PRACTICES

CAUTION!
SUBJECT TO ELECTROSTATIC DAMAGE
OR DECREASE IN RELIABILITY.
HANDLING PRECAUTIONS REQUIRED.

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MODEL 220/E220 HTU-C HDSL CENTRAL OFFICE UNIT DESCRIPTION

CONTENTS

FIGURES

TABLES

1. BACKGROUND

There is a movement within both domestic and international Operating Companies to use alternative technologies for transporting traditional T1 bandwidths. The technology currently deployed to provide this new style transport is known as High bit-rate Digital Subscriber Line (HDSL) technology. Bellcore has been active in this area for some time supporting several Regional Bell Operating Companies (RBOCs).

This movement is spurred by several motivations. The most important is possibly the improvement in deploying T1 service to a customer. Other motivations include the reduction in installation costs related to the elimination of mid-span repeaters and the benefits gained by using unconditioned cable.

1.1 HDSL Technology Overview

Typically, T1 circuits are deployed from a telephone company office using a device know as an office repeater (see **Figure 1**). If the circuit termination point is farther than 3,000 feet from the serving office, a T1 loop repeater is generally installed to recover and regenerate the signal before the loop attenuation encountered renders the signal unusable. Subsequent spacing of loop repeaters is approximately 6,000 feet.

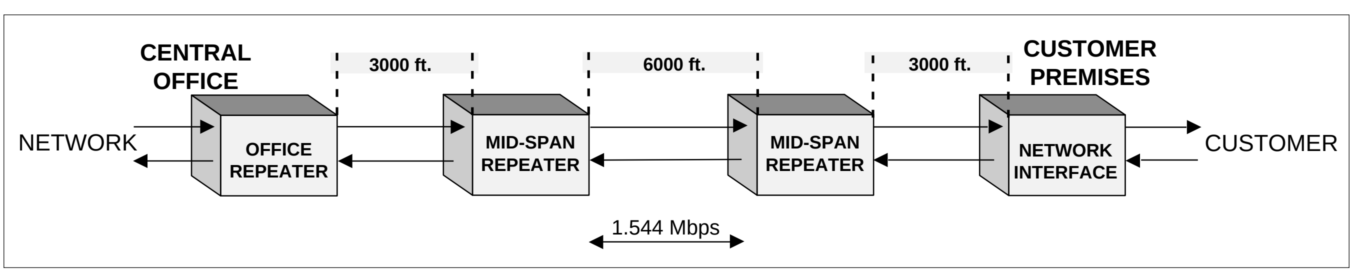

Figure 1. Traditional T1 Example

The T1 line is then terminated on the customer premises with a T1 Channel Service Unit (CSU). In some places, such as a dense metropolitan area, providing an acceptable location for a loop repeater can become expensive. As a consequence of deploying loop repeaters, a portion of telephone company equipment is no longer located in the Central Office (CO) and therefore requires additional expense in servicing and maintaining the circuit. The HDSL concept is to enhance the transmission scheme for T1 signals such that a complete Carrier Service Area (CSA) can be addressed without the need for a loop repeater or conditioned local loops.

A CSA varies depending on wire gauge, but extends roughly 9,000 to 12,000 feet from a serving office. Also, total bridged tap lengths of up to 2,500 feet are permissible with single bridged tap lengths not exceeding 2,000 feet.

The existing T1 transmission scheme is Alternate Mark Inversion (AMI) resulting in a power spectrum centered around 772 kHz. Attenuation (loss), crosstalk, and other undesirable effects of transmitting information over twisted pair cables increase as the frequency of the power spectrum increases.

One benefit of HDSL, then, is to lower the power spectrum in frequency by modifying the transmission scheme. The HDSL modulation technique employs echo cancelling technology to transmit and receive (full duplex) on a single pair of wires. In a 4-wire system (such as T1), this technique could be applied to both pair of wires effectively reducing by half, the frequency range of the associated power spectrum. In addition to using echo cancellation techniques, a scheme for encoding multiple bits of information into symbols is also used. Modulation techniques such as those employed in ISDN U-interface products referred to as 2B1Q make more efficient use of the available bandwidth. In this case it serves to lower the transmission symbol rate and therefore the frequency range of the power spectrum, while maintaining the same data rate by encoding several bits of information into a single symbol. By lowering the frequency content of the HDSL signal, the effects such as attenuation and crosstalk can be reduced to tolerable levels, thereby allowing transmission over longer distances.

In applications that benefit from the elimination of the loop repeaters or the lack of conditioned local loop pairs, the cost savings associated with HDSL can be substantial. **Figure 1** illustrates a typical T1 circuit of 12,000 feet in length. **Figure 2** provides an alternative arrangement utilizing HDSL technology.

2. APPLICATIONS

HDSL technology is a candidate to transport signals for all of the following applications.

- Serving Office to Customer
- Interoffice Trunking
- Fiber Pedestal to Customer
- Digital Loop Carrier Circuits

The equipment in use today which is replaced by HDSL products include the T1 Network Interface Unit (NIU) at the customer premises and the office repeater in the RBOC CO, as well as mid-span repeaters.

The objective of HDSL is to eliminate the T1 loop repeater requirements and the copper conditioning requirements. The ADTRAN HDSL system is designed to provide DS1 based services over loops which comply with Carrier Service Area (CSA) guidelines. CSA deployment guidelines are given below.

1. All loops are non-loaded only.

2. For loops with 26 AWG cable, the maximum loop length including bridged tap lengths is 9 kFt.

3. For loops with 24 AWG cable, the maximum loop length including bridged tap lengths is 12 kFt.

4. Any single bridged tap is limited to 2 kFt.

5. Total bridged tap length is limited to 2.5 kFt.

6. The total length of multi-gauge cable containing 26 AWG cable must not exceed

$12 - \{(3*L^{26})/9\} - L^{BTAP}$ (in kFt)

L^{26} = Total length of 26 AWG cable excluding Bridged Taps

L^{BTAP} = Total length of all Bridged Taps

This deployment criteria is summarized in the chart shown in **Figure 3.**

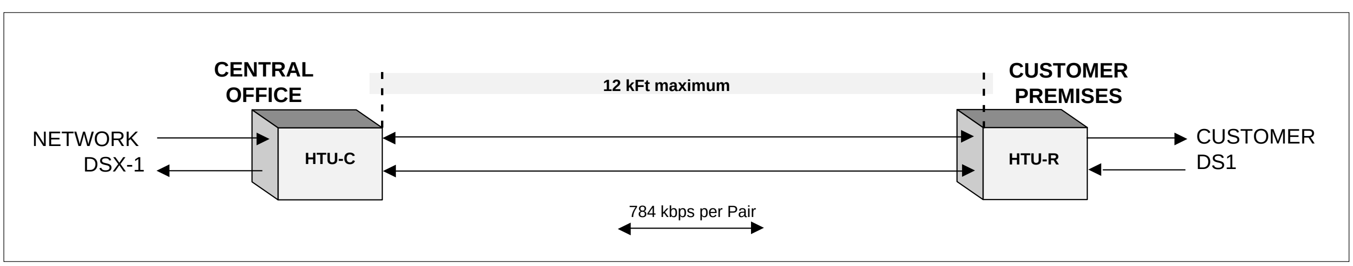

Figure 2. HDSL Alternative to a Traditional T1 Circuit

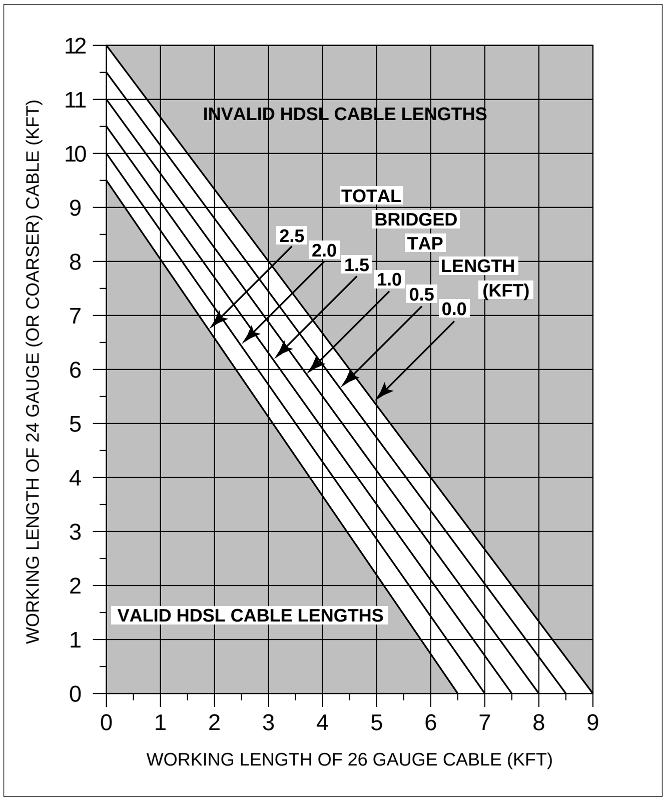

Figure 3. HDSL Deployment Guidelines

3. PRODUCT OVERVIEW

ADTRAN HDSL products are provided in two models. One model is used in telephone office operations, and the other serves as Network Channel Terminating Equipment (NCTE) in customer premises operation (see **Figure 4**). The system operates over four wires with a data rate of approximately 1.6 Mbps. This is accomplished using echo cancelling technology on two pair of wires, each operating at 784 kbps. The 1.544 Mbps T1 stream is transported along with a small amount of overhead bandwidth used for network and system-related functions. A typical HDSL arrangement is shown in **Figure 4**.

Status information related to the presence of each signal and loopback condition is provided at both ends of the loop. Performance and status information related to each of the two subsystems is available at the CO unit through LED displays. The unit supports SF, ESF, framed, unframed, AMI, and B8ZS T1 signal formats.

A system block diagram of the HTU-C is shown in **Figure 5**.

