220/E220 Low Voltage HTU-C M R High-bit-rate Digital Subscriber Line Transceiver Unit for the Central Office Installation and Maintenance

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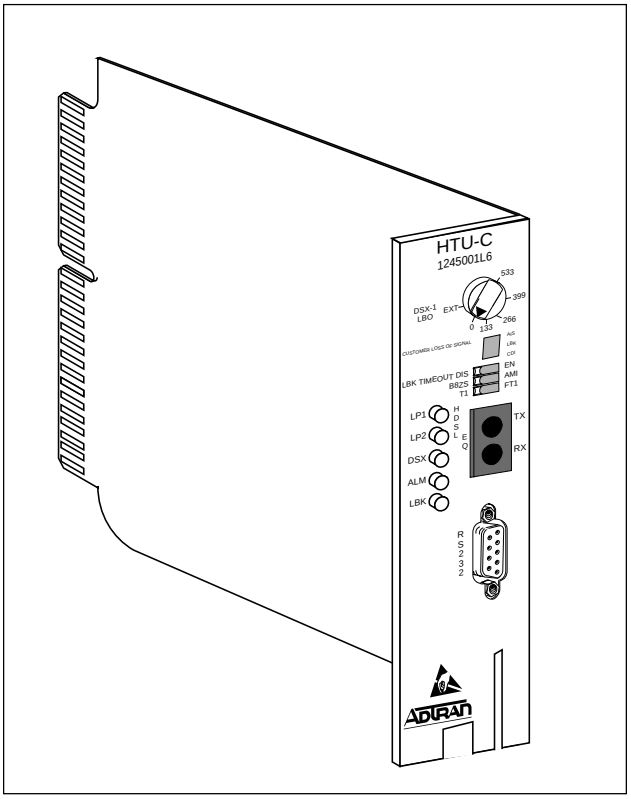

Figure 1. ADTRAN HTU-C M R

1. GENERAL

The ADTRAN 220/E220 HDSL Transceiver Unit for the Central Office (HTU-C M R), P/N 1245001L6, is the Central Office (CO) unit used to deploy an HDSL T1 circuit using 4-wire metallic facilities. The unit occupies one slot in a standard 220 Office Repeater Bay or the ADTRAN E220 Shelf.

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 M R works in conjunction with the ADTRAN HTU-R and HREs to provide a DS1 service up to 36,000 feet on the local loop.

This HTU-C M R works with multiple list versions of the HDSL unit for the Remote end (HTU-R) and HDSL Range Extender (HRE) as listed below:

Part Number	Description
1244021L1	Low Voltage HTU-R T400 CP
1244022L1	Low Voltage HTU-R SA
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 T200 SA
1245026L1	Low Voltage HTU-R T200 CI
1245045L1	Low Voltage 239 T1 HRE

The HTU-C M R can be deployed in circuits consisting of one or two HREs and an HTU-R.

NOTE

When deployment requires the use of two HREs, the HTU-C M R can be deployed with two Low Voltage HREs (1244041L2, 1245042L1, 1244044L1, or 1245045L1) and one Low Voltage HTU-R (1245026LX).

The HDSL local loop operates as two independent subsystems, each operating over a single twisted pair. The HTU-C M R communicates over these pairs to the HDSL Transceiver Unit for the 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 via the backplane of the 220 shelf. DSX-1 and HDSL signals are connected through wire-wrap pins or the 50-pin shelf connectors relative to each individual slot.

The HTU-C M R contains onboard fuses. If a fuse opens, it supplies a -48 Vdc voltage to the fuse alarm bus and all front panel indicators will turn *off*. These fuses are not field-replaceable.

The 220/E220 HTU-C M R uses a DC-to-DC converter to derive its internal logic and span powering voltages from the -48 Vdc office supply. Span powering voltages meet all requirements of Class A2 voltages as specified by Bellcore GR-1089-CORE.

Revision History

This practice is being reissued to incorporate CLEI code change.

2. INSTALLATION

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

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 of this practice).

The 220/E220 Low Voltage HTU-C M R 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 (SW1), a three-position slide switch (SW2), and a three-position dipswitch pack (SW3) accessible from the faceplate of the unit must be used to manually configure the mode of operation. Manual configuration can be performed after installing the unit into the shelf. Faceplate switch locations are illustrated in **Figure 1**. Option settings for SW1, SW2 and SW3 are detailed in **Tables 2**, **3**, and **4**, respectively.

Table 1. Compliance Codes

Code	Input	Output
Installation Code (IC)	A	–
Telecommunication Code (TC)	–	X
Power Code (PC)	F	C

Table 2. SW1 Rotary Switch Option Settings [1]

Switch	Position	Description
SW1		DSX-1 Line Buildout Selects operation of the line buildout 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 3. SW2 Option Settings

Position	Description
AIS	Upon customer Loss of Signal (DS1) at the terminating end of the HDSL circuit, AIS is generated from the HTU-R toward the network.
LBK	Upon customer Loss of Signal (DS1) at the terminating end of the HDSL circuit, a logical network loopback is initiated at the HTU-R.
CDI [3]	Upon customer Loss of Signal (DS1) at the terminating end of the HDSL circuit, the HTU-R returns DS1 Idle Signal to the network. This signal is also known as Customer Disconnect Indication (CDI).

[3] The CDI is generated by transmitting the framing received from the network while overwriting the payload with a repeating pattern. For applications where the DS1 is Extended Superframe, the data link is overwritten with a Yellow Alarm that is interrupted once every second by a 100-millisecond code burst of 7E HEX).

Table 4. SW3 Option Settings

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

Switch	Function	Description
SW3-1	Latching Loopback	
	T1	**Selects full T1 loopbacks**
	FT1	Enables DDS Latching Loopback operation
SW3-2	Code Select	
	AMI	Alternate Mark Inversion (AMI) is selected
	B8ZS	**B8ZS line code is selected**
SW3-3	Loopback Timeout	
	Enabled	Loopback timeout is enabled, 120 minutes
	Disabled	**Loopback timeout is disabled**

Faceplate Indicators

The HTU-C M R has five faceplate LEDs which indicate operational status. **Table 5** defines these LEDs.

Table 5. 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 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.

Powering Options

Using Jumper P3, illustrated in **Figure 2**, the HTU-C M R can be optioned for two different span powering modes. By strapping P3 for "L" span powering mode, the HTU-C M R will provide span powering -140 Vdc. This mode allows span powering of circuits without HREs or with one HRE.

By strapping P3 for the "H" span powering mode, the HTU-C M R will provide span powering at less than -190 Vdc. This mode allows span powering of circuits with two HREs and an HTU-R.

