubler circuits. All status screens contain the same DS1 interface information.

Figure 22 shows the SET CLOCK Menu Screen. Both the Time and Date are set with this menu. Set the hours and minutes, using the military (24-hour) convention. Setting the seconds is optional. Enter the date in the sequence and format shown. List 1 HRU-412 units having software versions 6.4 and above, and all List 6, List 7 HRU-412 units can also be set to the same time and date as the HLU-200 List 1D by entering a U to the "Update Remote" query. All time information is lost when power is removed. The last date, however, is retained in NVRAM and reappears when power is restored.

Figure 23 shows the SYSTEM SETTINGS Menu Screen. All 13 user options can be set from this screen. To change any option, enter its character key which is shown inside the parenthesis within each parameter description. This causes the screen to refresh with the new. After all parameters have been selected, press **E** then **C**. The newly selected parameters are now activated.

Figure 24 shows the LOOPBACK MENU Screen for a two-Doubler system. Each of the four modules can be looped back towards the network or the customer from this screen. NDU2 and CDU2 are not available for single Doubler applications and only NLOC, NREM, CLOC and CREM are available for non-Doubler applications.

Figures 25 through 28 show the PERFORMANCE DATA screens for Doubler applications. Both the Errored and Unavailable Seconds for both HDSL loops and each T1 input are listed at 15-minute intervals over a four hour time interval. The SPAN 1 Screen contains data on the two HDSL loops between the HLU-200 List 1D and the first Doubler (HDU1). The SPAN 2 Screen refers to the loops between the first Doubler (HDU1) and the HRU-412 for one Doubler circuits or between the first and second Doublers (HDU1 and HDU2) for two-Doubler circuits. The SPAN 3 Screen refers to the loops between the second Doubler and the HRU-412 for two-Doubler circuits. All status screens contain the same DS1 interface errors. Earlier and later data, in four-hour chunks on six different screens per span, can be accessed by pressing **P** (Previous) or **N** (Next) respectively. Performance data from the different spans can be accessed by entering **S** (Span). All of the counters can be set to **0** by pressing **C** from the HLU-200 List 1D SPAN STATUS Screen shown in Figures 18 through 21. Note that since the HLU-200 List 1D is considered the master module, this clears *all* performance data screens at both the HLU-200 List 1D and the HRU-412. The RS-232 terminal interface at the HRU-412 does not allow the counters to be cleared.

Figures 29 through 32 show the 7-DAY PERFORMANCE HISTORY screens for Doubler applications. The "Errored Seconds" and "Unavailable Seconds" for both HDSL loops and each of the two DS1 inputs are listed for the current and previous seven days. The SPAN 1 Screen contains data on the two HDSL loops between the HLU-200 List 1D and the first Doubler (HDU1). The SPAN 2 Screen refers to the loops between the first Doubler (HDU1) and the HRU-412 for one-Doubler circuits or between the first and second Doublers (HDU1 and HDU2) for two-Doubler circuits. The SPAN 3 Screen refers to the loops between the second Doubler and the HRU-412 for two-Doubler circuits. All status screens contain the same DS-1 interface errors. All of the counters can be set to **0** by pressing **C** on the HLU-200 List 1D SPAN STATUS Screen (Figures 18 through 21). Note that since the HLU-200 List 1D is considered the master module, this clears all performance data

screens at both the HLU-200 List 1D and the HRU-412. The RS-232 terminal interface at the HRU-412 does not allow the counters to be cleared.

Figures 33 through 35 show the ALARM HISTORY screens for Doubler applications. The alarms are defined in Paragraph 6.1. The LOS and PWR system alarms are common to all spans. Only the LOSW, ES and MARGIN are span specific alarms. The PWR-OPEN and PWR-SHRT alarms indicate alarm conditions on the HLU-200 List 1D. Neither PWR alarm is available on the other spans. In Figures 33 through 35, the "First" and "Last" columns contain the time and date stamp of the first and last occurrence of each alarm. The "Current" column shows the status of each alarm. The "Count" column lists the number of times each alarm occurred. All the data can be cleared by pressing C (Clear). The maximum non-overflowing count is 999. The SPAN 1 Screen concerns alarms that occurred on the two HDSL loops between the HLU-200 List 1D and the first Doubler (HDU1). The SPAN 2 Screen refers to the loops between the first Doubler (HDU1) and the HRU-412 for one-Doubler circuits or between the first and second Doublers (HDU1 and HDU2) for two-Doubler circuits. The SPAN 3 Screen refers to the loops between the second Doubler and the HRU-412 for two-Doubler circuits.

