PRACTICES

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

Section 61245001L7-5
Issue 1, May 1998
CLEI Code #T1L2BUCBAA

E220/220 T1 HTU-C
HDSL Transceiver Unit -- Central Office
INSTALLATION/MAINTENANCE

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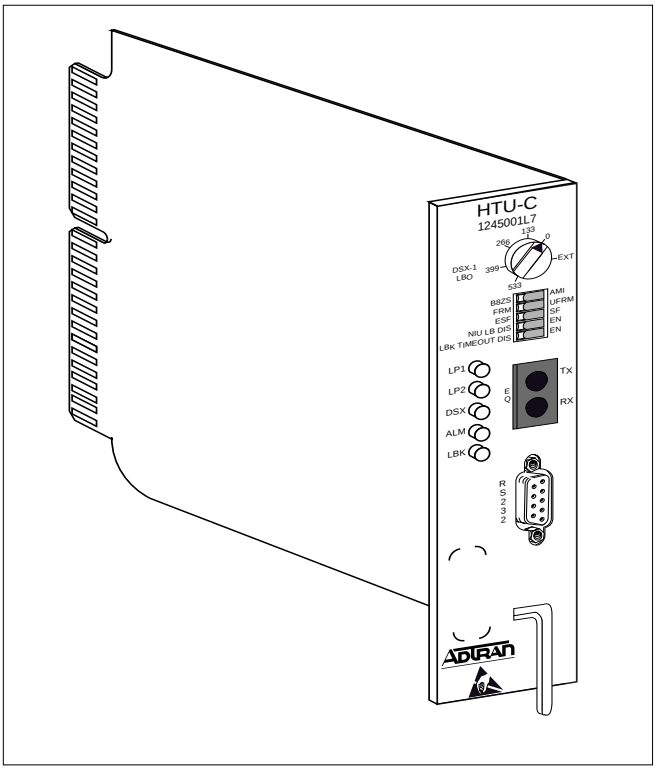


Figure 1. ADTRAN HTU-C

1. GENERAL

The ADTRAN E220/220 Low Voltage HDSL Transceiver Unit for the Central Office (HTU-C), part number 1245001L7, is the Central Office (CO) unit used to deploy an HDSL T1 circuit using four-wire metallic facilities. The unit occupies one slot in a standard 220 Office Repeater Bay or the ADTRAN E220 Shelf. Figure 1 is an illustration of the ADTRAN HTU-C.

DSX-1 signals are provided to and received from the network while 2B1Q HDSL signals are provided to the local loop. The ADTRAN HTU-C works in conjunction with the ADTRAN HTU-R and HRE to provide a DS1 service up to 24,000 feet on the local loop.

This HTU-C works with multiple list versions of the HDSL unit remote end (HTU-R) and HDSL range extender (HRE) as listed below:

- 1244041L2, Low Voltage T400 HRE
- 1244042L1, Low Voltage 819A HRE
- 1244044L1, Low Voltage 439 HRE
- 1245021L1, Low Voltage HTU-R T200 CP
- 1245022L1, Low Voltage HTU-R SA
- 1245026L1, Low Voltage HTU-R CI

The Low Voltage HTU-C can be deployed in circuits consisting of one HTU-C and one HTU-R. When deployment requires the HDSL Range Extender, the Low Voltage HTU-C can be deployed with one Low Voltage HRE (T400 or 819A) and one Low Voltage HTU-R.

The HDSL local loop operates as two independent subsystems each operating over a single twisted pair. The HTU-C communicates over these two twisted pairs to the HDSL Transceiver Unit Remote end (HTU-R). Each subsystem carries half of the total bandwidth along with a small amount of overhead used for maintenance and performance monitoring.

System power and alarm bus connections are made through the backplane of the 220 shelf. DSX-1 and HDSL signals are connected through the wire-wrap pins or the 50 pin shelf connectors related to each individual slot.

The HTU-C contains onboard fuses. If a fuse opens, it supplies a–48 VDC voltage to the fuse alarm bus and all front panel indicators will be *Off*. These fuses are not designed to be field replaceable.

The E220/220 Low Voltage HTU-C uses a DC-to-DC converter to derive its internal logic and span powering voltages from the -48 VDC office supply. The E220/220 Low Voltage HTU-C can span power HREs and HTU-Rs as listed above. When used with Low Voltage HREs and HTU-Rs, the HTU-C can span power the Low Voltage HTU-R and Low Voltage HRE at less than –140 VDC. Span powering voltages meet all requirements of Class A3 voltages as specified by Bellcore GR-1089-CORE.

Revision History

This is the first issue of this practice. In subsequent issues, changes will be summarized in this paragraph.

2. INSTALLATION

After unpacking the unit, 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).

The E220/220 Low Voltage 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 and the ADTRAN E220 RP Shelf. No installation wiring is required.

One six-position rotary switch (RSW) and a five-position dipswitch pack (SW1) accessible from the faceplate of the unit are used to configure the mode of operation. Figure 1 shows the location of these switches.

A definition of each switch is shown in Tables A and B. Configuration may be performed by manually selecting each option switch, or alternatively, may be performed using the RS-232 craft access port. Manual configuration can be performed after installing the unit into the shelf.

When the unit is powered up, changing a single faceplate switch only affects that single parameter. When the unit is powered down, changing a single faceplate switch causes a global reset to revert back to all faceplate switch settings.

NOTE *Craft interface allows configuration of DS0 Blocking and additional loopback timeout settings.*

Faceplate Indicators

The HTU-C has five faceplate LEDs which indicate operational status. Table C defines these LEDs.

Table A. Front Panel Rotary Switch Option Settings [1]

Switch	Function	Description
RSW	DSX-1 Line Build-Out	This rotary switch is used to select operation of the line build-out equalizer in series with the DSX-1 output.
	EXT	Selects external line build-out [2]
	0	Line length from 0-133 feet of ABAM cable
	133	Line length from 133-266 feet of ABAM cable
	266	Line length from 266-399 feet of ABAM cable
	399	Line length from 399-533 feet of ABAM cable
	533	Line length from 533-655 feet of ABAM cable

[1] 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.

[2] If external line build-out is selected, the signal transmitted by the HTU-C is a 12V p-p signal. This must be considered when measuring the signal at the DSX EQ faceplate Bantam jack. The signal may appear hotter than it should be.

Table B. SW1 Option Settings [1]

(Default settings are indicated in **bold** typeface.)

Switch	Function	Description
SW1-1	Loopback Timeout	
	Enabled	Loopback Timeout is Enabled.[2, 3]
	Disabled	**Loopback Timeout is Disabled.**
SW1-2	NIU Loopback	This switch programs the ADTRAN HDSL system to respond to traditional T1 network interface unit (NIU) loop-up and loop-down codes. See Appendix A for more information on specific codes.
	Enabled	
	Disabled	
SW1-3	Manual Frame Select	
	SF	Selects Superframe (SF) format.
	ESF	**Selects Extended Superframe (ESF) format.**
SW1-4	T1 Framing	This switch selects the T1 framing mode.
	Unframed	Selects Unframed (UFRM) operation; SW1-3 is ignored.
	Framed	**Selects Framed operation.**
SW1-5	Manual Code Select	
	AMI	Alternate Mark Inversion (AMI) is selected.
	B8ZS	**B8ZS line code is selected.**

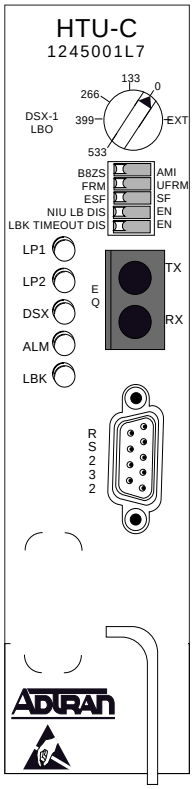
NOTE

[1] 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.

[2] Loopback timeout must be selected prior to initiating a loopback.

[3] 20-minute timeout is the default for Loopback Timeout Enabled. 60-minute and 120-minute timeouts are also available from the craft interface.