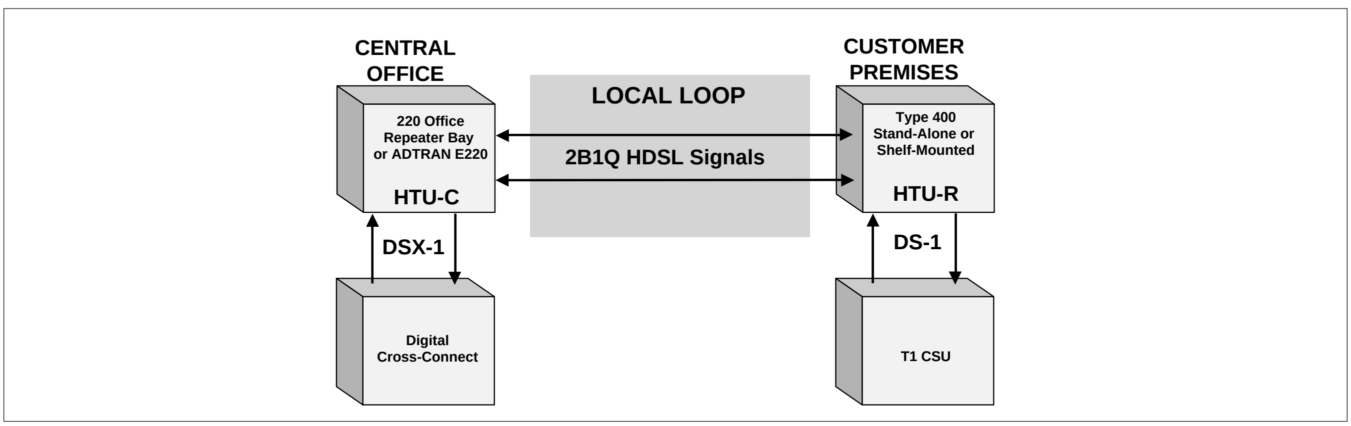

Figure 4. HDSL Equipment Arrangement

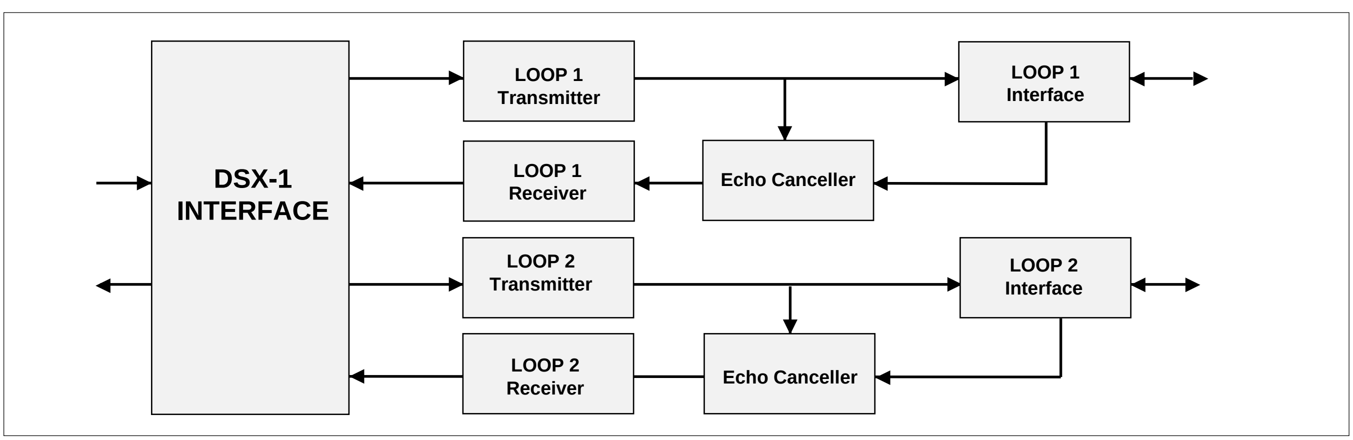

Figure 5. HTU-C Block Diagram

The ADTRAN 220/E220 HTU-C (P/N 1242002L4) is designed for operation in traditional 220 Office Repeater Bay shelves. The unit occupies a single slot in the shelf or in the ADTRAN E220 shelf. A DB9 connector mounted on the faceplate of the unit provides a control port interface for connecting a controlling terminal. This control port allows access to performance information, test status, and configuration information.

4. HDSL SYSTEM RELATED FEATURES

The HTU-C and HTU-R units have the following functionality.

1. Provides clear channel, transparent bidirectional transport of framed or unframed DS1 payloads.
2. Operates at a 10^{-7} Bit Error Rate over unconditioned CSA lines with no loop repeaters. The unit provides 6 dB of Near End Crosstalk (NEXT) margin on all T1E1.4 CSA loops and 0 dB of NEXT margin on T1E1.4 non-CSA loops. Up to 1 km of loop length disparity and ± 50 bps frequency offset between transmission directions is acceptable.
3. Start-up, including echo canceller convergence, is fully automatic. The system continuously adapts after start-up.
4. HDSL link performance monitoring is done on each end with remote results available. Performance history maintained similar to ESF requirements.
5. Transmission accomplished using dual-duplex (2 full duplex 2-wire subsystem), 784 kbps line rate , 2B1Q modulation, and ANSI T1.601 scrambler.
6. DSX-1 and DS1 interfaces are B8ZS and AMI compatible. A selectable Line Build-Out function for transmitted signals and an automatic Line Build-Out for received signals is provided.
7. The HTU-C and HTU-R operate over a standard temperature range of -40 to +70°C.
8. Meets FCC requirements for emissions and telco interconnection.

4.1 Specific HTU-C Features

- HTU-C is a plug-in capable of operating in a 220 office repeater bay shelf or the ADTRAN E220 shelf. The unit occupies a single slot in either shelf.
- Provides span power to the HTU-R through the 4-wire local loop. Span powering voltages are produced by the HTU-C from the -48 V supply. Span power derived is 0 and -130 V.
- Alarm closures are provided on the HTU-C for power, fuse, and loss of signal from the loop or the network.
- Ability to disable alarm relay pins (pin numbers 1, 20, and 21), a provisionable option.
- Compatible with SF and ESF signal formats.
- AMI and B8ZS compatible.
- Supports HDSL performance monitoring. Maintains performance history information for specific time periods up to seven days.
- HDSL (in-band and out-of-band), and manual loopback.
- Selectable Loopback Timeout
- DS0 Blocking
- Selectable DS1 Transmit Level (0, -7.5, -15, -22.5 dB, as measured @ 772 kHz)
- Selectable Line Build-Out toward office equipment.
- Automatic Line Build-Out on office interface input.
- Lightning protection on loop interface.
- Loss of signal detection in both transmission directions.
- Faceplate-mounted metallic splitting and monitor jacks on the DSX-1 interface.
- Faceplate-mounted metallic splitting access to HDSL local loops.
- Faceplate-mounted DB9 connector for craft access.
- Faceplate indicators for:
  - Power
  - HDSL Loop Synchronization (each pair)
  - HDSL Loop (Signal Quality)
  - DSX-1 Loop Synchronization
  - Alarm Condition
  - Loopback Active
  - Sealing (Span Powering) Current
  - Self-Test Active
- Faceplate-mounted pin jacks allow access to:
  - Span Power voltage monitoring points
  - Span Power current monitoring points
- Faceplate mounted Alarm Cutoff (ACO) switch for audible alarm cutoff.

5. INSTALLATION

5.1 After unpacking the unit, immediately inspect it for possible shipping damage. If damage is discovered, file a claim immediately with the carrier, then contact ADTRAN Customer Service (see **subsection 10.2**).

The 220/E220 HTU-C plugs directly into standard 220 office repeater shelves. These include Kentrox® T-Term 220, Wescom® 34220 and 34230, Lynch® 303MA30 as well as the ADTRAN E220 Shelf. The unit may be plugged into any slot. No installation wiring is required.

Two eight-position switch packs (SW1 and SW2) are used to configure the mode of operation for the unit. **Figure 6** shows the location of these switch packs. A definition of each switch is shown in **Table A.** Configuration may be performed by manually selecting each option switch, or alternatively, may be performed using the RS-232 craft access port. Manual configuration must be performed before installing the unit into the shelf.

Faceplate Indicators

2.2 The HTU-C has eight faceplate LEDs which indicate operational status. **Table B** defines these LEDs.

5.4 Faceplate Buttons

A single push-button is located on the HTU-C faceplate which is the Alarm Cutoff Switch (ACO). When an alarm condition is present, pressing the ACO button will release the alarm output signals on pins 1, 20, and 21. The alarm (ALM) LED will remain *On* until the alarm condition is cleared. This function operates as an alarm acknowledgment feature.

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Lynch is a registered trademark of Communication Systems, Inc.
Wescom is a registered trademark of Charles Industries, Ltd.

6. CONNECTIONS

6.1 The 220/E220 HTU-C occupies one card slot in a 220 Office Repeater Bay. Power and alarm signals are provided to the card through the backplane of the shelf. DSX-1 and HDSL loop signals are connected to the wire-wrap pins or mass termination shelf connectors corresponding to the slot the unit occupies. See **Figure 7** for HTU-C edge connector wiring.

6.2 The HTU-C is capable of span powering the HTU-R by applying simplex current to the local loop. Approximately 100 *m*A of current is coupled onto the HDSL span to power the HTU-R along with a Network Interface Unit located between the HTU-R and the customer. Loop 1 has the most negative potential for span powering. The span powering voltage is -130 volts with Loop 1 providing the negative voltage and Loop 2 providing the return (see **Figure 8**).

6.3 Alarm Connections

Pin 1 of the HTU-C slot interface connector provides a -48 V return connection upon an active alarm event. Additionally, pins 20 and 21 provide a normally open dry relay contact that closes upon an active alarm condition. These pins are enabled or disabled as a provisionable option; either through setting of manual switches (SW2-8), or through the terminal interface provisioning option (Main Menu, Option 6).

Pin 32 of the interface provides a fuse alarm signal that connects -48 VDC to this pin in the presence of a blown fuse.