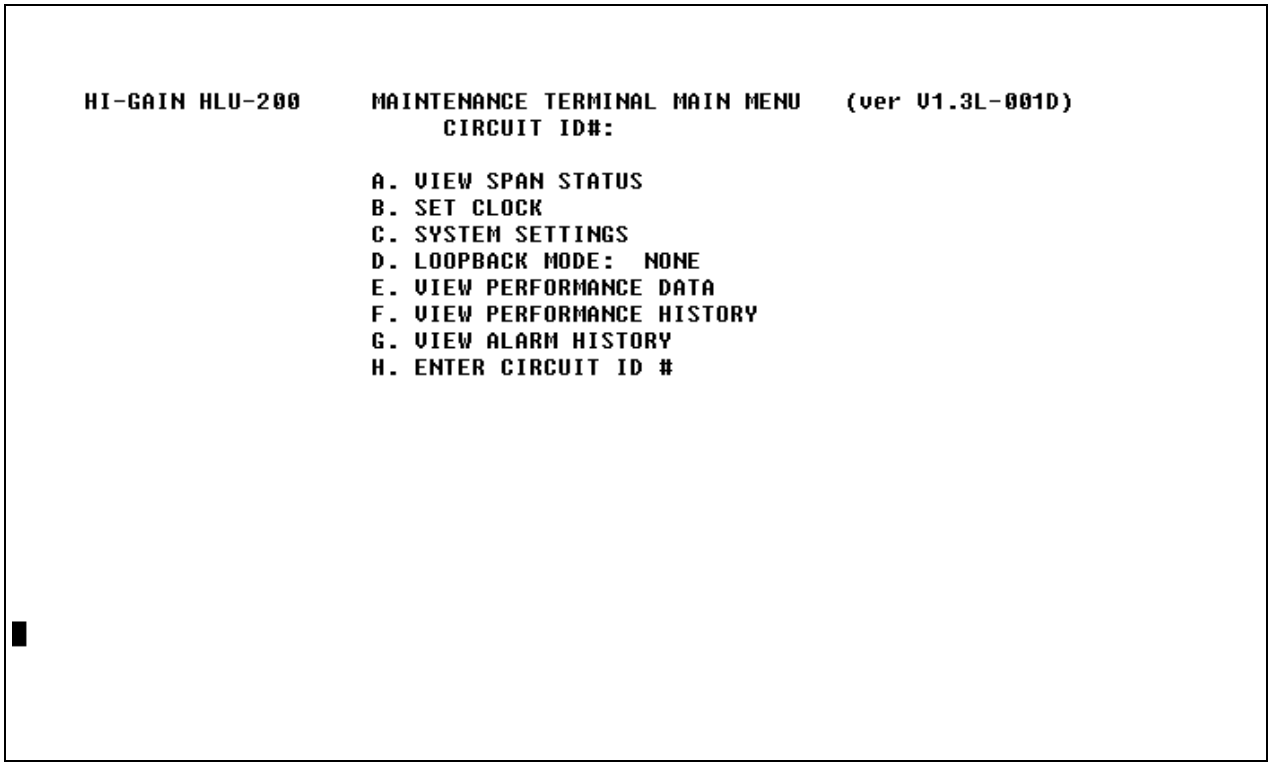


Figure 17. *HLU-200 List 1D Main Menu*

```
                          SPAN 1 STATUS
                ( HLU/ver1.3-001D:HDU1/ver2.6-0003)
TIME: 00:05:42
DATE: 05/16/96                    CIRCUIT ID#:

ALARMS:   NONE
LOOPBACK: OFF
                       HLU                          HDU1
                 HDSL-1       HDSL-2       HDSL-1       HDSL-2
              cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:         21/17/21     21/18/22     21/00/21     21/00/22 dB
PULSE ATTN:        00           00           00           00    dB
PPM OFFSET:        00           00           15           15    ppm
24 HOUR ES:     00000        00000        00001        00000  seconds
24 HOUR UAS:    00025        00018        00015        00008  seconds

                                DS1 STATUS
                              HLU                  HRU
24 HOUR BPV Seconds:          N/A                00005
24 HOUR UAS Count:            N/A                00005
Frame type:                Unframed             Unframed
Code type:                    N/A                 AMI

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

Figure 18. *HLU-200 List 1D Status Display - Span 1 (1 or 2 Doublers)*