Table C. Front Panel Indicators



Indicator	Description
LP1	Indicates five possible states 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 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	Indicates the following three conditions: 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 (SF mode), or CRC error (ESF mode) detected at DSX-1 signal. On Solid ..... Network-side DSX-1 signal is present and synchronized.
ALM	Indicates the following three conditions: Off ..... No alarm condition detected. Red ..... Alarm condition detected either locally (HTU-C), or locally and remotely (HTU-C and HTU-R). Yellow ..... Remote alarm condition detected.
LBK	Indicates three possible loopback states: 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.

3. CONNECTIONS

The E220/220 Low Voltage 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 2 for HTU-C edge connection wiring.

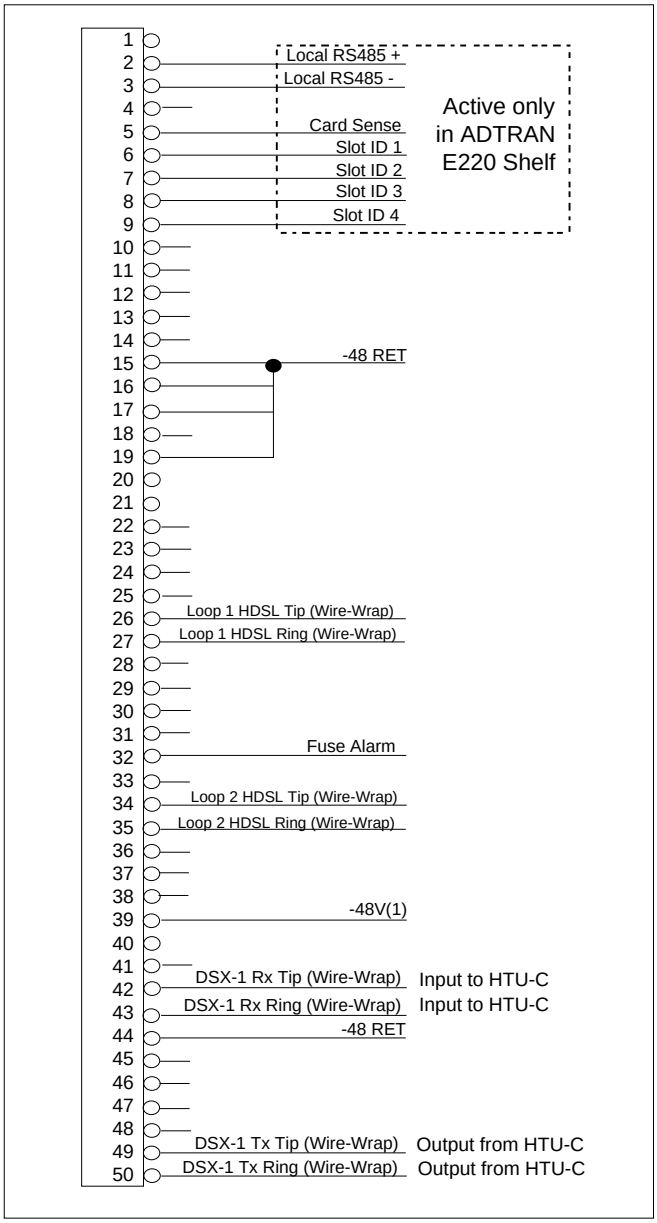


Figure 2. HTU-C Edge Connector Wiring

The HTU-C is capable of span powering the HTU-R by applying simplex current to the local loop. 30 to 155 *m*A of current is coupled onto the HDSL span to power the HTU-R and HRE when deployed. The span powering voltage is less than –140 volts with Loop 1 providing the negative voltage and Loop 2 the return (see Figure 3).

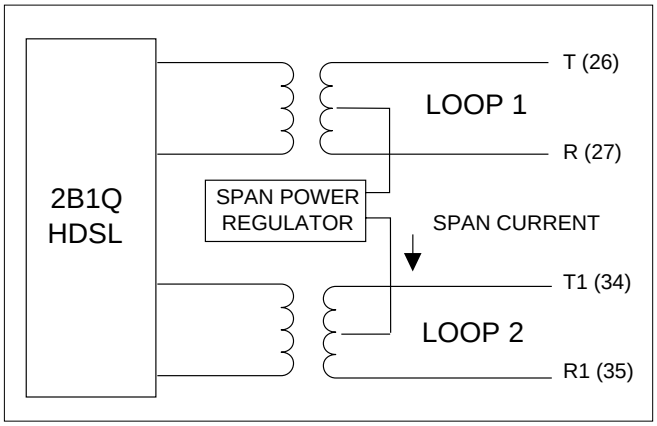


Figure 3. HTU-C Span Powering Diagram

HTU-C Alarm Outputs

Pin 32 of the HTU-C edge connector interface provides a fuse alarm signal that connects –48 VDC to this pin in the presence of a blown fuse. This indicates the card has malfunctioned and should be replaced.

HFAC Alarm Outputs

If the HTU-C is operating in an ADTRAN E220 or E220 RP Shelf with an HFAC (P/N 1244051LX or equivalent), the HTU-C provides information to the HFAC which is used to generate alarms. The HFAC alarm outputs are separate from the HTU-C alarm pin mentioned above. For more information on the HFAC controlled alarms, see the HFAC Installation and Maintenance practice, section 61244051LX-5.

4. HDSL SYSTEM TESTING

The ADTRAN HDSL system provides the 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.

HTU-C DSX EQ Bantam Jacks

The front panel of HTU-C contains metallic splitting bantam jacks for access to DSX-1 Tx and Rx from the local loop. This permits intrusive testing of the DSX-1 traffic on the HDSL local loop.

Figure 4 shows access provided by the DSX EQ bantam jacks.

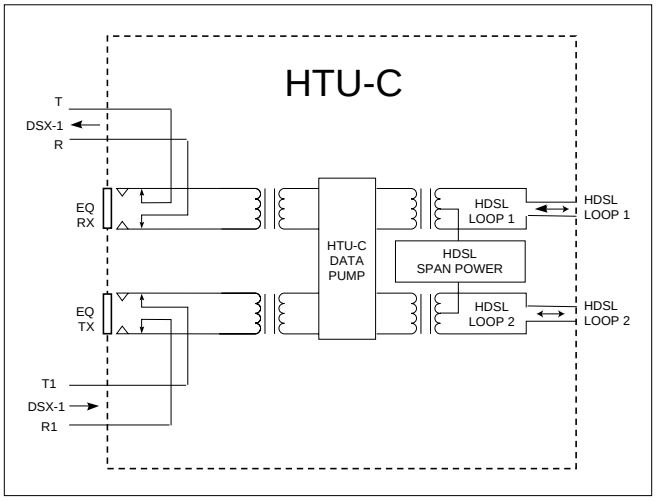


Figure 4. HTU-C Bantam Jack Arrangement

HTU-C Loopbacks

The HTU-C responds to two different loopback activation processes. First, loopback may be activated using the craft interface. The Loopback Options Screen which provides for the HTU-C, HTU-R, and HRE loopbacks will be described in subsection 5.

Secondly, the HTU-C responds to the industry defacto standard for HDSL loopbacks. A detailed description of these loopback sequences is given in Appendix A.

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 5 depicts all of the loopback locations possible with ADTRAN HDSL equipment.

When the unit is selected for framing, the addressable loopback codes will only be detected when sent in the appropriate framing mode. When the unit is selected for unframed, the addressable loopback codes will be detected regardless of the framing mode in which they are sent.

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.