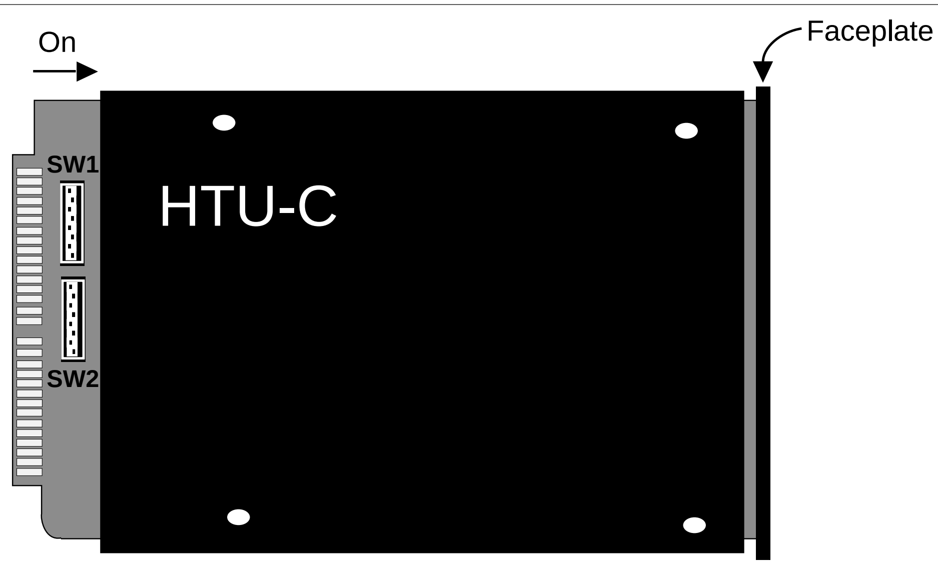

Figure 6. HTU-C Option Switch Locations

Table A. SW1 and SW2 Option Settings (Shaded selections indicate default settings)

Switch	Function	Description
SW1-1 **SW1-2** **SW1-3**	**LB0** **LB1** **LB2**	These switches select operation of the Line Build-Out equalizer in series with the DSX-1 output.

SW1-3 LB2	SW1-2 LB1	SW1-1 LB0	Line Length (Feet)	Cable Loss
Off	*Off*	*Off*	Selects External Line Build-Out*	
Off	*Off*	*On*	Not Assigned	
Off	*On*	*Off*	Not Assigned	
Off	***On***	***On***	**0-133 ABAM Cable**	**0.6 dB**
On	*Off*	*Off*	133-266 ABAM Cable	1.2 dB
On	*Off*	*On*	266-399 ABAM Cable	1.8 dB
On	*On*	*Off*	399-533 ABAM Cable	2.4 dB
On	*On*	*On*	533-655 ABAM Cable	3.0 dB

*** If External Line Build-Out is selected, the signal transmitted by the HTU-C is a 12 V signal. This must be considered when measuring the signal at the EQ or MON faceplate jacks. The signals may appear *hotter* than they should be.**

Switch	Function	Description
SW1-4 ***On*** *Off*	**Auto Code Detect** **Enabled (Automatic)** Disabled (Manual)	When this switch is On, the unit automatically detects the line code as B8ZS or AMI.
SW1-5 *On* ***Off***	**Manual Code Select** AMI **B8ZS**	When SW1-4 is *Off*, SW1-5 *Off* selects B8ZS line code, while SW1-5 *On* selects AMI.
SW1-6 ***On*** *Off*	**Auto Frame Detect** **Enabled (Automatic)** Disabled (Manual)	When SW1-8 is *Off*, this switch enables automatic detection of the T1 framing mode. When SW1-6 is *On*, Auto Frame Mode detection is enabled and the unit selects Superframe (SF), and Extended Superframe (ESF) modes automatically. When *Off*, SW1-7 manually selects the framing mode.
SW1-7 *On* ***Off***	**Manual Frame Select** SF **ESF**	When SW1-6 and SW1-8 are *Off*, SW1-7 *On* selects SF. SW1-7 *Off* selects ESF.
SW1-8 *On* ***Off***	**T1 Framing** Unframed **Framed**	Selects the T1 framing mode. SW1-8 *On* selects unframed operation. SW1-8 *Off* selects framed operation.

Note: When automatic T1 framing and format selection is enabled on the HDSL system, the HTU-C adapts to the framing and coding format present on the DSX-1 input. The HTU-R adapts to the framing and coding format of the DS1 signal. However, while the HTU-C or HTU-R is in loopback, the faceplate LED indicating T1 Format (AMI or B8ZS) may not correspond to the unit's input signal. Once the loopback condition has cleared, the unit will once again indicate the format present at input.

Switch		Function	Description
SW2-1 ***On*** *Off*		**NIU Loopback** **Enabled** Disabled	The HTU-R can be programmed to respond to traditional T1 Network Interface Unit (NIU) loop-up and loop-down codes. See ADTRAN HTU-R Installation/Maintenance practice, section 61242004L2-5A for more information on specific codes.
SW2-3	**SW2-2**	**DS1 Transmit Level** (Customer side of HTU-R)	The DS1 signal level delivered to the customer through the HTU-R may be selected as one of four values: 0, -7.5, -15, and -22.5 dB.
Off	***Off***	**0 dB**	
Off	*On*	-7.5 dB	**DS1 attenuation measurements are made at 772 kHz.**
On	*Off*	-15.0 dB	**Attenuation measurements made at different frequencies may show *hotter* than**
On	*On*	-22.5 dB	**expected transmit levels.**
SW2-5	**SW2-4**	**Loopback Timeout Period**	The period of time the unit will remain in loopback before automatically
Off	***Off***	**Timeout Disabled**	timing out is programmed using SW2-4 and SW2-5. Values range from 20
Off	*On*	20 Minutes	minutes to no timeout.
On	*Off*	60 Minutes	
On	*On*	120 Minutes	**Loopback Timeout must be selected prior to initiating a loopback.**
SW2-7	**SW2-6**	**DS0 Blocking**	Individual time slots may be blocked from customer access. Selecting
Off	***Off***	**None**	*None* enables the entire T1 stream. Other switch options include 6, 12,
Off	*On*	6 (Slots 19-24)	and 18 DS0s. Other options are available using the RS-232 craft access
On	*Off*	12 (Slots 13-24)	port. When using this method for blocking DS0 channels, random channel
On	*On*	18 (Slots 7-24)	selection can be made. See Appendix II for DS0 blocking operation details.
SW2-8 *On* ***Off***		**Alarm Relay** Enabled **Disabled**	When this switch is *On*, the unit's alarm relay (pins 1, 20, and 21) is activated. When this switch is *Off*, the alarm relay is disabled.

Note: The HTU-C transfers the local configuration to the HTU-R when circuit synchronization is achieved. The HTU-R then sets its configuration to match the HTU-C.

Table B. Front Panel Indicators

Indicator	Description
PWR	Indicates power to the HTU-C is present and suitable.
LP1	Indicates five possible states (described below) of the quality of the HDSL signals on Loop 1. ***Off*** No synchronization of HTU-C and HTU-R on Loop 1. ***Red*** Poor signal quality on Loop 1 (≤ 10^{-7} BER). ***Yellow*** Marginal signal quality on Loop 1 (≤ 2 dB margin above 10^{-7} BER). ***Green*** Good signal quality on Loop 1 (> 2 dB margin above 10^{-7} BER). ***Blinking*** An error detected on either end of Loop 1 will cause this LED to blink briefly.
LP2	Indicates five possible states (described below) of the quality of the HDSL signals on Loop 2. ***Off*** No synchronization of HTU-C and HTU-R on Loop 2. ***Red*** Poor signal quality on Loop 2 (≤ 10^{-7} BER). ***Yellow*** Marginal signal quality on Loop 2 (≤ 2 dB margin above 10^{-7} BER). ***Green*** Good signal quality on Loop 2 (> 2 dB margin above 10^{-7} BER). ***Blinking*** An error detected on either end of Loop 2 will cause this LED to blink briefly.
DSX	This LED indicates three conditions described below. ***Off*** Network side DSX-1 signal is absent or is of a format that does not match the provisioning of the HDSL circuit. ***Blinking*** BiPolar Violation (BPV), frame bit error in SF mode, or CRC error in ESF mode detected at DSX-1 signal. ***On Solid*** Network side DSX-1 signal is present and synchronized.
ALM	This LED indicates three conditions described below. ***Off*** No alarm condition detected. ***Red*** Local alarm (HTU-C) or local and remote alarms (HTU-C and HTU-R) condition detected. ***Yellow*** Remote alarm condition detected.
LBK	This LED indicates three possible loopback states as described below. ***Off*** Unit is not in loopback or armed state. ***Blinking*** The loopback arming sequence has been detected. In this state the unit is armed (ready for loopback) but not in loopback. ***On Solid*** Local (HTU-C) loopback is active.
SC	This LED indicates two conditions described below. ***Off*** Sealing current is absent, indicating a possible open loop condition on one or more pairs. ***On Solid*** Sealing current (actually span powering current) to the HTU-R is operational.
ST	This LED indicates three possible modes for Self Test as described below. ***Off*** Self Test inactive. ***Blinking*** Self Test has detected a potential problem with the unit. (Refer to **subsection 10** for technical support information.) ***On Solid*** Self Test in progress.