```
                          SPAN 2 STATUS
                (HDU1/ver2.6-0003: HRU/ver1.7-0007)
TIME: 00:37:39
DATE: 05/16/96                    CIRCUIT ID#:

ALARMS:   CHREV
LOOPBACK: OFF
                       HDU1                         HRU
                 HDSL-1       HDSL-2       HDSL-1       HDSL-2
              cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:         21/00/22     22/00/22     21/19/21     21/18/22 dB
PULSE ATTN:        00           00           00           00    dB
PPM OFFSET:        00           00          -20          -19    ppm
24 HOUR ES:     00002        00002        00004        00006  seconds
24 HOUR UAS:    00015        00012        00001        00000  seconds

                                DS1 STATUS
                              HLU                  HRU
24 HOUR BPV Seconds:          N/A                00007
24 HOUR UAS Count:            N/A                00007
Frame type:                Unframed             Unframed
Code type:                    N/A                 AMI

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

Figure 19*. HLU-200 List 1D Status Display - Span 2 (1 Doubler).*

```
                          SPAN 2 STATUS
                 (HDU1/ver2.6-0003:HDU2/ver2.6-0003)
TIME: 00:07:40
DATE: 05/16/96                    CIRCUIT ID#:

ALARMS:   CHREV
LOOPBACK: OFF
                       HDU1                          HDU2
                  HDSL-1       HDSL-2       HDSL-1       HDSL-2
                cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:           21/00/22     21/00/22     21/00/22     22/00/22 dB
PULSE ATTN:          00           00           00           00    dB
PPM OFFSET:          00           00          -12          -12    ppm
24 HOUR ES:       00001        00000        00001        00000  seconds
24 HOUR UAS:      00006        00004        00007        00005  seconds

                                 DS1 STATUS
                               HLU                  HRU
24 HOUR BPV Seconds:           N/A                00005
24 HOUR UAS Count:             N/A                00005
Frame type:                Unframed             Unframed
Code type:                     N/A                  AMI

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

Figure 20. *HLU-200 List 1D Status Display - Span 2 (2 Doublers)*

```
                          SPAN 3 STATUS
                 (HDU2/ver2.6-0003: HRU/ver1.7-0007)
TIME: 00:14:25
DATE: 05/16/96                    CIRCUIT ID#:

ALARMS:   NONE
LOOPBACK: OFF
                       HDU2                          HRU
                  HDSL-1       HDSL-2       HDSL-1       HDSL-2
                cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:           21/00/22     21/00/22     21/19/22     21/19/22 dB
PULSE ATTN:          00           00           00           00    dB
PPM OFFSET:          00           00          -06          -06    ppm
24 HOUR ES:       00001        00001        00002        00004  seconds
24 HOUR UAS:      00005        00005        00000        00000  seconds

                                 DS1 STATUS
                               HLU                  HRU
24 HOUR BPV Seconds:           N/A                00005
24 HOUR UAS Count:             N/A                00005
Frame type:                Unframed             Unframed
Code type:                     N/A                  AMI

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

Figure 21. *HLU-200 List 1D Status Display - Span 3 (2 Doublers)*

```
                              SET CLOCK

TIME: 00:16:07
DATE: 05/16/96
CIRCUIT ID#:


Format: HH:MM
        MM/DD/YY









NEW TIME:

NEW DATE:
```