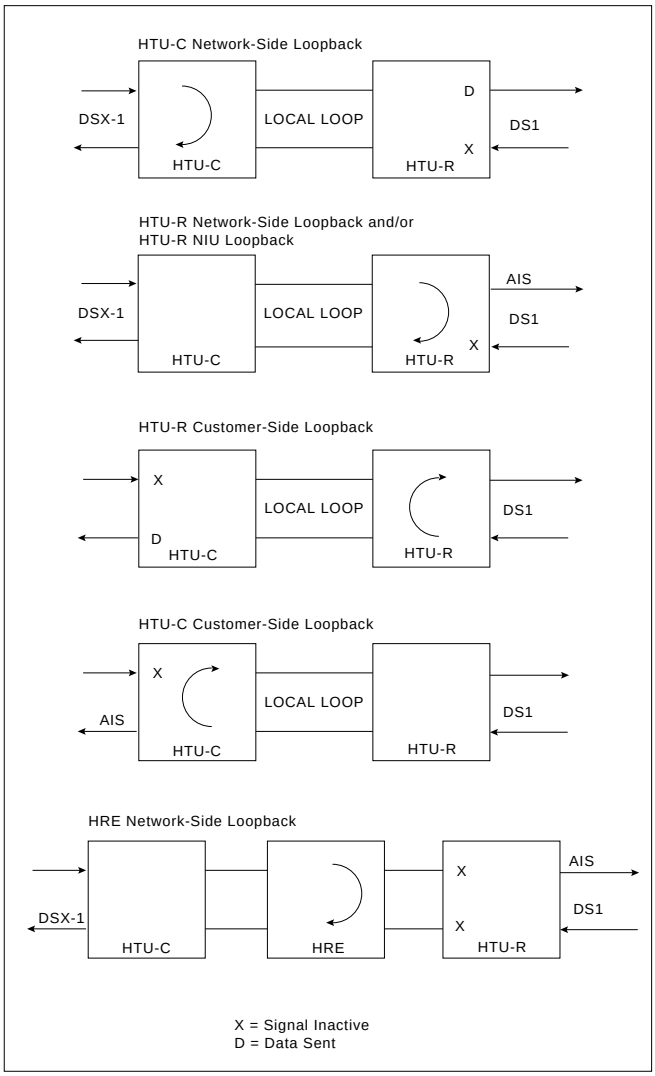


Figure 5. HDSL Loopbacks

5. CONTROL PORT OPERATION

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 6.

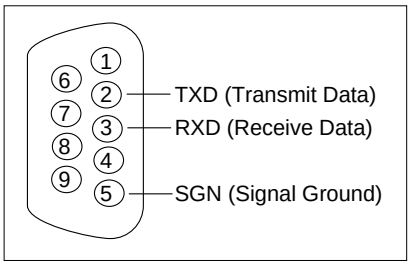


Figure 6. RS-232 (DB9) Pin Assignments

The terminal interface operates at data rates from 1.2 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.

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.*

Operation

For abbreviations used in the screen diagrams, see Table D.

The screens illustrated in Figures 7 through 14 are for an HDSL circuit deployed with ADTRAN's Low Voltage HDSL technology. The circuit includes an HTU-C,

Table D. Screen Abbreviations

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 occurs. ESF: Second in which 1544 BPVs or 320 CRC errors occur. HDSL ..... Second in which 165 CRC errors occurs.
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.

HTU-R, and HRE. This scenario was chosen for inclusiveness of functionality. However, other configurations are possible and their displays will vary slightly from those shown in this section.

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 7.

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 8, 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 9 provides quick access to status information for both the HTU-C and HTU-R. By pressing **H**, the Current System Status screen for the HRE will be displayed. See Figure 9A for the HRE Current System Status screen.

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 10. By pressing **H**, the Performance History screen for the HRE will be displayed. See Figure 10A for the HRE Performance History screen.

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

Figures 9 and 9A consolidate 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 *

** LOSS is typically several dB less than the insertion loss measured at 200 kHz. The LOSS measurement is a better indication of the loop's attenuation of the 2B1Q signal than the insertion loss measured at a single frequency. Adtran HDSL can operate on cables with an excess of 30 dB LOSS.*

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 or –15 dB (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 $\leq$ 0 dB ($\approx 10^{-7}$ BER)
1-8 ..... Margin measurement above 10^{-7} BER in dB
9 ..... Margin is $\geq$ 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 $\leq$ Margin $\leq$ 2 (Yellow) ..... Marginal Loop Quality
Margin > 2 (Green) ..... Good Loop Quality

Figures 11 and 12 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 13 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 retains the last provisioning changes to determine its operating mode.

NOTE *The DS1 Output Level option in the Provisioning Screen of the HTU-C can only be altered if the circuit contains a 2nd or 4th generation HTU-R. (The generation of the product is identified in the fourth digit of the product number.)*

The Troubleshooting Display, shown in Figure 14, 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.