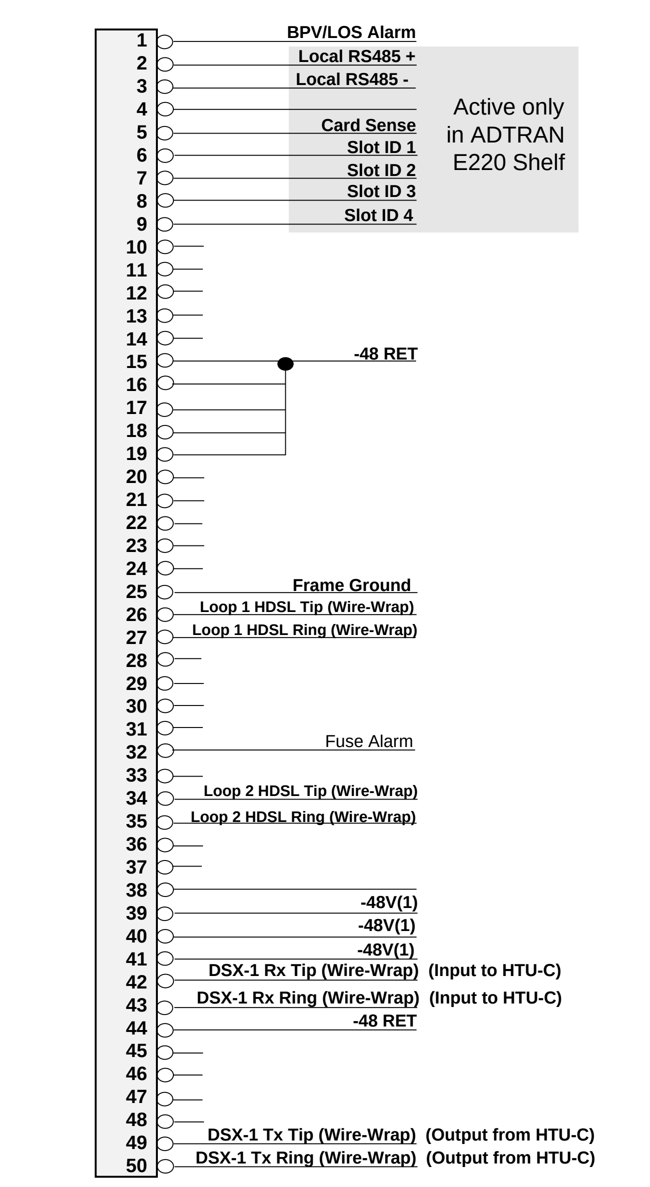

Figure 7. HTU-C Edge Connector Wiring

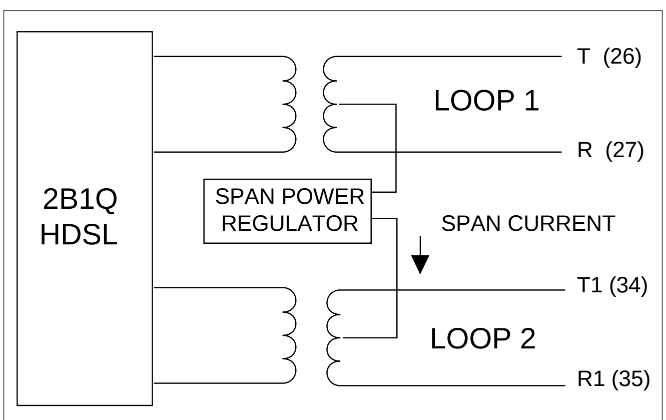

Figure 8. HTU-C Span Powering Diagram

7. HDSL SYSTEM TESTING

The ADTRAN HDSL system provides extensive ability to monitor the status and performance of the DSX-1 signals, DS1 signals, and HDSL loop signals. Detailed performance monitoring is provided by the faceplate-mounted RS-232 Control Port or the ADTRAN HDSL Fuse/Alarm/Control Unit (HFAC) Shelf Controller. These features are valuable in troubleshooting and isolating any system level problems that may occur at installation or during operation of the HDSL system. The following subsections describe additional testing features conducted with the front panel Bantam jacks as well as the voltage and current monitoring access jacks.

7.1 Bantam Jack Description

The front panel of the HTU-C contains both monitoring and metallic splitting Bantam jacks. In general, the monitoring jacks provide a non-intrusive tap onto a signal line that permits the connection of test equipment to monitor the characteristics of that signal. For example, the DSX-1 monitor jack can be used to connect to a bit error rate tester to monitor for synchronization, test patterns, etc. The metallic splitting jacks provide an intrusive, signal interrupting access to the line. This permits parameters to be measured such as loop resistance, background noise level, insertion loss, etc. It is very important to know the direction of the access provided by a metallic splitting jack. Detailed descriptions of the HTU-C Bantam jacks are given in the following subsections. **Figures 9, 10, 11,** and **12** show the complete Bantam Jack arrangement and details for specific jacks.

7.2 HTU-C Bantam Jacks LP1 and LP2, DSX-1 EQ, and DSX-1 MON

The HTU-C provides three dual Bantam jacks on the front panel. The first jack, labeled LP1 and LP2, provides metallic splitting access to the individual HDSL local loops. LP1 is Loop 1 while LP2 is Loop 2. See **Figure 10**.

WARNING!
POTENTIALLY HAZARDOUS VOLTAGE

The HDSL loop Bantam jacks are designed with make-before-break contact arrangement. HDSL span powering voltage is present on the internal contacts of this connector. Therefore, during the insertion of a male Bantam plug into the jack, these voltages can be briefly applied to the equipment being connected. Voltage is removed once the Bantam male is fully seated into the connector. Test equipment not designed to withstand 130 volts of span power may be damaged. To eliminate this condition, connect the Bantam cables to the HDSL loop jack before connecting the cables to the test equipment.

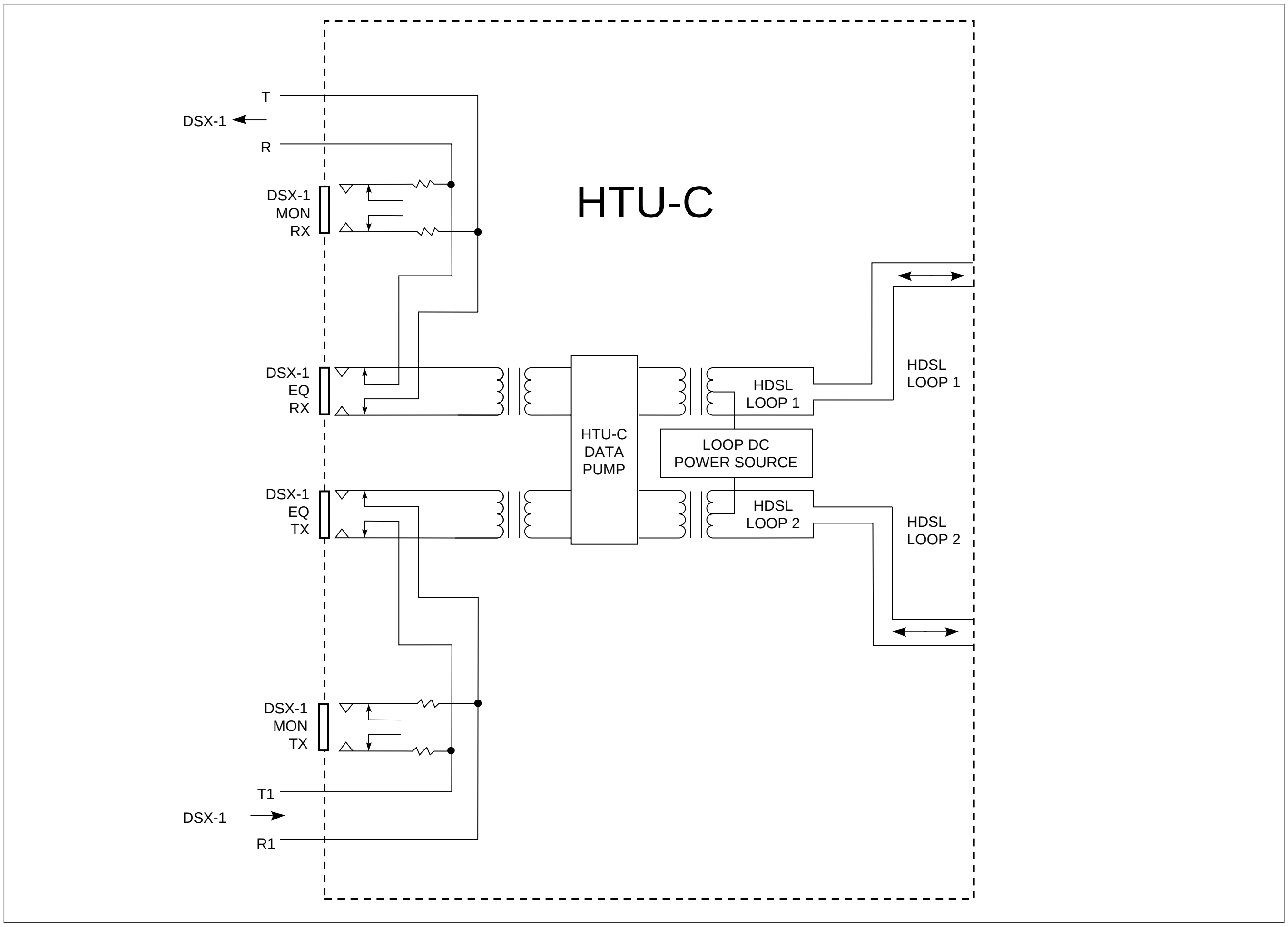

Figure 9. HTU-C Bantam Jack Arrangement

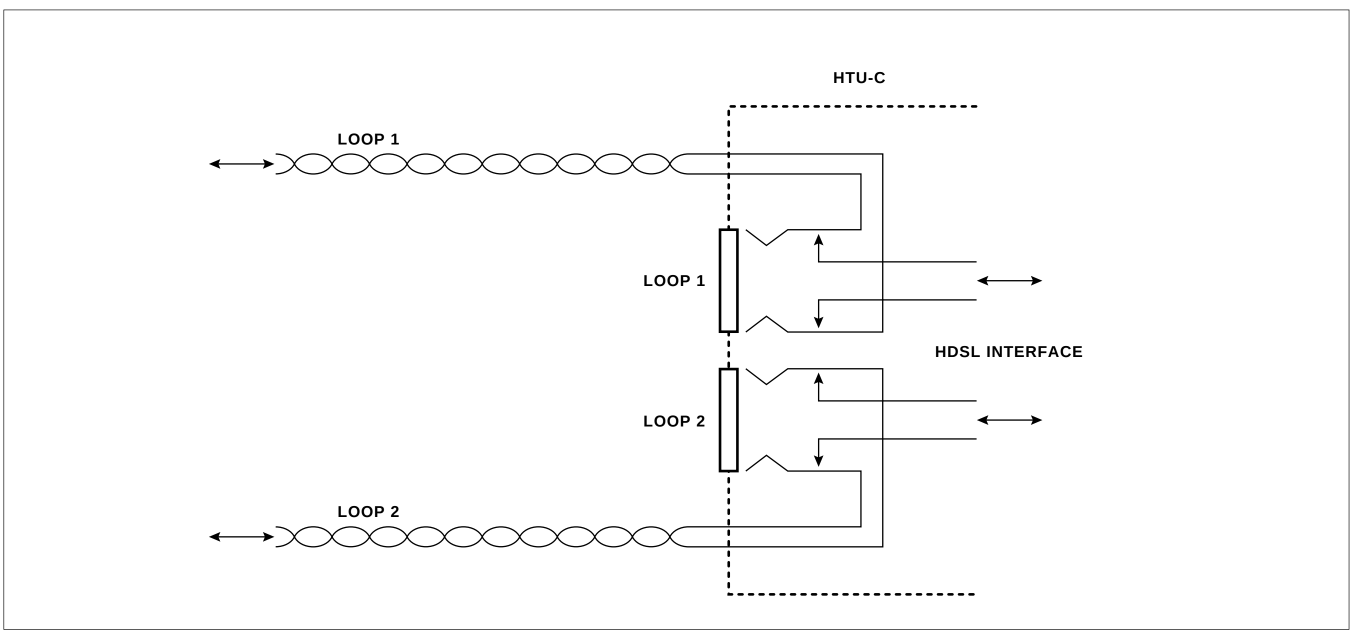

Figure 10. HDSL LP1 and LP2

The second jack, labeled EQ, provides a metallic splitting of the DSX-1 lines for connecting test equipment to transmit and receive signals with the HTU-C. See **Figure 10**.