Framing

The HTU-C M R can be optioned to operate either in Auto Framed or Unframed mode via Jumper P4, illustrated in Figure 2. The default setting is Auto.

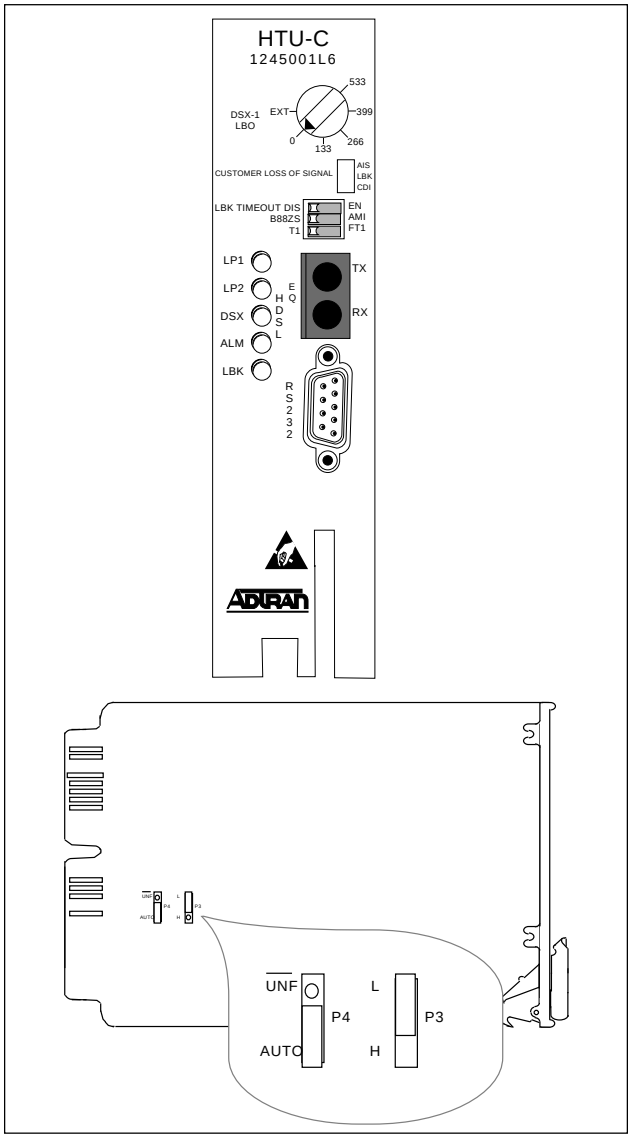

Figure 2. HTU-C M R Switch Arrangement

3. CONNECTIONS

The 220/E220 HTU-C M R 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. Connections to the DSX-1 pins are intended for intra-building wiring only. See **Figure 3** for HTU-C M R edge connector wiring.

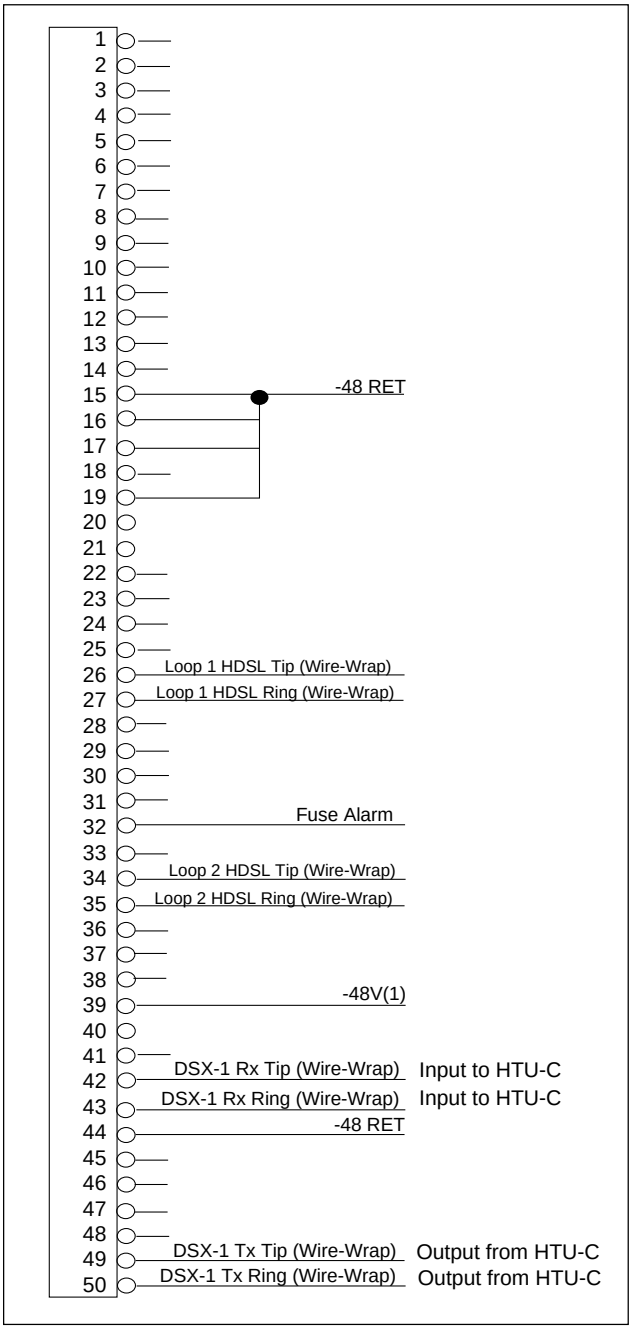

Figure 3. HTU-C M R Edge Connector Wiring

The HTU-C M R is capable of span powering the HTU-R by applying simplex current to the local loop. 10 to 125 *m*A of current is coupled onto the HDSL span to power the HTU-R and HRE when deployed. The span powering voltage can be configured to be either less than -140 volts or -190 volts with Loop 1 providing the negative voltage and Loop 2 the return (see **Figure 4**).

HTU-C M R Alarm Outputs

Pin 32 of the HTU-C M R 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.

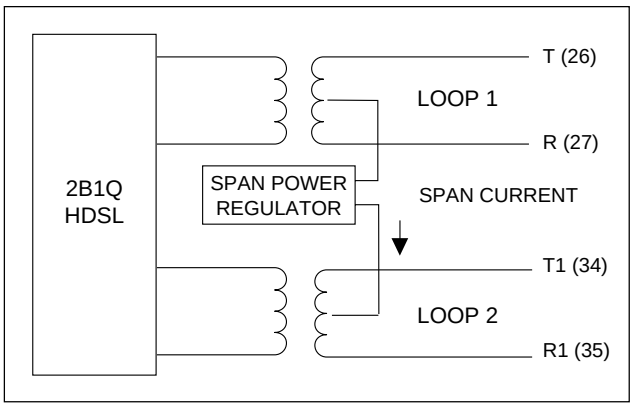

Figure 4. HTU-C M R Span Powering Diagram

HFAC Alarm Outputs

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

The front panel of HTU-C M R 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 5 shows access provided by the DSX EQ bantam jacks.