Figure 22. *HLU-200 List 1D Set Clock Menu*

```
                           SYSTEM SETTINGS

TIME: 00:17:39
DATE: 05/16/96                    CIRCUIT ID#:


SMART-JACK (L)B:    ENABLE
(S)PECIAL LPBK:     GNLB
(P)OWER:            ENABLE
(Z)BTSI:            OFF
ES ALARM TH(R)ES:   NONE
LOOPBACK (T)IMEOUT: 60
(A)LARM:            ENABLE
(D)S1 LINE CODE:    AMI
(F)RAMING:          AUTO
AIS ON (H)DSL LOSW: 2 LOOPS
AIS ON S(M)JK/NREM: ENABLE
MAR(G)IN ALM THRES: 4
DSO (B)LOCKING: xx - Blocked Channels
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

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

Figure 23. *HLU-200 List 1D System Settings Menu*

```
                              LOOPBACK MENU

TIME: 00:20:03
DATE: 05/16/96
CIRCUIT ID#:


                          A. DISABLE LOOPBACKS
                          B. NETWORK LOOP HLU          (NLOC)
                          C. NETWORK LOOP HRU          (NREM)
                          D. NETWORK LOOP DOUBLER 1    (NDU1)
                          F. NETWORK LOOP DOUBLER 2    (NDU2)
                          G. CUSTOMER LOOP HLU         (CREM)
                          H. CUSTOMER LOOP HRU         (CLOC)
                          I. CUSTOMER LOOP DOUBLER 1   (CDU1)
                          J. CUSTOMER LOOP DOUBLER 2   (CDU2)



                                  (E)xit
```

Figure 24. *HLU-200 List 1D Doubler Loopback Menu*

```
Date: 05/16/96          SPAN 1 PERFORMANCE DATA
CIRCUIT ID#:
                    ERRORED SECONDS/UNAVAILABLE SECONDS

            DS1          HDSL-1              HDSL-2
            HRU       HLU      HDU1       HLU      HDU1
20:30    000/000   000/000  000/000    000/000  000/000
20:45    000/000   000/000  000/000    000/000  000/000
21:00    000/000   000/000  000/000    000/000  000/000
21:15    000/000   000/000  000/000    000/000  000/000
21:30    000/000   000/000  000/000    000/000  000/000
21:45    000/000   000/000  000/000    000/000  000/000
22:00    000/000   000/000  000/000    000/000  000/000
22:15    000/000   000/000  000/000    000/000  000/000
22:30    000/000   000/000  000/000    000/000  000/000
22:45    000/000   000/000  000/000    000/000  000/000
23:00    000/000   000/000  000/000    000/000  000/000
23:15    000/000   000/000  000/000    000/000  000/000
23:30    000/000   000/000  000/000    000/000  000/000
23:45    000/000   000/000  000/000    000/000  000/000
00:00    000/000   000/000  000/000    000/000  000/000
00:15    005/005   000/025  001/015    000/018  000/008

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

Figure 25*. HLU-200 List 1D Performance Data - Span 1 (1 or 2 Doublers)*

```
Date: 05/16/96        SPAN 2 PERFORMANCE DATA
CIRCUIT ID#:
                  ERRORED SECONDS/UNAVAILABLE SECONDS

           DS1          HDSL-1            HDSL-2
           HRU      HDU1      HRU     HDU1      HRU
20:45    000/000  000/000  000/000  000/000  000/000
21:00    000/000  000/000  000/000  000/000  000/000
21:15    000/000  000/000  000/000  000/000  000/000
21:30    000/000  000/000  000/000  000/000  000/000
21:45    000/000  000/000  000/000  000/000  000/000
22:00    000/000  000/000  000/000  000/000  000/000
22:15    000/000  000/000  000/000  000/000  000/000
22:30    000/000  000/000  000/000  000/000  000/000
22:45    000/000  000/000  000/000  000/000  000/000
23:00    000/000  000/000  000/000  000/000  000/000
23:15    000/000  000/000  000/000  000/000  000/000
23:30    000/000  000/000  000/000  000/000  000/000
23:45    000/000  000/000  000/000  000/000  000/000
00:00    000/000  000/000  000/000  000/000  000/000
00:15    005/005  001/006  002/000  000/004  004/000
00:30    000/000  000/000  000/000  000/000  000/000

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

Figure 26. *HLU-200 List 1D Performance Data - Span 2 (1 Doubler).*