The third jack, labeled MON, provides a non-intrusive access point for monitoring the transmit and receive signals at the DSX-1 interface point. See **Figure 12**.

7.3 Span Powering Test Points

Four pin jacks are located on the faceplate for measuring of span power voltages and currents. $^{+}$V and $^{-}$V are high impedance access points to measure the voltage across Loop 1 and Loop 2. The measurement is in volts and directly correlates to the voltage applied to the loop to power the HTU-R. For example, if $^{+}$V to $^{-}$V measures 130 V, then the span powering voltage is 130 volts. This measurement should be 130 V ± 10%.

The jacks labeled $^{+}$I and $^{-}$I are used to determine the span powering current. This is a voltage produced across a 1 ohm resistor; therefore, the measurement in volts is equivalent to the span powering current in amps. For example, if 100 *m*V is measured from $^{+}$I to $^{-}$I, the span powering current is 100 *m*A. Normal operation produces span powering currents up to 140 *m*A maximum.

7.4 HTU-C Loopbacks

The HTU-C responds to two different loopback activation processes. First, loopback may be commanded manually using the control port interface. **Figure 19** depicts the Loopback Options Screen which provides for both HTU-C and HTU-R loopbacks.

Secondly, the HTU-C responds to the 3 bits in 7, 4 bits in 7 loopup commands of the HTU-R and HTU-C, respectively; and the 3 bits in 5 loopdown command for both elements. A detailed description of these loopback sequences is given in **Appendix I**.

The loopback condition imposed in both cases is a logic level loopback at the point within the HTU-C where the DSX-1 signal passes into the HDSL modulators. **Figure 13** depicts all of the loopback locations possible with ADTRAN HDSL equipment.

In addition to network-side loopbacks, the HTU-C provides customer-side loopbacks initiated by using the terminal control port. In this mode, either an AIS signal or customer data is supplied to the network. Customer-side loopbacks must be deactivated by using the terminal.

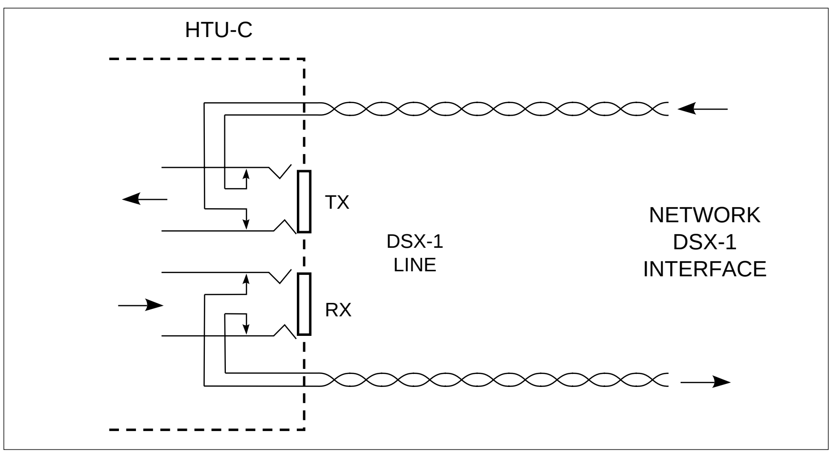

Figure 11. HTU-C DSX-1 EQ Diagram

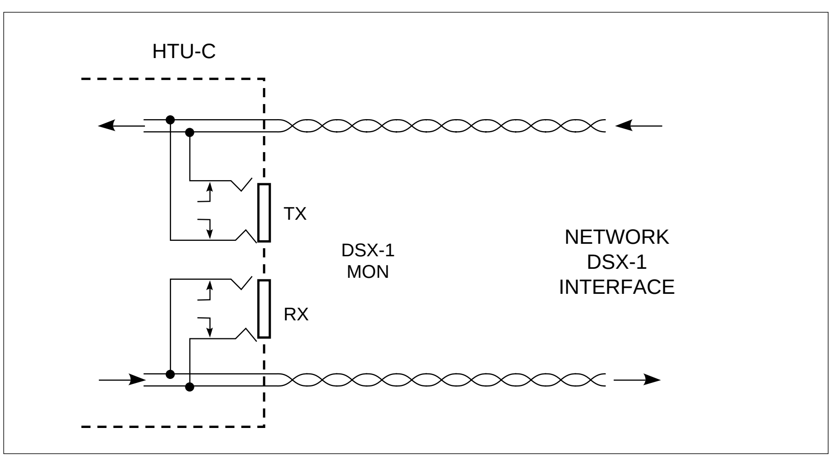

Figure 12. HTU-C DSX-1 MON Diagram

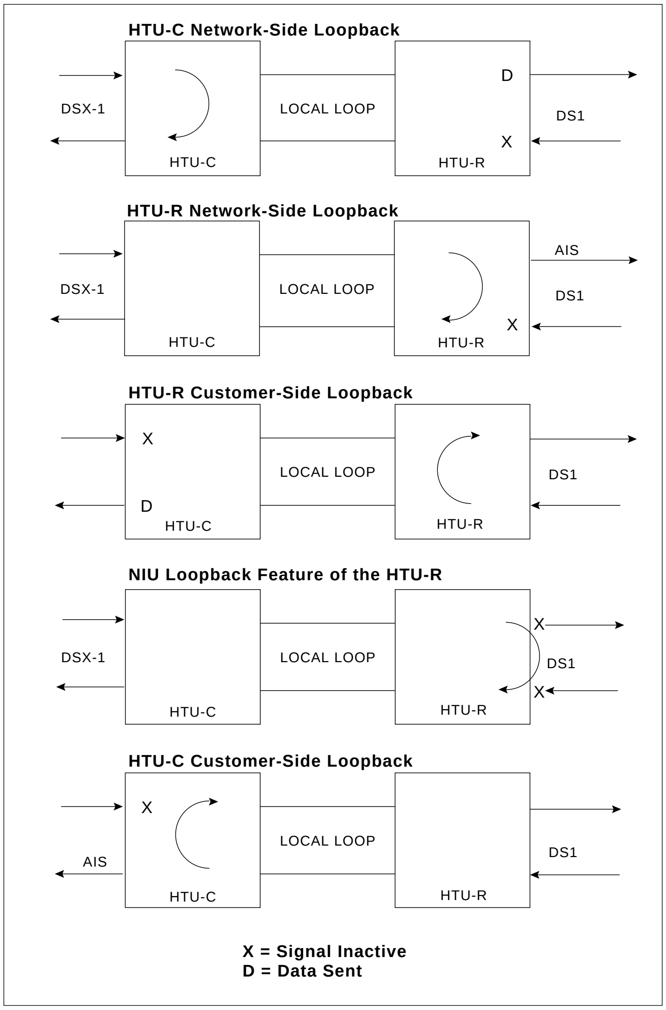

Figure 13. HDSL Loopbacks

8. CONTROL PORT OPERATION

8.1 The HTU-C provides a faceplate-mounted DB9 connector that supplies an RS-232 interface for connection to a controlling terminal. The pinout of the DB9 is illustrated in **Figure 14**.

The terminal interface operates at data rates from 2.4 kbps to 19.2 kbps. The asynchronous data format is fixed at 8 data bits, no parity, and 1 stop bit. The supported terminal type is VT 100 or compatible.

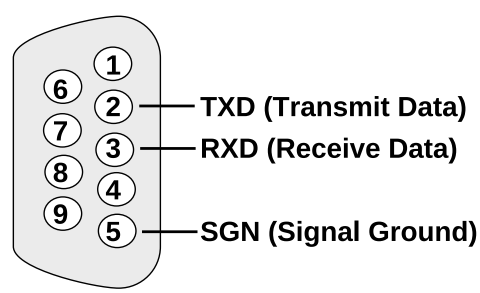

Figure 14. RS-232 (DB9) Pin Assignments

Many portable personal computers use power saving programs that are known to interfere with applications running on the personal computer. If using a portable personal computer with terminal emulation capability, communication between the computer and the HDSL unit may be periodically disrupted if power saving programs are being used on the personal computer. The symptoms may include misplaced characters appearing on the screen and/or the occurrence of screen timeouts. These symptoms are not disruptive to the operation of the circuit and are avoidable if the power saving options are disabled or removed.

Note: When operating the unit in the ADTRAN E220 Shelf with an HFAC (HDSL shelf controller), all remote terminal operation must be made through the control port of the shelf controller, not the HTU-C.

8.2 Operation

For abbreviations used in the screen diagrams, see **Table C**.

A terminal session is initiated by entering multiple space bar characters, which are used by the HTU-C to determine the speed of the terminal. Once the speed has been determined, an Introductory Menu is presented, as illustrated in **Figure 15**.