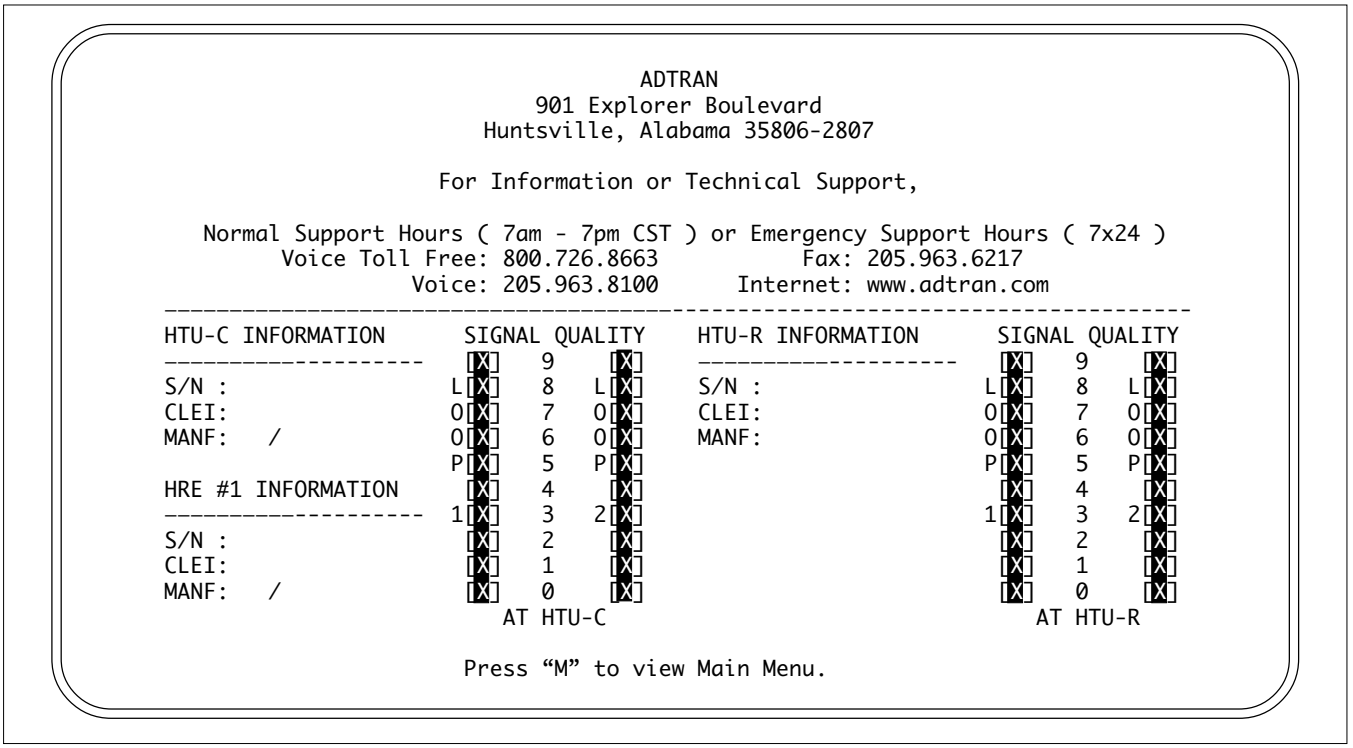


Figure 7. Introductory Menu Screen

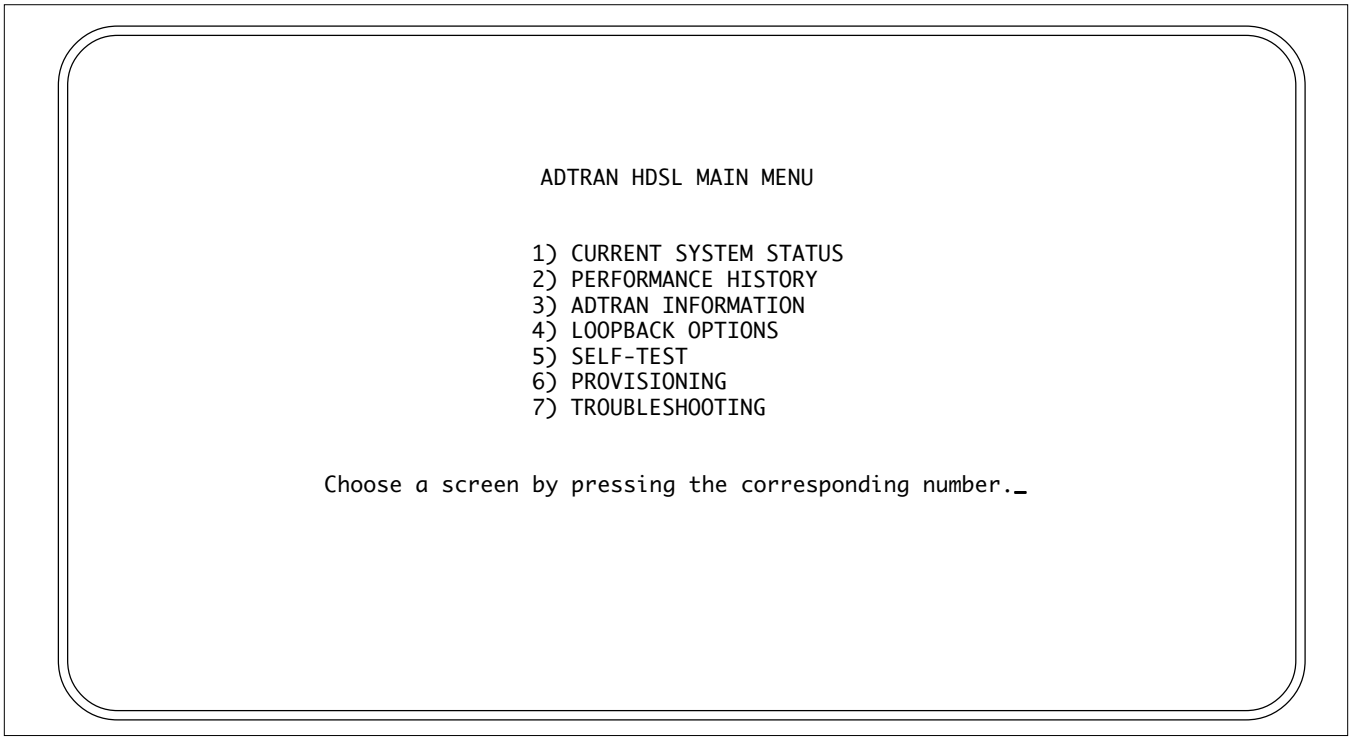


Figure 8. HDSL Main Menu Screen

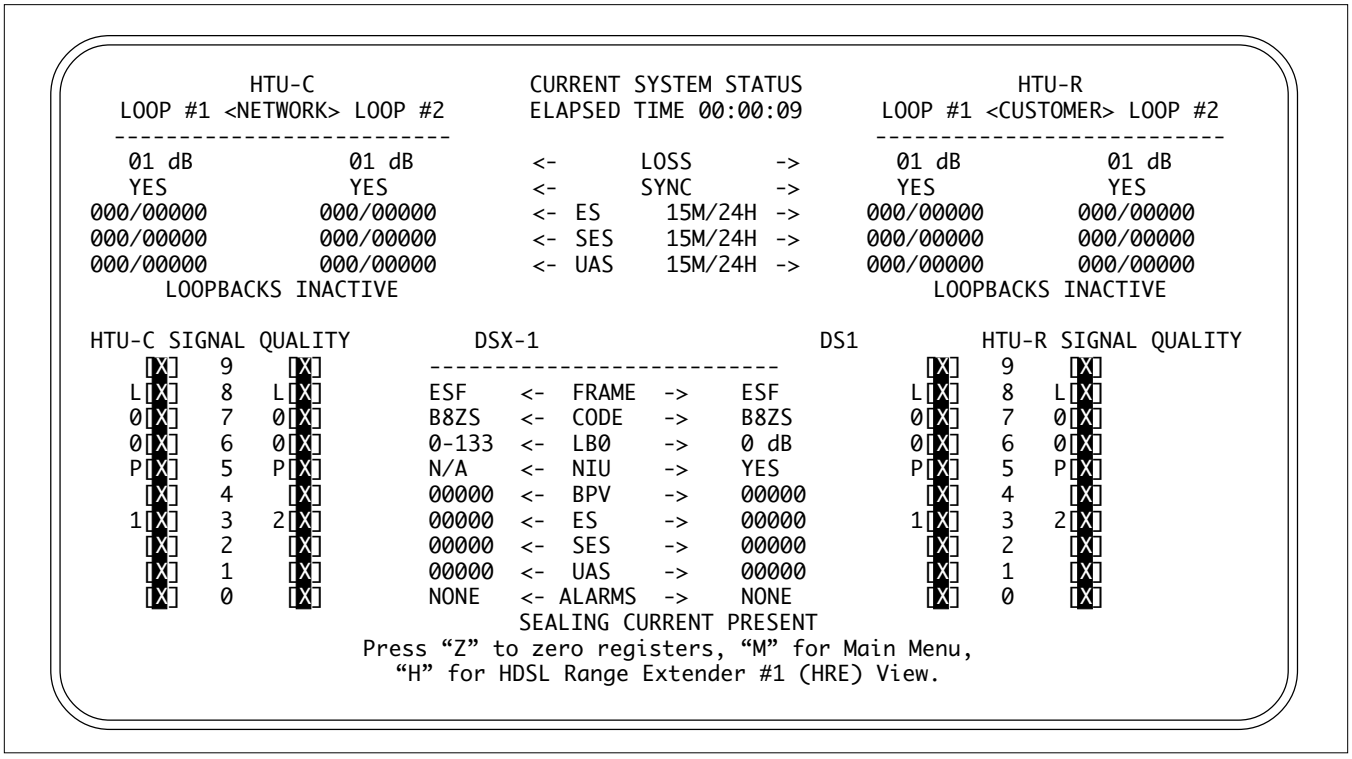


Figure 9. Current System Status Screen

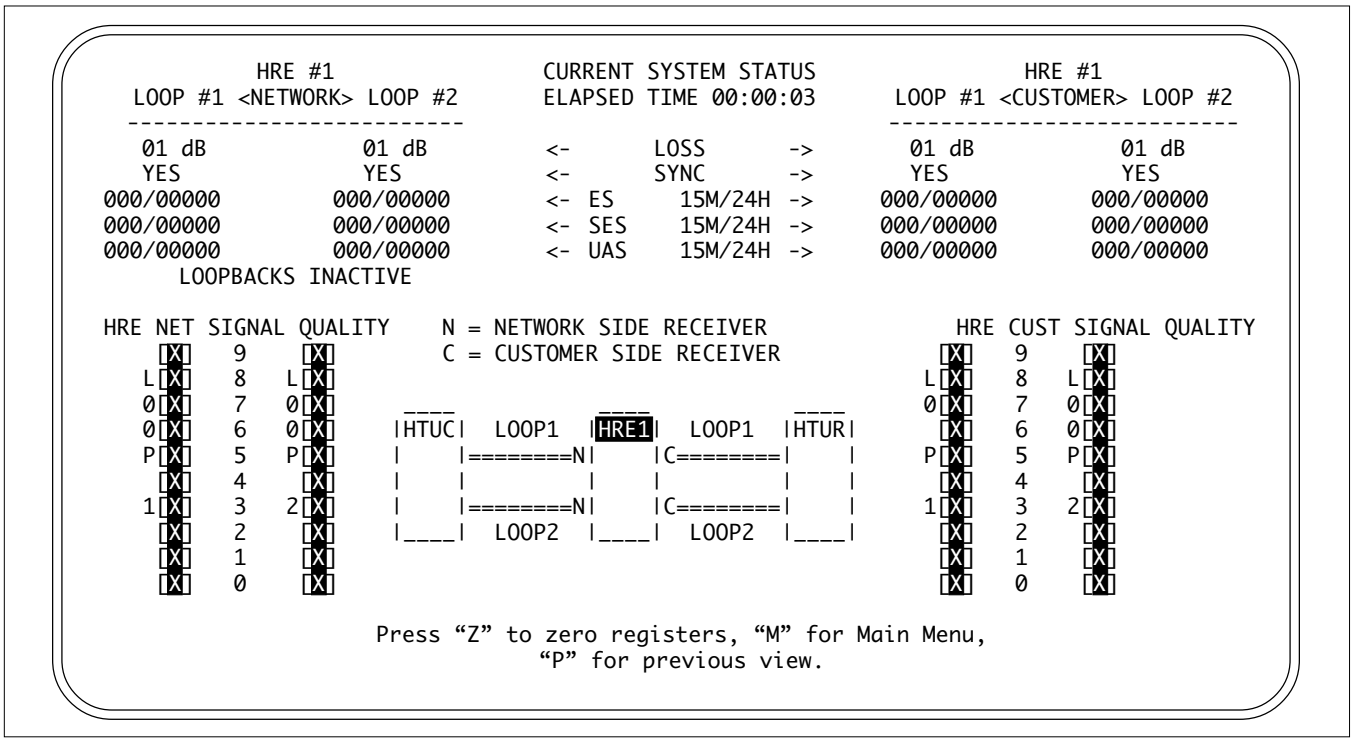


Figure 9A. Current System Status Screen - HRE

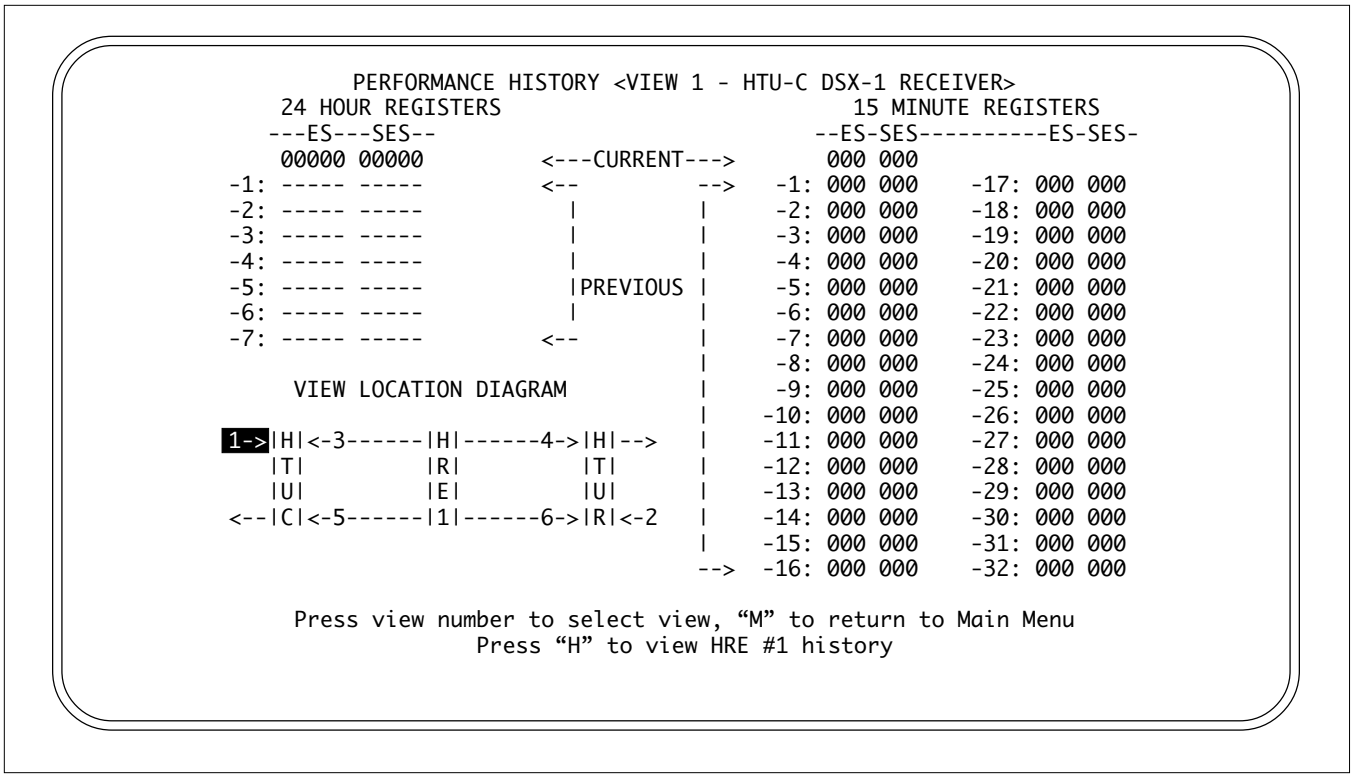


Figure 10. Performance History Screen

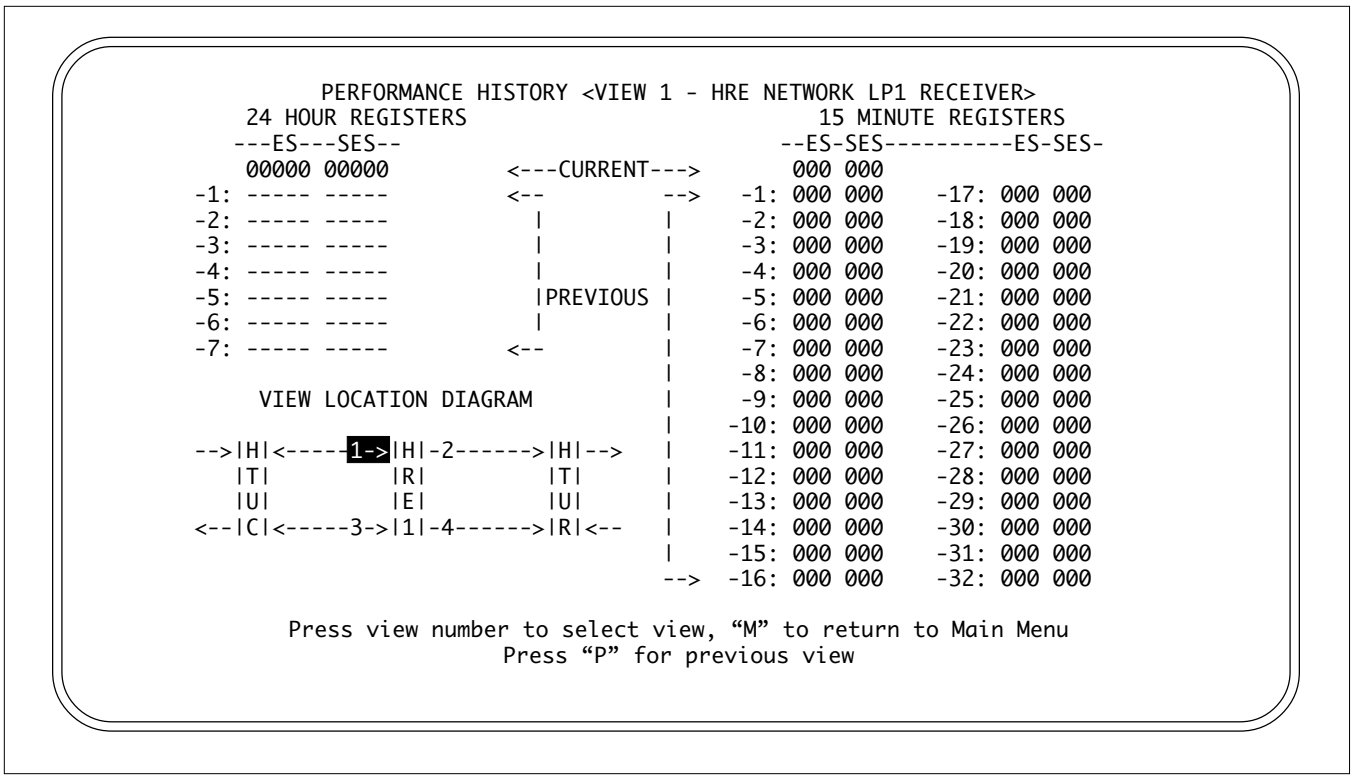


Figure 10A. Performance History Screen - HRE