```
Date: 05/16/96        SPAN 2 PERFORMANCE DATA
CIRCUIT ID#:
                  ERRORED SECONDS/UNAVAILABLE SECONDS

           DS1          HDSL-1            HDSL-2
           HRU      HDU1      HDU2     HDU1      HDU2
20:30    000/000  000/000  000/000  000/000  000/000
20:45    000/000  000/000  000/000  000/000  000/000
21:00    000/000  000/000  000/000  000/000  000/000
21:15    000/000  000/000  000/000  000/000  000/000
21:30    000/000  000/000  000/000  000/000  000/000
21:45    000/000  000/000  000/000  000/000  000/000
22:00    000/000  000/000  000/000  000/000  000/000
22:15    000/000  000/000  000/000  000/000  000/000
22:30    000/000  000/000  000/000  000/000  000/000
22:45    000/000  000/000  000/000  000/000  000/000
23:00    000/000  000/000  000/000  000/000  000/000
23:15    000/000  000/000  000/000  000/000  000/000
23:30    000/000  000/000  000/000  000/000  000/000
23:45    000/000  000/000  000/000  000/000  000/000
00:00    000/000  000/000  000/000  000/000  000/000
00:15    005/005  001/006  001/007  000/004  000/005

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

Figure 27*. HLU-200 List 1D Performance Data - Span 2 (2 Doublers)*

```
Date: 05/16/96          SPAN 3 PERFORMANCE DATA
CIRCUIT ID#:
                    ERRORED SECONDS/UNAVAILABLE SECONDS

            DS1           HDSL-1              HDSL-2
            HRU      HDU2       HRU      HDU2       HRU
20:30    000/000   000/000   000/000   000/000   000/000
20:45    000/000   000/000   000/000   000/000   000/000
21:00    000/000   000/000   000/000   000/000   000/000
21:15    000/000   000/000   000/000   000/000   000/000
21:30    000/000   000/000   000/000   000/000   000/000
21:45    000/000   000/000   000/000   000/000   000/000
22:00    000/000   000/000   000/000   000/000   000/000
22:15    000/000   000/000   000/000   000/000   000/000
22:30    000/000   000/000   000/000   000/000   000/000
22:45    000/000   000/000   000/000   000/000   000/000
23:00    000/000   000/000   000/000   000/000   000/000
23:15    000/000   000/000   000/000   000/000   000/000
23:30    000/000   000/000   000/000   000/000   000/000
23:45    000/000   000/000   000/000   000/000   000/000
00:00    000/000   000/000   000/000   000/000   000/000
00:15    005/005   001/005   002/000   001/005   004/000

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

Figure 28. *HLU-200 List 1D Performance Data - Span 3 (2 Doublers)*

```
Time: 00:26:33                      7 DAY HISTORY
CIRCUIT ID#:

                                    SPAN 1
                          ERRORED SECONDS/UNAVAILABLE SECONDS

            DS1              HDSL-1                    HDSL-2
            HRU          HLU         HDU1          HLU         HDU1
05/09    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/10    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/11    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/12    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/13    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/14    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/15    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current  00000/00005 00005/00000 00025/00001 00015/00000 00018/00000

                                    (E)xit (S)pan
```

Figure 29*. HLU-200 List 1D Performance Data History - Span 1 (1 or 2 Doublers)*

```
Time: 00:40:50                    7 DAY HISTORY
CIRCUIT ID#:

                                  SPAN 2
                        ERRORED SECONDS/UNAVAILABLE SECONDS

           DS1              HDSL-1                    HDSL-2
           HRU         HDU1          HRU         HDU1          HRU
05/09   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/10   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/11   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/12   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/13   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/14   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/15   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00000/00005 00005/00001 00006/00002 00000/00000 00004/00004

                                  (E)xit (S)pan
```

Figure 30. *HLU-200 List 1D Performance Data History - Span 2 (1 Doubler)*

```
Time: 00:28:08                    7 DAY HISTORY
CIRCUIT ID#:

                                  SPAN 2
                        ERRORED SECONDS/UNAVAILABLE SECONDS

           DS1              HDSL-1                    HDSL-2
           HRU         HDU1          HDU2        HDU1          HDU2
05/09   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/10   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/11   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/12   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/13   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/14   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/15   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00000/00005 00005/00001 00006/00001 00007/00000 00004/00000