From the Introductory Menu, the Main Menu may be selected. The Main Menu provides access to detailed performance and configuration information, as illustrated in **Figure 16**, HDSL Main Menu Screen.

From the Main Menu the following screens can be accessed:

1. Current System Status
2. Performance History
3. ADTRAN Information
4. Loopback Options
5. Self Test
6. Provisioning
7. Troubleshooting

The Current System Status screen illustrated in **Figure 17** provides quick access to status information for both the HTU-C and HTU-R.

The Elapsed Time display indicates the period of time since the unit began collecting performance information. At each 15-minute interval, the performance information is transferred to the 15-minute performance data register accessed from the Performance History screen. At each 24-hour interval, the performance data is transferred into the 24-hour performance data register also accessed using the Performance History screen. The Performance History screen is shown in **Figure 18**.

Table C. Screen Abbreviations Defined

Abbreviation	Definition
ES	Errored Seconds. **DSX/DS1:** (SF) Second in which a BPV or frame bit error occurs. (ESF) Second in which a BPV or CRC error occurs. **HDSL:** Second in which a CRC error occurs.
SES	Severely Errored Seconds. **DSX/DS1:** (SF) Second in which 1544 BPVs or 8 frame bit errors occur. (ESF) Second in which 1544 BPVs or 320 CRC errors occur. **HDSL:** Second in which 165 CRC errors occur.
UAS	Unavailable Seconds. **DSX/DS1:** Second in which there is a loss of signal or sync. **HDSL:** Second in which there is a loss of signal or sync.
SF	Superframe Format
ESF	Extended Superframe Format
B8ZS	Binary 8 Zero Substitution
AMI	Alternate Mark Inversion
LBO	Line Build-Out
BPV	Bipolar Violation **DSX/DS1:** Second in which a bipolar violation occurs
NIU	T1 Network Interface Unit
S/N	Serial Number
15M	Fifteen-Minute period
24H	Twenty-Four-Hour period

By pressing the letter **Z** at the Current System Status screen, performance registers will be reset to zero at the Current System Status screen and the Performance History screen.

Figure 17 consolidates current information for the HDSL, DSX-1, and DS1 interfaces. A key to the information provided is found in the center of the screen. Arrows indicate the key applies to both the HTU-C and HTU-R.

LOSS .... Pulse Attenuation Measurement
SYNC .... HDSL Loop 1 and Loop 2 Sync Status
ES 15M/24H ..... Errored Seconds*
SES 15M/24H ... Severely Errored Seconds*
UAS 15M/24H .. Unavailable Seconds*

* *The first number is for the current 15-minute period and the second is the current 24-hour period (Loop 1 and Loop 2 numbers are displayed).*

An indication of Pair Reversal (if present) is given at the bottom of the first key column. Status and configuration information for the DS1 and DSX-1 signals is located in the center of the screen near the bottom.

FRAME .. T1 Framing Format selected
CODE .... T1 Line Code selected
LBO .... Line Build-Out selected (for DSX-1); Customer Signal of 0, -7.5, -15, or -22.5 (for DS1)
NIU .... Network Interface Unit enabled?
BPV .... Bipolar Violations detected (DSX-1 and DS1)
ES .... Errored Seconds (DSX-1 and DS1)
SES .... Severely Errored Seconds (DSX-1 and DS1)
UAS .... Unavailable Seconds (DSX-1 and DS1)
Alarms .. Lists current alarm condition status

A measure of signal quality for each HDSL loop is displayed in graphic form on the bottom of the screen. The measure is from 0 (poor signal quality) to 9 (excellent signal quality). Guidelines for interpreting the indicators are given below.

0 .... Noise margin is ≤ 0 dB (≈ 10^{-7} BER)
1-8 .... Margin measurement above 10^{-7} BER in dB
9 .... Margin is ≥ 9 dB (excellent quality) above 10^{-7} BER

Predicting performance based upon signal quality varies with each loop. Generally, a noise margin of 0 or higher will support a bit error rate of better than 10^{-7}.

ADTRAN has defined the following as guidelines that correspond to the operation of the HTU-C faceplate LEDs labeled LP1 and LP2.

Margin < 0 (Red) .... Poor Loop Quality
0 ≤ Margin ≤ 2 (Yellow) .... Marginal Loop Quality
Margin > 2 (Green) .... Good Loop Quality

Figures 19 and **20** depict the HDSL Loopback and Self Test Option screens. Loopbacks and Self-Test may be evoked or terminated using these screens. A status of current loopback conditions is also provided.

Figure 21 displays current provisioning settings and allows for changing the system configuration. Provisioning changes are only allowed at the CO end of the circuit.

Provisioning changes made through this screen override the manual switch settings. The unit *remembers* the last provisioning changes to determine its operating mode.

The Troubleshooting Screen, shown in **Figure 22**, graphically presents an HDSL circuit. The unit reviews red, yellow, and blue alarm conditions in the circuit to automatically predict where a fault is located. Once a fault location is suspected, the corresponding portion of the circuit on the screen is highlighted and a message describing the failure is presented.

```
                              ADTRAN
                       901 Explorer Boulevard
                    Huntsville, Alabama 35806-2807

                 For information or service, please call:

    Sales and General: (205) 971-8000    Customer Service: (205) 971-8716
                     :                                   : (800) 726-8663
                 Fax: (205) 971-8699                 Fax: (205) 971-8717
-------------------------------------------------------------------------------
HTU-C INFORMATION      SIGNAL QUALITY    HTU-R INFORMATION      SIGNAL QUALITY
--------------------   [X]   9    [X]    --------------------   [X]   9    [X]
S/N :                  [X]   8    [X]    S/N :                  [X]   8    [X]
CLEI:                  [X]   7    [X]    CLEI:                  [X]   7    [X]
MANF:                  [X]   6    [X]    MANF:                  [X]   6    [X]
                       [X]   5    [X]                           [X]   5    [X]
                       [X]   4    [X]                           [X]   4    [X]
                       [X]   3    [X]                           [X]   3    [X]
                       [X]   2    [X]                           [X]   2    [X]
                       [X]   1    [X]                           [X]   1    [X]
                       [X]   0    [X]                           [X]   0    [X]
                     LOOP #1    LOOP #2                       LOOP #1    LOOP #2

                       Press "M" to view the Main Menu.
```

Figure 15. Introductory Menu Screen

```
                    ADTRAN HDSL MAIN MENU


                  1) CURRENT SYSTEM STATUS
                  2) PERFORMANCE HISTORY
                  3) ADTRAN INFORMATION
                  4) LOOPBACK OPTIONS
                  5) SELF-TEST
                  6) PROVISIONING
                  7) TROUBLESHOOTING


   Choose a screen by pressing the corresponding number.
```

Figure 16. HDSL Main Menu Screen

```
                              CURRENT SYSTEM STATUS
LOOP #1  <HTU-C>  LOOP #2     ELAPSED TIME 00:02:23     LOOP #1  <HTU-R>  LOOP #2
-------------------------                               -------------------------
   00               00          <-     LOSS     ->         01               01
   YES              YES         <-     SYNC     ->         YES              YES
000/00000        000/00000      <- ES   15M/24H ->      000/00000        000/00000
000/00000        000/00000      <- SES  15M/24H ->      000/00000        000/00000
017/00017        017/00017      <- UAS  15M/24H ->      017/00017        017/00017
    LOOPBACKS INACTIVE                                      LOOPBACKS INACTIVE

     SIGNAL QUALITY         DSX-1                  DS1        SIGNAL QUALITY
     [X]   9    [X]       ----------------------------        [X]   9    [X]
     [X]   8    [X]       SF       <-  FRAME ->     SF        [X]   8    [X]
     [X]   7    [X]       B8ZS     <-  CODE  ->   B8ZS        [X]   7    [X]
     [X]   6    [X]       0-133    <-  LBO   ->   0 dB        [X]   6    [X]
     [X]   5    [X]       N/A      <-  NIU   ->     NO        [X]   5    [X]
     [X]   4    [X]       00000    <-  BPV   ->  00000        [X]   4    [X]
     [X]   3    [X]       00000    <-  ES    ->  00000        [X]   3    [X]
     [X]   2    [X]       00000    <-  SES   ->  00000        [X]   2    [X]
     [X]   1    [X]       00143    <-  UAS   ->  00127        [X]   1    [X]
     [X]   0    [X]       RED      <- ALARMS ->    RED        [X]   0    [X]
   LOOP #1    LOOP #2        SEALING CURRENT PRESENT        LOOP #1    LOOP #2

               Press "Z" to zero registers or "M" for Main Menu.
```

Figure 17. Current System Status Screen

```
            PERFORMANCE HISTORY <VIEW 1 - HTU-C DSX-1 RECEIVER>
     24 HOUR REGISTERS                             15 MINUTE REGISTERS
    ---ES---SES--                              --ES-SES------------ES-SES-
     00000 00000         <---CURRENT--->         000 000
 -1: ----- -----         <--         -->   -1:  --- ---     -17: --- ---
 -2: ----- -----           |         |     -2:  --- ---     -18: --- ---
 -3: ----- -----           |         |     -3:  --- ---     -19: --- ---
 -4: ----- -----           |         |     -4:  --- ---     -20: --- ---
 -5: ----- -----           |PREVIOUS |     -5:  --- ---     -21: --- ---
 -6: ----- -----           |         |     -6:  --- ---     -22: --- ---
 -7: ----- -----         <--         |     -7:  --- ---     -23: --- ---
                                     |     -8:  --- ---     -24: --- ---
      VIEW LOCATION DIAGRAM          |     -9:  --- ---     -25: --- ---
     ___                 ___         |    -10:  --- ---     -26: --- ---
    |   |               |   |        |    -11:  --- ---     -27: --- ---
--1->|   |<-3--LOOP1--4->|   |---->   |    -12:  --- ---     -28: --- ---
    |   |               |   |        |    -13:  --- ---     -29: --- ---
<----|   |<-5--LOOP2--6->|   |<-2--   |    -14:  --- ---     -30: --- ---
    |___|               |___|        |    -15:  --- ---     -31: --- ---
    HTU-C               HTU-R       -->   -16:  --- ---     -32: --- ---

 Press view number to select view (ex. press "1" to select DSX-1 registers).
                     Press "M" to return to Main Menu.
```