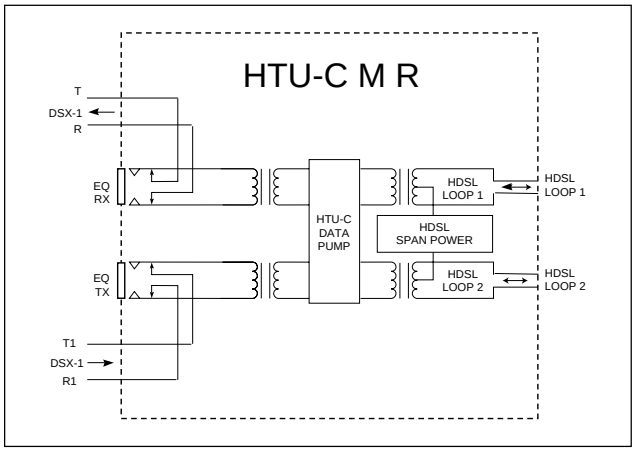

Figure 5. HTU-C Bantam Jack Arrangement

HTU-C M R Loopbacks

The HTU-C M R 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 M R, HTU-R, and HRE loopbacks are described in subsection 5 of this practice

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

This unit contains smartloop technology. That is, if the unit is optioned to operate in an unframed mode, it constantly monitors the DSX-1 for a framing pattern. If a framed loopback control sequence is sent, then the unit will initiate the proper loopback command (see Appendix A of this practice).

The loopback condition imposed in both cases is a logic level loopback at the point within the HTU-C M R where the DSX-1 signal passes into the HDSL modulators. **Figure 6** depicts all of the loopback locations possible with ADTRAN HDSL equipment.

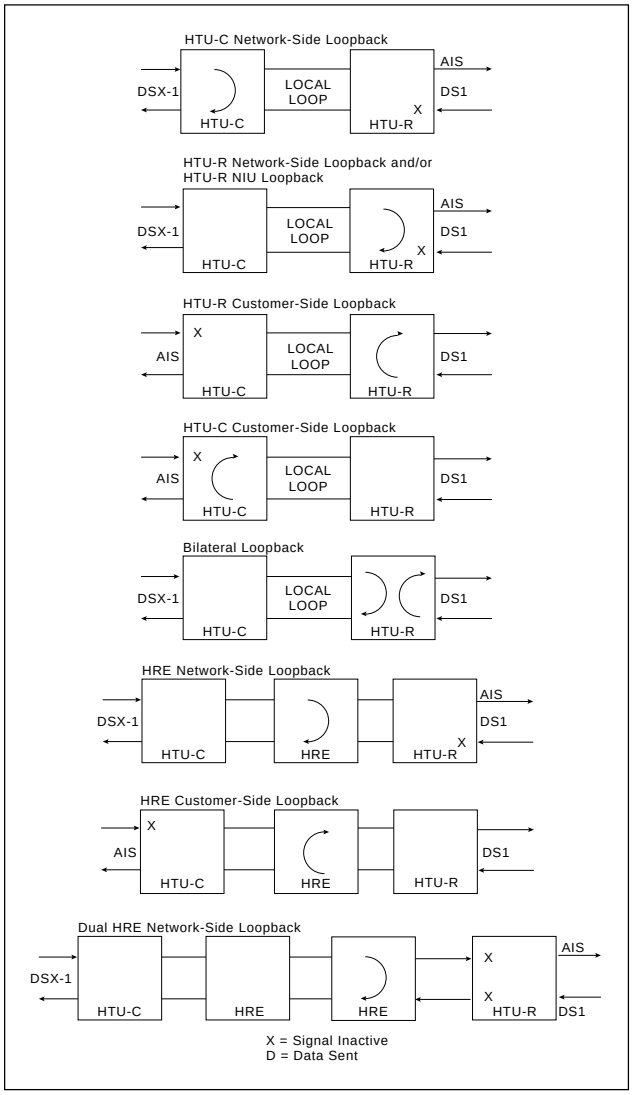

Figure 6. HDSL Loopbacks

In addition to network-side loopbacks, the HTU-C M R provides customer-side loopbacks initiated by using either the terminal control port or inband loop codes (see Appendix A). In this mode, an AIS signal is supplied to the network.

5. CONTROL PORT OPERATION

The HTU-C M R provides a faceplate-mounted DB9 connector that supplies an RS-232 interface for connection to a controlling terminal. The pinout of the DB-9 is illustrated in **Figure 7**.

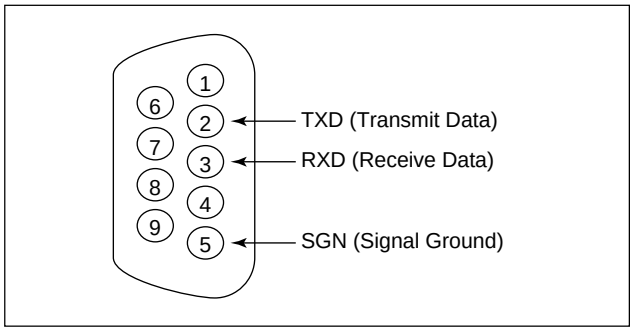

Figure 7. RS-232 (DB-9) Pin Assignments

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 VT100 or compatible.

Operation

For abbreviations used in the screen diagrams, see **Table 6**.

NOTE

If you are using a personal computer (PC) with terminal emulation capability, be sure to disable any power saving programs. Otherwise, communication between the PC and the HDSL unit may be disrupted, resulting in misplaced characters or screen timeouts.

Table 6. 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

The screens illustrated in Figures 8 through 16 are for an HDSL circuit deployed with ADTRAN's Low Voltage HDSL technology. The circuit includes an HTU-C M R, HTU-R, and two HREs. 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 M R to determine the speed of the terminal. Once the speed has been determined, the Introductory Menu will appear, illustrated in **Figure 8**.

From the Introductory Menu, the Main Menu may be selected. The Main Menu provides access to detailed performance and configuration information, illustrated in **Figure 9**, 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
8. Set Time/Date/Circuit ID

The Current System Status screen, illustrated in **Figure 10**, provides quick access to status information for both the HTU-C M R and HTU-R. Type "H" once to view the Current System Status screen for the HRE #1; type "H" a second time to view the Current System Status Screen for HRE #2. See **Figure 10A** for the HRE Current System Status screen.