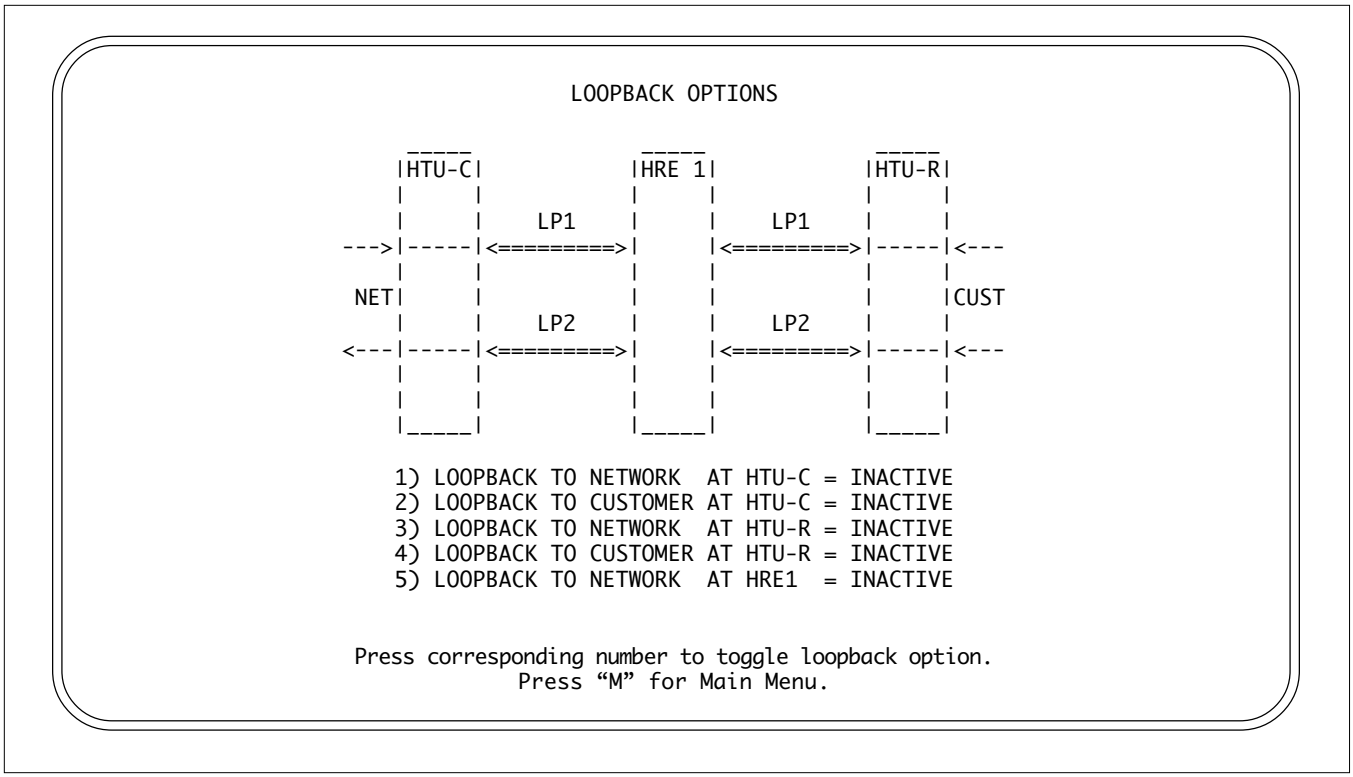


Figure 11. Loopback Options Screen

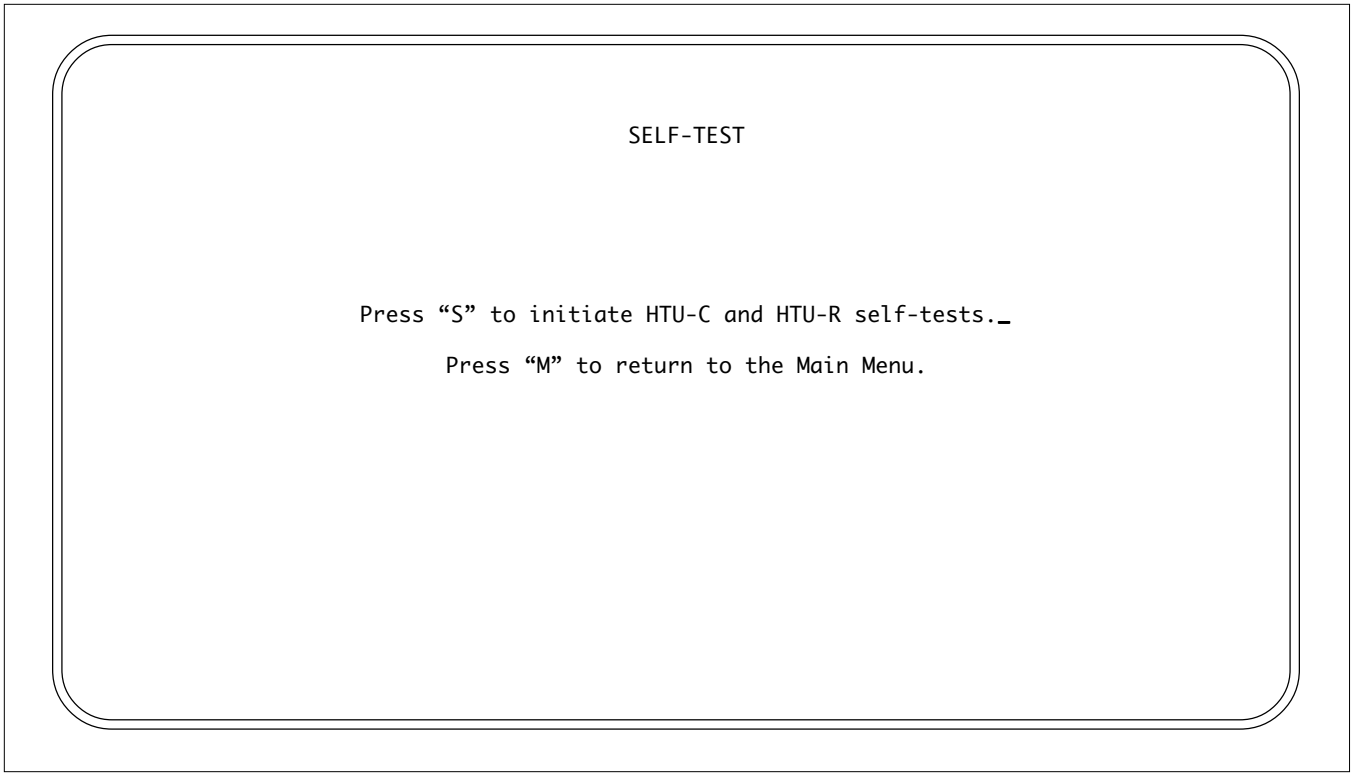


Figure 12. Self Test Options Screen

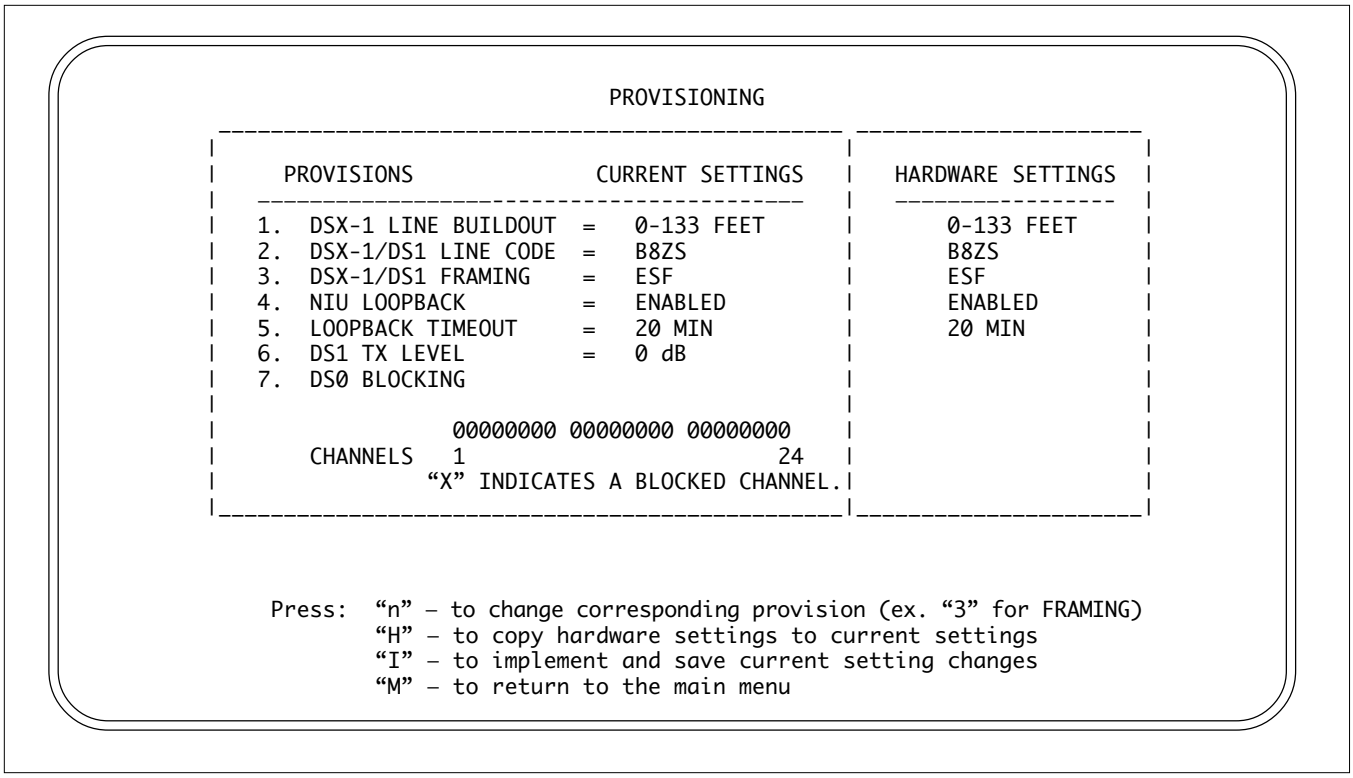


Figure 13. Provisioning Screen

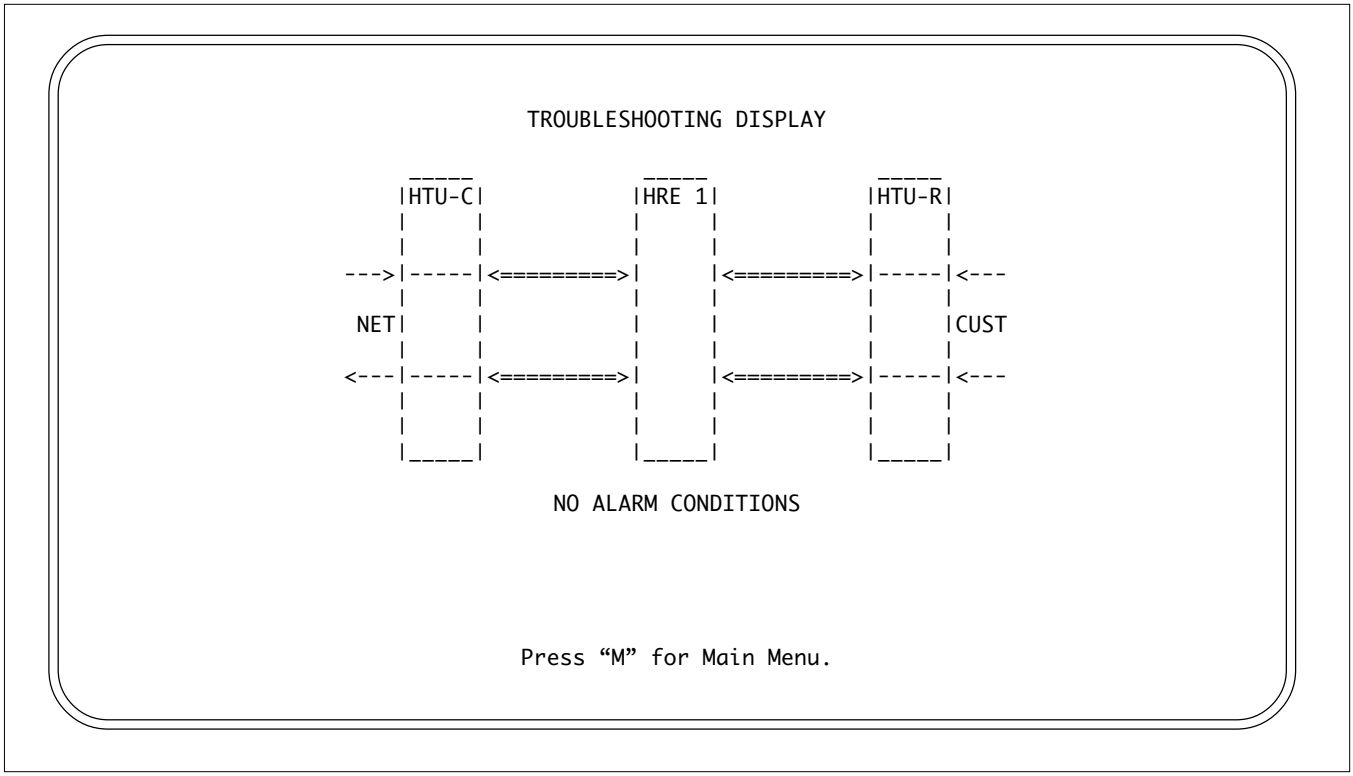


Figure 14. Troubleshooting Display

6. HDSL DEPLOYMENT GUIDELINES

The ADTRAN HDSL system is designed to provide DS1 based services over loops designed to 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 the following:

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

L^{26} = Total length of 26-AWG cable excluding bridged taps (in kft)

L^{BTAP} = Total length of all bridged taps (in kft)

This deployment criteria is summarized in the chart shown in Figure 15.

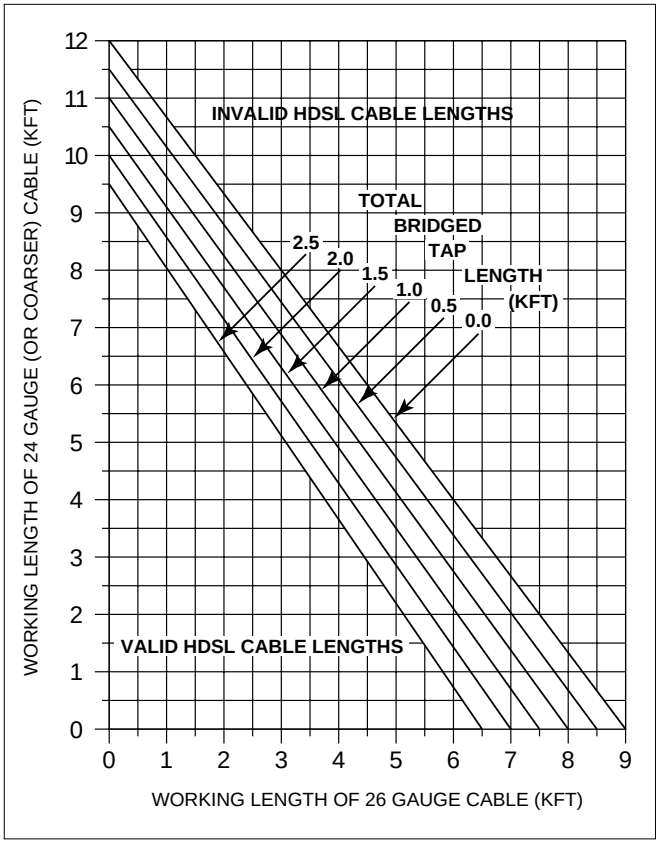


Figure 15. HDSL Deployment Guidelines

Loop loss per kft for other wire is summarized in Table E.

Table E. HDSL Loss Values
(200 kHz cable loss in dB/kft at 135Ω)

Cable Gauge	Cable Type	Temperature: 68°	90°	120°
26	PIC	3.902	4.051	4.253
26	Pulp	4.030	4.179	4.381
24	PIC	2.863	2.957	3.083
24	Pulp	3.159	3.257	3.391
22	PIC	2.198	2.255	2.333
22	Pulp	2.483	2.45	2.629
19	PIC	1.551	1.587	1.634
19	Pulp	1.817	1.856	1.909

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

Table F. Loop Insertion Loss Data

Frequency (Hz)	Maximum Loss (dB)
3,000	12.0
10,000	15.0
50,000	25.5
100,000	30.0
150,000	32.75
200,000	35.25

An approximation for the maximum amount of wideband noise on an HDSL local loop as measured by a 50 kbps filter is ≤ 31 dBrn.