Figure 18. Performance History Screen

```
                                 LOOPBACK OPTIONS
                  _________________             _________________
                 |            ___   |           |   ___           |
                 |           |   |  |           |  |   |          |
                 |           |   |==|===========|==|   |          |
    ---------->|--------->|   |  |   LOOP 1   |  |   |<---------|<----------
                 |           |   |  |           |  |   |          |
 NETWORK         |           |   |  |           |  |   |          |   CUSTOMER
                 |           |   |  |           |  |   |          |
    <----------|<---------|   |  |   LOOP 2   |  |   |--------->|---------->
                 |           |   |==|===========|==|   |          |
                 | DSX-1     |___|  |           |  |___|     DS1  |
                 |__________________|           |_________________|
                       HTU-C                          HTU-R

                        LOOPBACKS:                STATUS:
                  ________________________________  ______
                  1) LOOPBACK TO NETWORK  AT HTU-C   INACTIVE
                  2) LOOPBACK TO CUSTOMER AT HTU-C   INACTIVE
                  3) LOOPBACK TO NETWORK  AT HTU-R   INACTIVE
                  4) LOOPBACK TO CUSTOMER AT HTU-R   INACTIVE

               Press corresponding number to toggle loopback option.
                            Press "M" for Main Menu.
```

Figure 19. Loopback Options Screen

```
                              SELF-TEST


          Press "S" to initiate HTU-C and HTU-R self-tests.

                 Press "M" to return to the Main Menu.
```

Figure 20. Self Test Options Screen

```
                              PROVISIONING
 ___________________________________________________   ______________________
|                                                   | |                      |
|      PROVISIONS               CURRENT SETTINGS    | |   HARDWARE SETTINGS  |
|    ----------------------------------------------  | |   -----------------  |
|    1.  DSX-1 LINE BUILDOUT  =   0-133 ABAM        | |       0-133 ABAM     |
|    2.  DSX-1/DS1 LINE CODE  =   AUTO              | |       AUTO           |
|    3.  DSX-1/DS1 FRAMING    =   AUTO              | |       AUTO           |
|    4.  LOOPBACK TIMEOUT     =   120 MIN           | |       120 MIN        |
|    5.  DS1 OUTPUT LEVEL     =   0 dB              | |       0 dB           |
|    6.  NIU LOOPBACK         =   DISABLED          | |       DISABLED       |
|    7.  DS0 BLOCKING                               | |       NONE BLOCKED   |
|                                                   | |                      |
|                    00000000 00000000 00000000     | |                      |
|        CHANNELS    1                        24    | |                      |
|                     "X" BLOCKS THE CHANNEL.       | |                      |
|___________________________________________________| |______________________|

            To change a provision, type its corresponding number.

            Type "H" to make the hardware settings current.

            Type "M" to return to the main menu.
```

Figure 21. Provisioning Options Screen

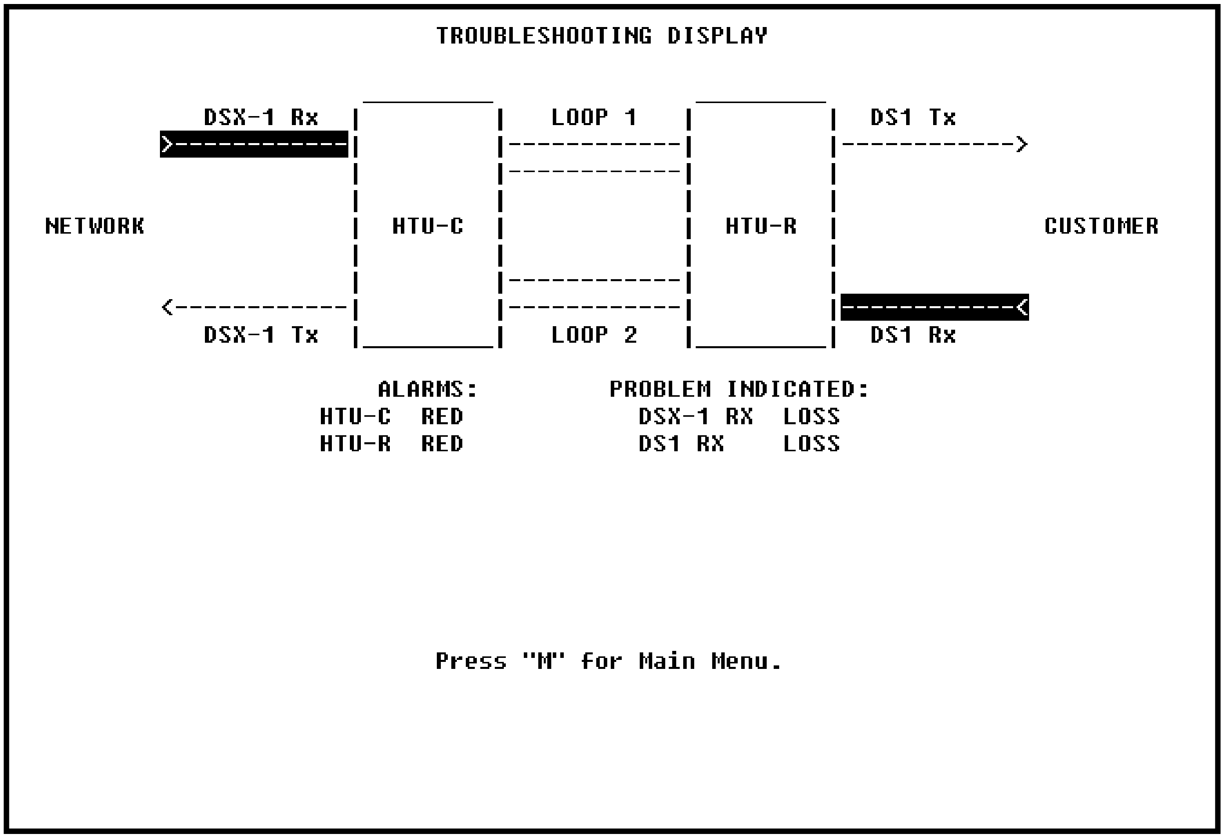

Figure 22. Troubleshooting Screen

9. HDSL DEPLOYMENT GUIDELINES

9.1 Recommended maximum local loop loss information for PIC Cable at 70°F, 135Ω, resistive termination is provided in **Table D**.

9.2 An approximation for the maximum amount of wideband noise on an HDSL local loop as measured by a 50 kbps filter is

≤ 31 dBrn *

9.3 An approximation for the maximum level of impulse noise as measured using a 50 kbps filter on an HDSL loop is

≤ 50 dBrn *

Table D. Loop Insertion Loss Data*

Frequency (Hz)	Maximum Loss (dB)
3000	12.0
10,000	15.0
50,000	25.5
100,000	30.0
150,000	32.75
200,000	35.25

* *These approximations are to be used as guidelines only and may vary slightly on different loops. Adhering to the guidelines should produce performance in excess of 10^{-7} BER.*

10. TROUBLESHOOTING PROCEDURES

Table E is a troubleshooting guide for the 220/E220 HTU-C.

11. MAINTENANCE

11.1 The ADTRAN 220/E220 HTU-C requires no routine maintenance. In case of equipment malfunction, use the faceplate Bantam jack connectors to help locate the source of the problem.

ADTRAN does not recommend that repairs be performed in the field. Repair services may be obtained by returning the defective unit to the ADTRAN Customer Service RMA Department.

12. PRODUCT SPECIFICATIONS

Product specifications are detailed in **Table F.**

Table E. Troubleshooting Procedures

Condition	Solution
All Front Panel Indicators *Off*.	**1.** Verify that -48 VDC power is properly connected to the shelf. **2.** Inspect the front panel fuse and verify that it is not blown. **3.** Insert the HTU-C into a known good slot and check for *On* condition of the PWR indicator. **4.** If Steps 1 and 2 pass, but Step 3 fails, replace the HTU-C.
Power OK but SC indicator is *Off*.	**1.** Check that neither HDSL Loop is open. **2.** If neither HDSL Loop is open, one of the following conditions exists: **a.** One or both HDSL Loops is shorted. **b.** There is a problem with the HTU-R DC powering circuit. **c.** There is a problem with the HTU-C powering circuit. This condition can be eliminated by trying a known good HTU-C in this slot.
PWR indicator is on, SC indicator is *On*, but one or both of the SYNC indicators remain off after one minute.	**1.** Verify that the loop conforms to CSA guidelines and is not too long. Verify that the loop loss at 200 kHz is less than 36 dB. **2.** Verify that both HDSL Loops have acceptable noise limits (see **subsections 6.3** and **6.4**). **3.** Verify that the Tip and Ring of each HDSL Loop belong to the same twisted pair. **4.** Verify that there is sufficient line power. $^{+}$V to $^{-}$V = 130 VDC ± 10% $^{+}$I to $^{-}$I = 70 to 140 *m*VDC **5.** If steps 1 - 4 pass and one or both of the Sync indicators remain Off, replace the unit with a known good HTU-C.

13. WARRANTY AND CUSTOMER SERVICE

ADTRAN will replace or repair this product within five years from the date of shipment if it does not meet its published specifications or fails while in service (see ADTRAN Equipment Warranty, Repair, and Return Policy and Procedure).