At each 15-minute interval, the performance information is transferred to the 15-minute performance data register accessed from the Performance History screen. This unit supports the display of performance information in 15-minute increments for the last 24-hour period. At each 24-hour interval, the performance data is transferred into the 24-hour performance data register also accessed using the Performance History screen, illustrated in **Figure 11**.

Type "H" once to view the Performance History screen for HRE #1; type "H" a second time to view the HRE Performance History Screen for HRE #2. See **Figure 11A** for the HRE Performance History Screen.

At the Current System Status screen, type "Z" to reset the current performance registers to zero on the Current System Status and Performance History screens.

Figures 10 and 10A 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 M R and HTU-R.

LOSS ..... Pulse Attenuation Measurement [4]
SYNC ..... HDSL Loop 1 and Loop 2 Sync Status
ES 15M/24H ..... Errored Seconds [5]
SES 15M/24H ... Severely Errored Seconds [5]
UAS 15M/24H .. Unavailable Seconds [5]

[4] 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.

[5] 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
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 ≤ 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

The Provisioning Screen, illustrated in **Figure 12**, is displays the existing provisioning parameters. These parameters cannot be changed via software but are represented on this screen to inform the craftsperson of the provisioned parameters. Options that can be changed via hardware settings are listed with an asterisk (*).

Predicting performance based upon signal quality varies with each loop. Generally, a noise margin of 0 or higher will support a bit error rate (BER) 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

Figure 13 and **Figure 14** illustrate 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.

The Troubleshooting Display, illustrated in **Figure 15**, graphically represents 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 will appear.

The Set Time/Date/Circuit ID menu screen, illustrated in **Figure 16**, provides additional provisioning options. The time parameters are to be entered as military time (for example, 3:15 p.m. should be entered as "15:15:00"). The Circuit ID can be entered as a 25-character string of alphanumeric characters.

```
CIRCUIT ID: Circuit XXXXX                                   02/01/99  11:16:27

                                  ADTRAN
                              901 Explorer Boulevard
                            Huntsville, Alabama 35806-2807

---------------------- For Information or Technical Support -------------------
       Support Hours ( Normal 7am - 7pm CST, Emergency 7 days x 24 hours )
Phone: 800.726.8663 / 888.873.HDSL  Fax: 256.963.6217  Internet: www.adtran.com
-------------------------------------------------------------------------------
HTU-C INFORMATION      SIGNAL QUALITY    HTU-R INFORMATION      SIGNAL QUALITY
-----------------       [X]   9    [X]    -----------------       [X]   9    [X]
S/N :     A1875        L[X]   8   L[X]    S/N :                  L[X]   8   L[X]
CLEI: T1L1B264AA       O[X]   7   O[X]    CLEI:                  O[X]   7   O[X]
MANF: 07/98            O[X]   6   O[X]    MANF:   /              O[X]   6   O[X]
                       P[X]   5   P[X]                           P[X]   5   P[X]
HRE #1 INFORMATION      [X]   4    [X]                            [X]   4    [X]
------------------     1[X]   3   2[X]                           1[X]   3   2[X]
S/N : j810C2360         [X]   2    [X]                            [X]   2    [X]
CLEI: T1R5PPYDAA        [X]   1    [X]                            [X]   1    [X]
MANF: 04/98             [X]   0    [X]                            [X]   0    [X]
                           AT HTU-C                                  AT HTU-R

                        Press “M” to view Main Menu.
```

Figure 8. Introductory Menu Screen

```
CIRCUIT ID: Circuit XXXXX                                   02/01/99  11:19:06

                              ADTRAN HDSL MAIN MENU


                          1) CURRENT SYSTEM STATUS
                          2) PERFORMANCE HISTORY
                          3) ADTRAN INFORMATION
                          4) LOOPBACK OPTIONS
                          5) SELF-TEST
                          6) PROVISIONING
                          7) TROUBLESHOOTING
                          8) SET TIME/DATE/CIRCUIT ID
```