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

NOTE *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.*

7. TROUBLESHOOTING PROCEDURES

Table G is a troubleshooting guide for the E220/220 Low Voltage HTU-C.

8. MAINTENANCE

Table G. Troubleshooting Guide

Condition	Solution
All front panel indicators are off.	1. Verify that –48 VDC power is properly connected to the shelf. 2. Insert the HTU-C into an operational slot and check the LED indicators. When the unit is powered, at least one LED will be on. 3. If step 1 passes, but step 2 fails, replace the HTU-C.
Other	See Table C on page 3 for information regarding the state of the circuit as described by the front panel indicators.

The ADTRAN E220/220 Low Voltage 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.

9. PRODUCT SPECIFICATIONS

Product specifications are detailed in Table H.

10. WARRANTY AND CUSTOMER SERVICE

ADTRAN will replace or repair this product within ten 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).

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

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

ADTRAN Customer Service:
ADTRAN Telco Technical Support ..... (800) 726-8663
Standard support hours: ..... Monday-Friday
7 a.m. - 7 p.m. CST
Emergency support: ..... 7 days/week, 24 hours/day

Sales ..... (800) 827-0807

RMA (repair service) ..... (256) 963-8722

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

Table H. HDSL 220/E220 Low Voltage HTU-C 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 HDSL Loop 1, Channels 13-24 on HDSL Loop 2

Power

Tested with the ADTRAN Low-Voltage HRE (P/N 1244.042L1) and the ADTRAN Low Voltage HTU-R (1245.021L1).

Total Power:	-48 VDC @ 180 *m*A with HTU-R -48 VDC @ 370 *m*A with HTU-R and HRE
HTU-C Power Dissipation:	5 watts with HTU-R 6 watts with HRE and HTU-R
Span Power:	<-140 VDC (Internally Generated) current limited at 150 *m*A
Fusing:	1.00 A BUSS GMT-1.00 or equivalent (not field replaceable)

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:	1.2 kbps to 19.2 kbps
Data Format:	8 data bits, no parity, 1 stop bit

Part Number

HTU-C 220/E220 Circuit Pack	1245001L7

Appendix A
HDSL LOOPBACKS

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.

Upon deactivation of a loopback, the HDSL system will synchronize automatically. Note that the synchronization process of the HDSL system upon deactivation of the HRE loopback could take up to 15 seconds, ensuring all system elements are synchronized.

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.

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.

The unframed method produces periodic control sequences and the normal DS1 framing bit is omitted.

The 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.

DDS Latching Loopback Operation

If the unit is optioned for FT1 mode, then DDS Latching Loopback operation is supported as described in Bellcore TA-TSY-000077, Issue 3, Section 5.1.3. The HTU-C and any HRE units which are in the HDSL circuit are treated as Identical Tandem Dataports and the HTU-R is treated as a Different Tandem Dataport. For a complete description of the DDS Latching Loopback codes, refer to Bellcore TA-TSY-000077, Issue 3, Section 5.1.3.

Loopback Control Codes

A summary of control sequences is given in Tables A-1 and A-2.

NOTE *In all control code sequences presented, the in-band codes are shown left-most bit transmitted first, and the ESF data link codes with right-most bit transmitted first.*

Table A-1. HDSL Enhanced Loopback Control Codes

Type	*Source*	*Code*	*Name*
	(N)	*3in7 (1110000)*	*Loopback data from network toward network in the HTUR.*
	(N)	*4in7 (1111000)*	*Loopback data from network toward network in the HTUC.*
Abbreviated	*(N)*	*2in6 (110000)*	*Loopback data from network toward network in first HRE.*
	(C)	*6in7 (1111110)*	*Loopback data from customer toward customer in HTUC.*
	(C)	*5in7 (1111100)*	*Loopback data from customer toward customer in HTUR.*
	(C)	*4in6 (111100)*	*Loopback data from customer toward customer in first HRE.*
	(N)	*FF1E*	*Loopback data from network toward network at HTUC.*
	(C)	*3F1E*	*Loopback data from customer toward customer at HTUC.*
	(N)	*FF04*	*Loopback data from network toward network at HRE1.*
	(C)	*3F04*	*Loopback data from customer toward customer at HRE1.*
Wescom	*(N)*	*FF02*	*Loopback data from network toward network at HTUR.*
	(C)	*3F02*	*Loopback data from customer toward customer at HTUR*
	(N)	*1in6 (100000)*	*Loopback data from network toward network at HTUR.*
	(N)	*FF48 (ESF-DL)*	*Loopback data from network toward network at HTUR.*
	(N/C)	*1in3 (100)*	*Loopdown everything.*
	(N/C)	*FF24 (ESF-DL)*	*Loopdown everything.*

Notes: *The Source column indicates which side of the interface the control codes are sent from. For example, an (N) indicates a network sourced code while a (C) indicates a customer sourced code.*

All codes are inband unless labeled ESF-DL.

All codes listed above must be sent for a minimum of 5 seconds in order for them to be detected and acted upon.

Table A-2. Inband Addressable Loopback Codes

FUNCTION	CODE	RESPONSE
ARM	11000 (also known as a 2-in-5 pattern)	NIU LOOPBACK ENABLED: The HTU-R will loopup towards the network. No AIS or errors will be sent as a result of this loopback. The HTU-C and HRE will ARM.
DISARM	11100 (also known as a 3-in-5 pattern)	The HTU-C and HRE are removed from the armed state. If any of the units are in loopback when the 11100 pattern is received, they will loopdown. The LBK LEDs will turn off on all units.
HTU-C NETWORK LOOPUP	D3D3 (1101 0011 1101 0011)	If the units have been armed and no units are in loopback*, the HTU-C will loopup towards the network, 2 seconds of AIS (all 1s) will be sent, 5 seconds of data will pass, and then 231 bit errors will be injected into the DSX-1 signal. As long as the pattern continues to be sent, 231 errors will be injected every 20 seconds. When the pattern is removed, the unit will remain in loopback. If the pattern is reinstated, the injection of 231 bit errors will resume at 20 second intervals.
HRE NETWORK LOOPUP	C741 (1100 0111 0100 0001)	If an HRE is present, the units have been armed, the HRE will loopup towards the network, 2 seconds of AIS (all 1s) will be sent, 5 seconds of data will pass, and then 10 bit errors will be injected into the DSX-1 signal. As long as the pattern continues to be sent, 10 errors will be injected every 20 seconds. When the pattern is removed, the unit will remain in loopback. If the pattern is reinstated, the injection of 10 bit errors will resume at 20 second intervals.
LOOPDOWN	9393 (1001 0011 1001 0011)	Any HTU-C and HRE units currently in loopback towards the network will loopdown and will not attain the armed state.
QUERY LOOPBACK	D5D5 (1101 0101 1101 0101)	If the units are armed and the HTU-C, HRE, or HTU-R are in network loopback, errors are injected into the DSX-1 signal upon detection of the query loopback pattern. As long as the pattern continues to be sent, errors are injected again every 20 seconds. The number of errors injected each time depends on which unit is in loopback. 231 errors are injected if the HTU-C is in network loopback, 20 at a time if the HTU-R is in network loopback, and 10 at a time if the HRE is in network loopback.
LOOPBACK TIMEOUT OVERRIDE	D5D6 (1101 0101 1101 0110)	If the units are armed and this pattern is sent, the loopback time out will be disabled. The time out option will be updated on the PROVISIONING menu of the HTU-R (viewable through the RS-232 port) to NONE. As long as the units remain armed, the time out will remain disabled. When the units are disarmed, the loopback time out will return to the value it had before the D5D6 code was sent.
SPAN POWER DISABLE	6767 (0110 0111 0110 0111)	If the units are armed and this pattern is sent, the HTU-C will deactivate its span power supply, turning off the HTU-R and HRE (if present). As long as the pattern continues to be sent, the span power supply will remain disabled. When the pattern is no longer being sent, the HTU-C will reactivate its span power supply, turning the remote unit(s) on. All units will retrain and return to the armed and unlooped state.

Note: all codes listed above must be sent for a minimum of 5 seconds in order for them to be detected and acted upon.
* If NIU is enabled, then the HTU-R can be in network loopback when the HTU-C or HRE loopup codes are sent.