                                  (E)xit (S)pan
```

Figure 31. *HLU-200 List 1D Performance Data History - Span 2 (2 Doublers)*

```
Time: 00:29:48                    7 DAY HISTORY
CIRCUIT ID#:

                                    SPAN 3
                          ERRORED SECONDS/UNAVAILABLE SECONDS

            DS1              HDSL-1                    HDSL-2
            HRU         HDU2          HRU         HDU2          HRU
05/09    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/10    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/11    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/12    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/13    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/14    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
05/15    00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current  00000/00005 00005/00001 00005/00002 00000/00001 00005/00004




                                    (E)xit (S)pan
```

Figure 32. *HLU-200 List 1D Performance Data History - Span 3 (2 Doublers)*

```
                                ALARM HISTORY

TIME: 00:32:16
DATE: 05/16/96
CIRCUIT ID#:

Type                First                Last                Current        Count
LOS, DS1-HLU                                                OK             000
LOS, DS1-HRU                                                OK             000
SPAN1 LOSW, HDSL1                                           OK             000
SPAN1 LOSW, HDSL2                                           OK             000
SPAN1 ES, HDSL1                                             OK             000
SPAN1 ES, HDSL2                                             OK             000
SPAN1 MARGIN L1                                             OK             000
SPAN1 MARGIN L2                                             OK             000
PWR-OPEN                                                    OK             000
PWR-SHRT                                                    OK             000

LAST CLEARED:  05/16/96-00:31

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

Figure 33. *HLU-200 List 1D Alarm History - Span 1 (1 or 2 Doublers)*

```
                              ALARM HISTORY

TIME: 00:33:18
DATE: 05/16/96
CIRCUIT ID#:

Type              First              Last               Current        Count
LOS, DS1-HLU                                            OK             000
LOS, DS1-HRU                                            OK             000
SPAN2 LOSW, HDSL1                                       OK             000
SPAN2 LOSW, HDSL2                                       OK             000
SPAN2 ES, HDSL1                                         OK             000
SPAN2 ES, HDSL2                                         OK             000
SPAN2 MARGIN L1                                         OK             000
SPAN2 MARGIN L2                                         OK             000
PWR-OPEN                                                OK             000
PWR-SHRT                                                OK             000

LAST CLEARED:  05/16/96-00:31


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

Figure 34. *HLU-200 List 1D Alarm History - Span 2 (1 or 2 Doublers)*

```
                              ALARM HISTORY

TIME: 00:34:09
DATE: 05/16/96
CIRCUIT ID#:

Type              First              Last               Current        Count
LOS, DS1-HLU                                            OK             000
LOS, DS1-HRU                                            OK             000
SPAN3 LOSW, HDSL1                                       OK             000
SPAN3 LOSW, HDSL2                                       OK             000
SPAN3 ES, HDSL1                                         OK             000
SPAN3 ES, HDSL2                                         OK             000
SPAN3 MARGIN L1                                         OK             000
SPAN3 MARGIN L2                                         OK             000
PWR-OPEN                                                OK             000
PWR-SHRT                                                OK             000

LAST CLEARED:  05/16/96-00:31


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

Figure 35. *HLU-200 List 1D Alarm History - Span 3 (2 Doublers)*

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 (TAC).

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
BIA Technical Assistance Center 800.366.3891, ext.73223 952.917.3223 Fax: 952.917.3776 Email: technical@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.	

Product information may be downloaded from the ADC website at *www.adc.com* or by contacting your sales representative.

This publication may be verified at any time by contacting ADC's Technical Assistance Center at 1.800.366.3891, extension 73223 (in USA or Canada) or 1.952.917.3223 (outside USA and Canada) or by writing to ADC Telecommunications, Inc., Attn: Technical Assistance Center, Mail Station #77, P.O. Box 1101, Minneapolis, MN 55440-1101, USA.

CERTIFICATION AND WARRANTY

FCC CLASS A COMPLIANCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause 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.

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 been 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 DSL Systems, Inc. voids the user's warranty.

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

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