Figure 9. HDSL Main Menu Screen

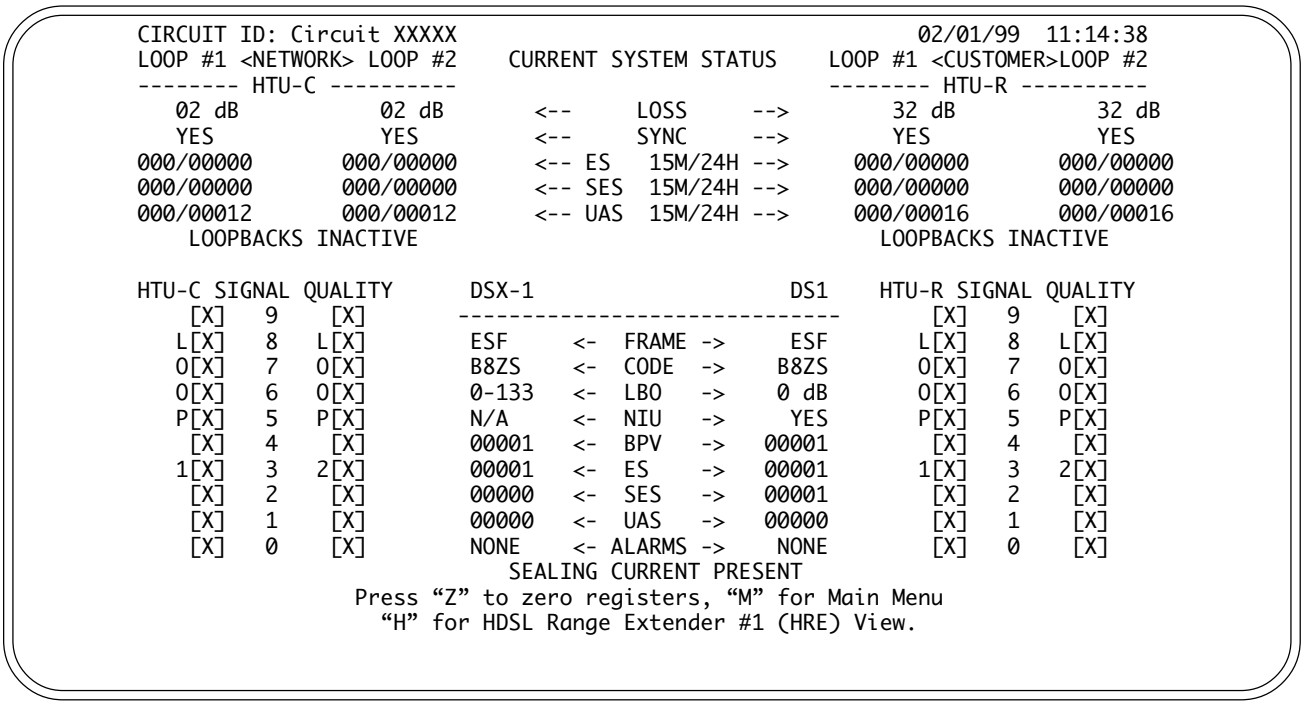

Figure 10. Current System Status Screen

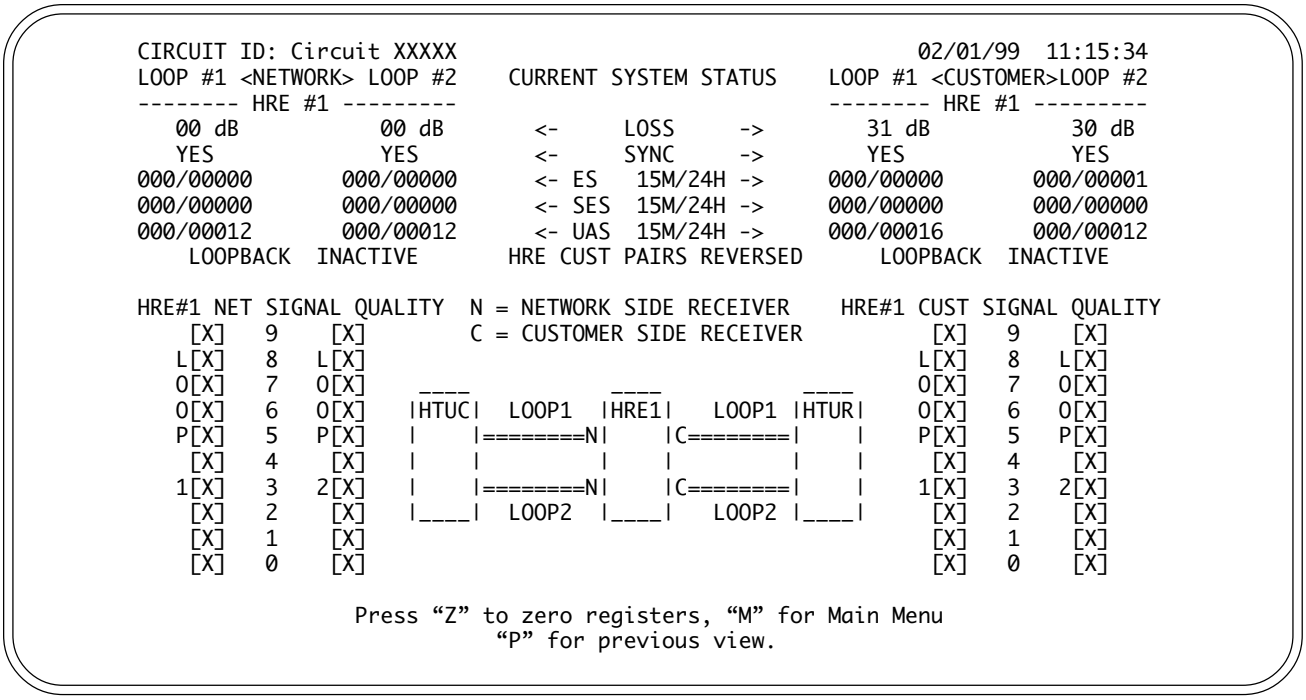

Figure 10A. Current System Status Screen - HRE

```
CIRCUIT ID: Circuit XXXXX                                    02/01/99  11:16:06
     24 HOUR REGISTERS   PERFORMANCE HISTORY        15 MINUTE REGISTERS
        --ES-SES--                                    --ES-SES-----ES-SES--
      00001 00000         <--CURRENT-->        000 000
01/31 ----- -----         <--          -->  11:15 000 000      07:15 --- ---
01/30 ----- -----           |          |    11:00 001 000      07:00 --- ---
01/29 ----- -----           |          |    10:45 --- ---      06:45 --- ---
01/28 ----- -----           |          |    10:30 --- ---      06:30 --- ---
01/27 ----- -----           |PREVIOUS  |    10:15 --- ---      06:15 --- ---
01/26 ----- -----           |          |    10:00 --- ---      06:00 --- ---
01/25 ----- -----         <--          |    09:45 --- ---      05:45 --- ---
                                       |    09:30 --- ---      05:30 --- ---
VIEW 1 : HTU-C DSX-1                   |    09:15 --- ---      05:15 --- ---
                                       |    09:00 --- ---      05:00 --- ---
1-->|H|<--3----|H|-----4-->|H|-->      |    08:45 --- ---      04:45 --- ---
   |T|         |R|         |T|         |    08:30 --- ---      04:30 --- ---
   |U|         |E|         |U|         |    08:15 --- ---      04:15 --- ---
<--|C|<--5-----|1|-----6-->|R|<--2     |    08:00 --- ---      04:00 --- ---
                                       |    07:45 --- ---      03:45 --- ---
Press view number to select view       -->  07:30 --- ---      03:30 --- ---
Press “H” to view HRE #1 history
                                          Press “B” to go back 8 hours

                    Press “M” to return to the Main Menu
```

Figure 11. Performance History Screen

```
CIRCUIT ID: Circuit XXXXX                                      02/01/99  11:25:00
PERFORMANCE HISTORY <VIEW 1 - HRE NETWORK LP1 RECEIVER>
    24 HOUR REGISTERS                          15 MINUTE REGISTERS
   ---ES---SES--                             --ES-SES----------ES-SES-
    00000 00000         <---CURRENT--->       000 000
-1: ----- -----         <--          -->   -1: 000 000    -17: 000 000
-2: ----- -----           |          |     -2: 000 000    -18: 000 000
-3: ----- -----           |          |     -3: 000 000    -19: 000 000
-4: ----- -----           |          |     -4: 000 000    -20: 000 000
-5: ----- -----           |PREVIOUS  |     -5: 000 000    -21: 000 000
-6: ----- -----           |          |     -6: 000 000    -22: 000 000
-7: ----- -----         <--          |     -7: 000 000    -23: 000 000
                                      |     -8: 000 000    -24: 000 000
     VIEW LOCATION DIAGRAM            |     -9: 000 000    -25: 000 000
                                      |    -10: 000 000    -26: 000 000
-->|H|<-----1->|H|-2------>|H|-->     |    -11: 000 000    -27: 000 000
   |T|         |R|         |T|        |    -12: 000 000    -28: 000 000
   |U|         |E|         |U|        |    -13: 000 000    -29: 000 000
<--|C|<-----3->|1|-4------>|R|<--     |    -14: 000 000    -30: 000 000
                                      |    -15: 000 000    -31: 000 000
Press view number to select view.     -->  -16: 000 000    -32: 000 000
Press “H” to view HRE #1 history.          Press “B” to go back 8 hours.

Press “M” to return to the Main Menu.
```