13.1 Return Material Authorization (RMA) is required prior to returning equipment to ADTRAN.

13.2 For service, RMA requests, or further information, contact one of the following numbers:

ADTRAN Customer Service:

RMA	**(205) 971-8722**
Technical Support	**(800) 726-8663**
Applications Engineering	**(800) 615-1176**
Sales	**(800) 827-0807**

Repair and Return Address:
ADTRAN, Inc.
Customer Service Department
901 Explorer Boulevard
Huntsville, Alabama 35806-2807

Table F. HDSL 220/E220 HTU-C Unit Specifications

Loop Interface	
Modulation Type:	2B1Q
Mode:	Full Duplex, Echo Cancelling
Number of Pairs:	Two
Bit Rate:	784 kbps per pair
Baud Rate:	392K baud per pair
Service Range:	Defined by Carrier Service Area Guidelines
Loop Loss:	36 dB maximum @ 200 kHz
Bridged Taps:	Single Taps < 2000 feet, Total Taps < 2500 feet
Performance:	Compliant with Bellcore TA-NWT-001210
HDSL Tx Signal Level:	13.5 dBm
Input Impedance:	135Ω
Return Loss:	20 dB (40 kHz to 200 kHz)
Network Interface	
4-WIRE DSX-1	
DSX-1 Output Level:	0 dB
DSX-1 Line Build Out:	0-133 feet ABAM 134-266 feet ABAM 267-399 feet ABAM 400-533 feet ABAM 534-655 feet ABAM
DSX-1 Line Code:	AMI, B8ZS
DSX-1 Format:	SF, ESF, Unframed
DSX-1 Channelization:	Channels 1-12 on Loop 1, Channels 13-24 on Loop 2
Power	
Total Power:	48 VDC @ 20 W, typical (includes HTU-C, HTU-R, and an external NIU)
HTU-C Power dissipation	≤10 W maximum
HTU-C -48 VDC Current Drain:	≤ .5 A
Span Power:	-130 VDC (Internally Generated) current limited at 250 *m*A
Fusing:	1.00 A BUSS GMT-1.00 or equivalent
Clock	
Clock Sources:	Internal, DSX-1 Derived
Internal Clock Accuracy:	± 25 ppm, (exceeds Stratum 4). Meets T1.101 timing requirements.
Tests	
Diagnostics:	Self-Test, Local Loopback (HTU-C), Remote Loopback (HTU-R)
Physical	
23" 220 Office Repeater Shelf-Mounted	
Dimensions:	5.6" high x 1.25 wide x 10.1" deep
Weight:	Less than 1 lb.
Environment	
Temperature:	Operating (Standard): -40° to +70°C Storage: -40° to +85°C
Control Port	
Interface	RS-232 (DB9)
Terminal type:	VT 100 or compatible
Async Speed:	2.4 kbps to 19.2 kbps
Data Format:	8 data bits, no parity, 1 stop bit

Appendix I
HDSL LOOPBACKS

1. HDSL MAINTENANCE MODES

This appendix describes operation of the HDSL system with regard to detection of in-band and ESF facility data link loopback codes. The HDSL network loopback points described below are shown in **Figure 23**.

HTU-C Loopback:
A regenerative Loopback of the DSX-1 signal toward the network.

HTU-R Loopback:
A regenerative Loopback of the DS1 signal toward the network. This loopback is in addition to a separate Smartjack loopback. Separate activation sequences are provided for the HTU-R and the Smartjack loopback initiation.

The HDSL loopbacks are implemented such that the downstream HDSL elements (toward the customer) remain synchronized. This is accomplished by transmitting scrambled 1s toward the customer, which reduces HDSL retraining delays and expedites the loopback testing procedures.

1.1 Loopback Process Description

In general, the loopback process for the HDSL system elements is modeled on the corresponding DS1 system process. Specifically, the HTU-C loopback is similar to an Intelligent Office Repeater loopback and the HTU-R loopbacks are similar to an inline T1 Repeater loopback.

State transitions result from in-band and ESF Data Link sequences as well as timeout operations.

In-band control code sequences are transmitted over the DS1 link by either the *Unframed* or *Overwrite* method. The HDSL elements respond to either method.

Unframed Method: Produces periodic control sequences and the normal DS1 framing bit is omitted.

Overwrite Method: Produces periodic control sequences. However, once per frame, the framing bit overwrites one of the bits in the control sequence.

The unit can detect the loopback activation or deactivation code sequence *only* if an error rate of $1E^{-03}$ or better is present.

1.2 States and State Transitions Description

The following subsections briefly describe each state and state transition. A summary of timeout and control sequences is given in **Table G**.

> **Note: In all control code sequences presented, the in-band codes are shown leftmost bit transmitted first, and the ESF Data Link codes with rightmost bit transmitted first.**

1.3 Deactivated State

The deactivated state is the normal mode of operation. Each HDSL element is transparent to the data flow. However, the in-band data flow and the ESF data link are monitored for loopback activation (loopup) sequences.

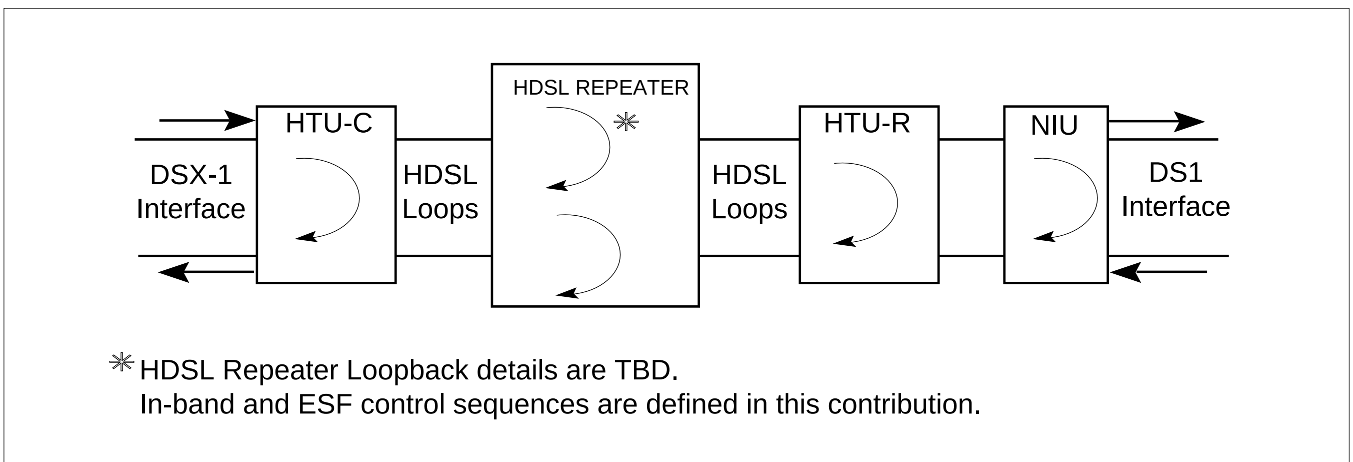

Figure 23. HDSL Loopback Points

Table G. HDSL Loopback Control Codes

Name	Code	Detection Time	Comments
Activation (HTU-C) **Activation (HTU-R)**	1111000 1110000	4 seconds 4 seconds	Signal sent in-band. HDSL elements in the deactivated state make the transition to the loopup state.
Smartjack Activation (In-band) **Smartjack Activation (ESF)**	11000 0001 0010 1111 1111	4 seconds 4 times	Signal sent in-band or over ESF data link. HTU-R will transition to the loopup state if NIU loopback is enabled.
Deactivation (In-band) **Deactivation (ESF)**	11100 0010 0100 1111 1111	4 seconds 4 times	Signal sent in-band or over ESF data link. HDSL elements in the loopup state will transition to the deactivated state.
Loopup Timeout		Programmable at HTU-C: None, 20, 60, or 120 minutes	HDSL elements in the loopup state will transition to the deactivated state.

Transition to Activated (Loopup) State

An in-band control code sequence is used to command a specific HDSL element to move from the deactivated state into the loopup state. Each HDSL element has a unique 7-bit activation control code sequence as show below:

HTU-C Activation Sequence
1111000

HTU-R Activation Sequence
1110000

Each HDSL element will loopup after receiving the proper activation sequence for 4 seconds.

Smartjack Loopback

When the HTU-C is provisioned for NIU loopback enabled, the HTU-R will transition from the deactivated state to the loopup state upon receiving either of the following in-band and ESF facility data link control codes:

HTU-R Smartjack Loopup Sequence (in-band)
11000

HTU-R Smartjack Loopup Sequence (ESF)
0001 0010 1111 1111

The HTU-R will loopup after receiving the in-band activation sequence for 4 seconds or the ESF sequence four consecutive times.

> **Note: The HTU-C and the HTU-R can simultaneously exist in the loopup state if the HTU-R is placed in the loopup state using one of the Smartjack loopup sequences and the HTU-C is placed in the loopup state using the 7-bit HTU-C activation sequence.**

1.4 Activated (Loopup) State

While in the activated state, the HDSL elements loop the DSX-1 signal back to the network. The in-band data flow and the ESF data link are monitored for the deactivation sequences. The HDSL elements can also timeout from the activated state.

Transition from the Activated (Loopup) State

All HDSL elements deactivate upon receiving either of the in-band and ESF data link deactivation sequences. The deactivation sequences are as follows:

Deactivation Sequence (In-band)
11100

Deactivation Sequence (ESF)
0010 0100 1111 1111

Each HDSL element will deactivate after receiving the in-band deactivation sequence for 4 seconds or the ESF sequence four consecutive times.

The HDSL elements will also deactivate if the programmable loopback timeout value is reached. The loopback timeout which is programmable at the HTU-C can be set to the following values:

Loopup Timeout
None, 20, 60, or 120 minutes

The HDSL loopback control codes are summarized in **Table G**.

Appendix II
DS0 BLOCKING

ADTRAN has implemented the DS0 blocking feature enabling the HDSL system to remain transparent to customer data. This allows ADTRAN products to comply with the transparency requirements of Bellcore TA-NWT-001210. However, when the circuit is provisioned for ESF operation, this transparency results in a condition described below.

If a customer of a Fractional T1 service fills any of the unused DS0 channels with information other than an all 1s idle code, the ADTRAN HDSL system will block this information from reaching the remote end of the circuit. This forces information in those DS0 channels to be an all 1s idle code.

The result of this blocking is that the CRC checksum delivered to the remote end will not match the checksum calculated by the remote T1 CSU. This implies errors are being made on the loop when actually the blocking function created the CRC errors. Enabled DS0 channels pass error-free.

In order to avoid this condition, Fractional T1 customers are encouraged to fill the unused timeslots with and idle code. This is a common capability on Fractional T1 CSU/DSU, D4 channel banks, and other CPE devices capable of connecting to Fractional T1 service.

ADTRAN

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