Figure 11A. Performance History Screen - HRE

```
CIRCUIT ID: Circuit XXXXX                                  02/01/99  11:18:17
                              PROVISIONING
 ____________________________________________________
|                                                    |
|       PROVISIONS                    SETTINGS       |
|     ---------------------------------------------  |
|     * DSX-1 LINE BUILDOUT     =   0-133 FEET       |
|       DS1 OUTPUT LEVEL        =   0 dB             |
|     * DSX-1/DS1 LINE CODE     =   B8ZS             |
|       DSX-1 FRAMING           =   ESF              |
|       DS1 FRAMING             =   ESF              |
|     * LOOPBACK TIMEOUT        =   NONE             |
|     * CUSTOMER LOSS RESPONSE  =   CDI              |
|     * LATCHING LOOPBACK MODE  =   T1               |
|                                                    |
|____________________________________________________|

Provisions marked with an asterisk (*) can be changed
using switches on the HTU-C.  DSX-1 and DS1 framing are
set automatically based on the received T1 framing.
DS1 output level can be changed using a strap on the
circuit board of the HTU-R.

        Press “M” to return to the Main Menu
```

Figure 12. Provisioning Screen

```
CIRCUIT ID: Circuit XXXXX                                  02/01/99  11:17:30
                              LOOPBACK OPTIONS
          _____                 _____                 _____
         |HTU-C|               |HRE 1|               |HTU-R|
         |     |      LP1      |     |     LP1       |     |
      --->|-----|<=============>|-----|<=============>|-----|<---
         |     |               |     |               |     |
      NET |     |               |     |               |     | CUST
         |     |      LP2      |     |     LP2       |     |
      <---|-----|<=============>|-----|<=============>|-----|--->
         |     |               |     |               |     |
         |_____|               |_____|               |_____|

           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
           5) LOOPBACK TO NETWORK  AT HRE-1 = INACTIVE
           6) LOOPBACK TO CUSTOMER AT HRE-1 = INACTIVE



      Press corresponding number to toggle loopback option.
              Press “M” to return to the Main Menu
```

Figure 13. Loopback Options Screen

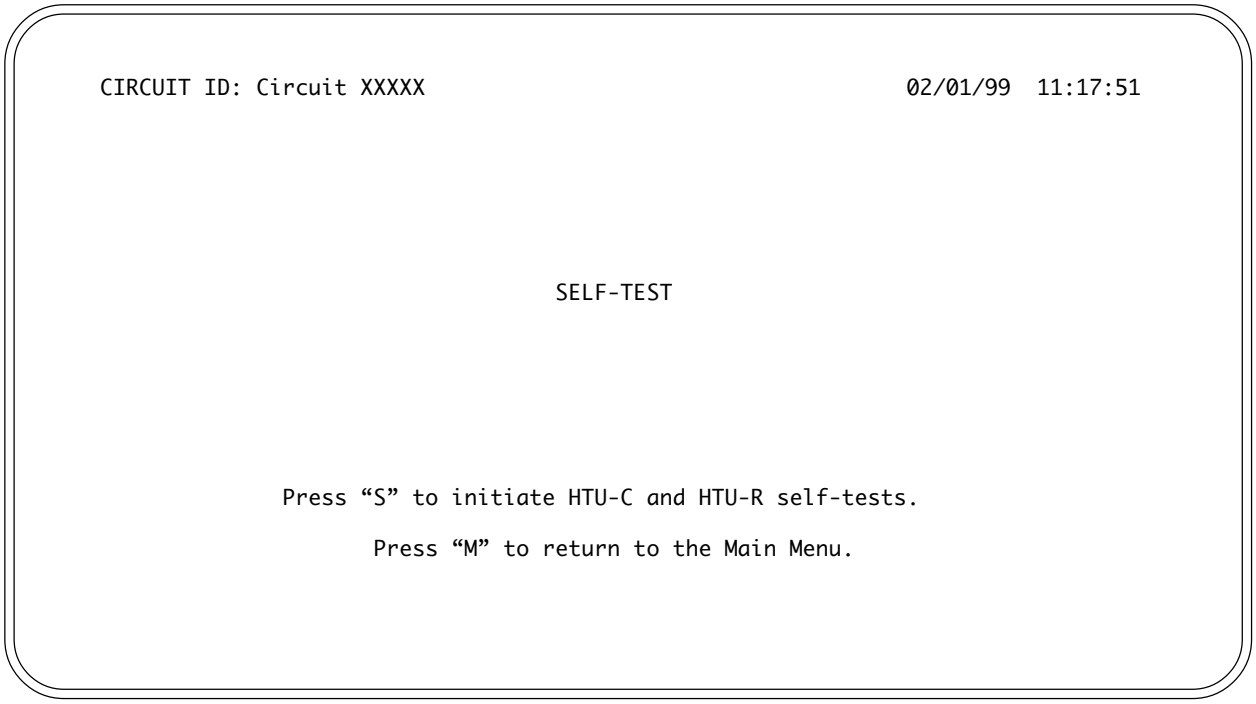

Figure 14. Self-Test Options Screen

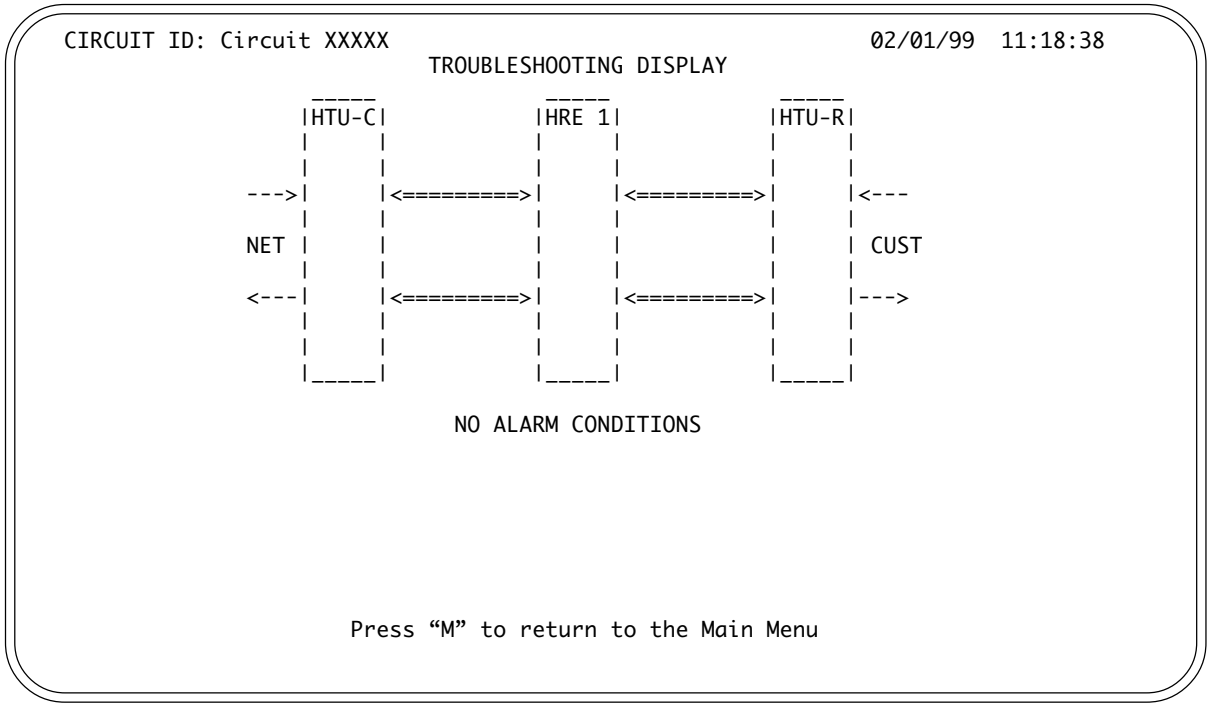

Figure 15. Troubleshooting Display

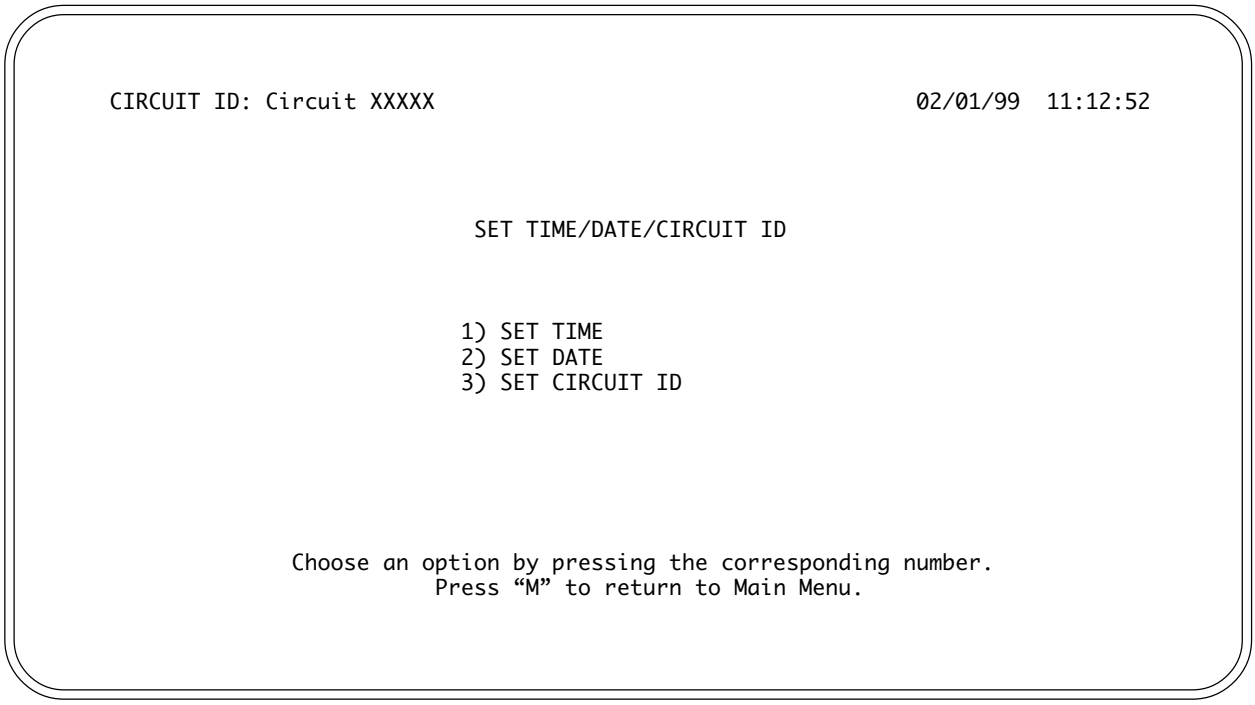

Figure 16. Set Time/Date/Circuit ID Screen

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 17**.

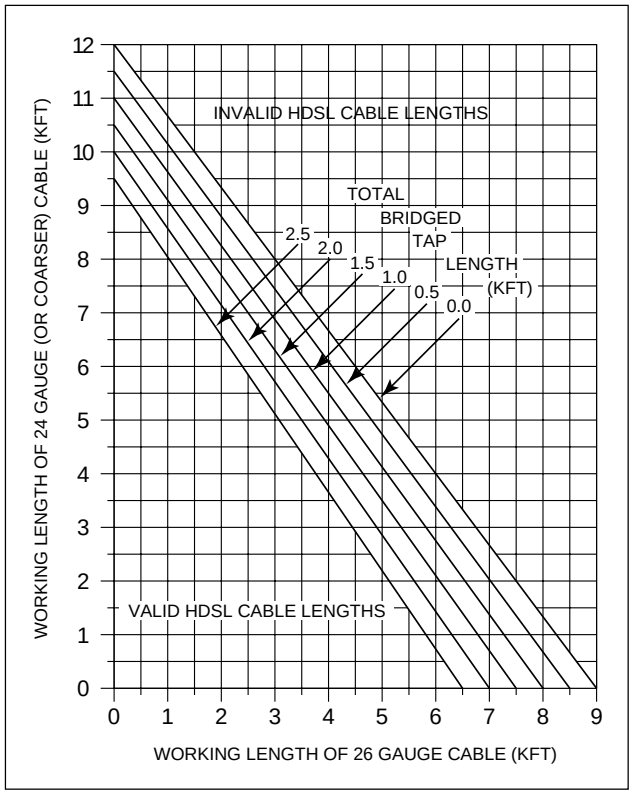

Figure 17. HDSL Deployment Guidelines

Loop loss per Kft for other wire is summarized in **Table 7**.

Table 7. 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	2.083
24	Pulp	3.159	3.257	3.391
22	PIC	2.198	2.255	2.333
22	Pulp	2.483	2.450	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 8**.

Table 8. 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
196,000	35.00
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.

Power Consumption

The ADTRAN 5th Generation Low Voltage E220 HTU-C M R current requirements vary depending on the number of span powered units included in the HDSL circuit. The configuration aid in **Table 9** can be used to determine maximum allowable shelf fill, while maintaining appropriate current drain.

7. TROUBLESHOOTING PROCEDURES

Table 10 is a troubleshooting guide for the 220/E220 HTU-C M R.

8. MAINTENANCE

The ADTRAN 220/E220 HTU-C M R 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.

Table 10. Troubleshooting Guide

Condition
All front panel indicators are *off*.
Solution
1. Verify that -48 Vdc power is properly connected to the shelf. 2. Insert the HTU-C M R 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.

Table 9. Power Consumption Worksheet

Step 1	Enter size of fuse for shelf (Amps)	(A)	_____	Amps
	(Size required for over current protection (i.e., 100%, 75%, 50%)	(B)	_____	Amps
Step 2	Determine the mix of HDSL circuits in shelf.			
	Percentage of circuits with an HTU-R only	(C)	_____	%
	Percentage of circuits with one HRE and an HTU-R	(D)	_____	%
	Percentage of circuits with two HREs and an HTU-R	(E)	_____	%
Step 3	Determine the current draw of the HDSL circuits.			
	Multiply (C) by 0.2 Amps (with no HRE)	(F)	_____	Amps/unit
	Multiply (D) by 0.3 Amps (with one HRE)	(G)	_____	Amps/unit
	Multiply (E) by 0.51 Amps (with two HREs)	(H)	_____	Amps/unit
Step 4	Add (F) through (H) to get total current draw	(I)	_____	Amps/unit
Step 5	Divide (B) by (I) to get the number of units per shelf		_____	Units/shelf*

* If the number of units/shelf is greater than or equal to the shelf's slot availability, full shelf population is allowable.

9. PRODUCT SPECIFICATIONS

Product specifications are detailed in **Table 11**.

10. WARRANTY AND CUSTOMER SERVICE

ADTRAN will replace or repair this product within 10 years from the date of shipment if it does not meet its published specifications or fails while in service (see: ADTRAN *Carrier Networks Equipment Warranty, Repair, and Return Policy and Procedure*, document: 60000087-10).

Contact Customer And Product Service (CAPS) prior to returning equipment to ADTRAN.

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

ADTRAN Sales

Pricing/Availability
(800) 827-0807

ADTRAN Technical Support

Presales Applications/Postsales Technical Assistance
(800) 726-8663

Standard hours: Monday-Friday, 7 a.m. - 7 p.m. CST
Emergency hours: 7 days/week, 24 hours/day

ADTRAN Repair/CAPS

Return for Repair/Upgrade
(256) 963-8722

Repair and Return Address

ADTRAN, Inc.
CAPS Department
901 Explorer Boulevard
Huntsville, Alabama 35806-2807

Table 11. Product 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 ..... Unframed, SF, ESF
Power *Tested with the ADTRAN Low-Voltage HRE (P/N 1244041L2) and the ADTRAN Low Voltage HTU-R (1245021L1).* Total Power ..... -48 Vdc @ 200 *m*A with HTU-R -48 Vdc @ 300 *m*A with HTU-R and HRE -48 Vdc @ 510 *m*A with HTU-R and two HREs HTU-C M R Power Dissipation ..... 5.2 watts with HTU-R 6.2 watts with HRE and HTU-R 8.6 watts with two HREs and HTU-R Span Power ..... -137 or -190 Vdc nominal for voltage and current limit at 125 *m*A +/-5% (Internally Generated) Fusing ..... 1.00 A (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), HRE Loopback
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 (DB-9) Terminal Type ..... VT100 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 M R 1245001L6

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 *insert* or *overwrite* method. The HDSL elements respond to either method. The insert method produces periodic control sequences that are not overwritten by the DS1 framing bits. 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

Control sequences are summarized in **Table A-1** and **Table A-2**.

NOTE

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

Table A-1. HDSL Loopback Control Codes

Type	Source	Code	Name
Abbreviated	(N)	3in7 (1110000)	Loopback data from network toward network in the HTU-R.
	(N)	4in7 (1111000)	Loopback data from network toward network in the HTU-C.
	(N)	2in6 (110000)	Loopback data from network toward network in first HRE.
	(N)	3in6 (111000)	Loopback data from network toward network in second HRE.
	(C)	6in7 (1111110)	Loopback data from customer toward customer in HTU-C.
	(C)	5in7 (1111100)	Loopback data from customer toward customer in HTU-R.
	(C)	4in6 (111100)	Loopback data from customer toward customer in first HRE.
	(C)	5in6 (111110)	Loopback data from customer toward customer in second HRE.
Wescom	(N)	FF1E	Loopback data from network toward network at HTU-C.
	(C)	3F1E	Loopback data from customer toward customer at HTU-C.
	(N)	FF04	Loopback data from network toward network at HRE1.
	(N)	FF06	Loopback data from network toward network at HRE2.
	(C)	3F04	Loopback data from customer toward customer at HRE1.
	(C)	3F06	Loopback data from customer toward customer at HRE2.
	(N)	FF02	Loopback data from network toward network at HTU-R.
	(C)	3F02	Loopback data from customer toward customer at HTU-R.
	(C)	FF48 (ESF-DL)	Loopback data from customer toward customer at HTU-R.
	(N)	1in6 (100000)	Loopback data from network toward network at HTU-R.
	(N)	FF48 (ESF-DL)	Loopback data from network toward network at HTU-R.
	(N/C)	1in3 (100)	Loopdown everything.
	(N/C)	FF24 (ESF-DL)	Loopdown everything.

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 and Response
Arm	11000 (also known as a 2-in-5 pattern) The HTU-R will loop up 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 loop down. The LBK LEDs will turn *off* on all units.
HTU-C Network Loop-up	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 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 Loop-up	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 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.
HRE2 Network Loop-up	C754 (1100 0111 0101 0100) If a second HRE is present, the units have been armed, the HRE will loop up towards the network, 2 seconds of AIS (all 1s) will be sent, 5 seconds of data will pass, and 200 bit errors will be injected into the DSX-1 signal. As long as the pattern continues to be sent, 200 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 200 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 retain 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. If the HTU-C is in network loopback, 231 errors are injected, 20 at a time if the HTU-R is in network loopback, 10 at a time if HRE #1 is in network loopback, and 200 at a time if HRE #2 is in network loopback.
Loopback Timeout Override	D5D6 (1101 0101 1101 0110) If the units are armed and this pattern is sent, the loopback timeout will be disabled. The timeout 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 timeout will remain disabled. When the units are disarmed, the loopback timeout 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 disarmed 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.