

## 3192 HTU-C High-bit-rate Digital Subscriber Line Transceiver Unit for the Central Office Installation and Maintenance

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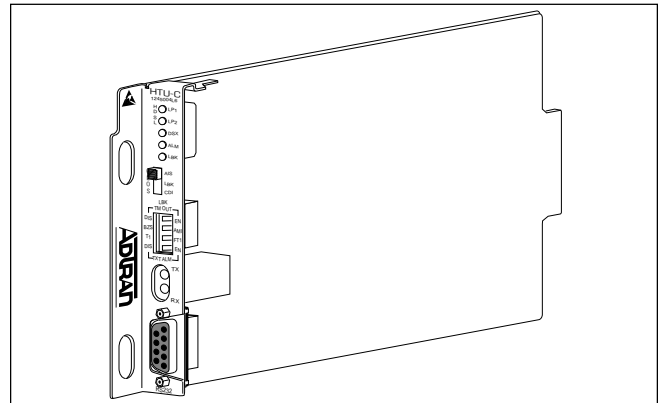
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**Figure 1. ADTRAN 3192 HTU-C**

## 1. GENERAL

The ADTRAN 3192 HDSL Transceiver Unit for the Central Office (HTU-C), P/N 1245004L6, 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 CI Wescom 3192 Office Repeater Bay.

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 HDSL Transceiver Unit for the Remote end (HTU-R) and HDSL Range Extender (HRE) to provide a DS1 service up to 36,000 feet on the local loop.

This HTU-C works with multiple list versions of the HTU-R and 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 SA
1245026L1 .....	Low Voltage HTU-R CI
1245026L4 .....	Low Voltage HTU-R
1245026L5 .....	Low Voltage HTU-R w/PRM
1245045L1 .....	Low Voltage 239 T1 HRE

The HTU-C can be deployed in circuits consisting of one HTU-C and one HTU-R. When deployment requires the HDSL Range Extender (HRE), the HTU-C can be deployed with one Low Voltage HRE (T400, 239, 439, or 819A) and one Low Voltage HTU-R.

**NOTE**

**When deployment requires the use of two HREs, the HTU-C can be deployed with two HREs (P/N 1244041L2, 1245045L1, 1244044L1, or 1244042L1) and one HTU-R (P/N 1245026LX).**

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 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 3192 shelf. DSX-1 and HDSL signals are connected through the wire-wrap pins or the 64-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 3192 HTU-C uses a DC-to-DC converter to derive its internal logic and span powering voltages from the -48 Vdc office supply. The 3192 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 be configured to span power the Low Voltage HTU-R and Low Voltage HRE at either less than -140 Vdc or at -190 Vdc (for applications requiring two HREs and an HTU-R). Span powering voltages meet all requirements of Class A2 voltages as specified by Bellcore GR-1089-CORE.

**Revision History**

This practice has been reissued to incorporate a CLEI code change.

**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 of this practice).

The 3192 HTU-C plugs directly into standard CI Wescom 3192 office repeater shelves. The unit may be plugged into any of the first 28 slots of the 3192 shelf. No installation wiring is required.

One three-position slide switch (SW1), one eight-position rotary switch (SW2) and one four-position Dipswitch pack (SW3) are used to configure the mode of operation. **Figure 2** shows the location of these switches.

A definition of each switch is shown in **Tables 1, 2, and 3**. Configuration changes must be performed by manually selecting each option switch. 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 1. SW1 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 <sup>1</sup> .....	Customer Disconnect Indication. Upon Customer Loss of Signal (DS1) at the terminating end of the HDSL circuit, the HTU-R returns DS1 Idle Signal to the network.

<sup>1</sup> 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 FE (HEX).

**Table 2. Rotary Switch (SW2) Option Settings**

This rotary switch is used to select operation of the line buildout equalizer in series with the DSX-1 output.

Switch	Function	Description
SW2-0	0 .....	Line length from 0-133 feet of ABAM cable
SW2-1	133 .....	Line length from 133-266 feet of ABAM cable
SW2-3	266 .....	Line length from 266-399 feet of ABAM cable
SW2-4	399 .....	Line length from 399-533 feet of ABAM cable
SW2-5	533 .....	Line length from 533-655 feet of ABAM cable

**Table 3. SW3 Option Settings**  
(Default settings are indicated in **bold** typeface.)

Switch	Label	Description
SW3-1	..LBK TM OUT .....	Loopback Timeout enable/disable DIS ..... Disabled EN ..... <b>Enabled: Loopback timeout is 120 minutes.</b>
SW3-2	.....	Manual Code select AMI ..... Alternate Mark Inversion is selected <b>B8ZS ..... B8ZS line code is selected.</b>
SW3-3	.....	Latching Loopback <b>T1 ..... Selects full T1 loopback code sequences.</b> FT1 ..... Enables DDS Latching Loopback operation.
SW3-4	..EXT ALM .....	External Alarm enable/disable. <b>DIS ..... Disabled</b> EN ..... Enabled

**Electrical Code Compliance**

**Table 4** shows Telecommunications Codes for the 3192 HTU-C. The 3192 HTU-C complies with the requirements covered under UL 1459 third edition and is intended to be installed in an enclosure with an Installation Code (IC) of “B” or “E.”

**NOTE**

**This product is intended for installation (in Restricted Access Locations) only. Input current at maximum load is 1 A at -48 Vdc. Maximum output at overcurrent condition is 160 mA at -188 Vdc.**

**Table 4. Telecommunications Codes**

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

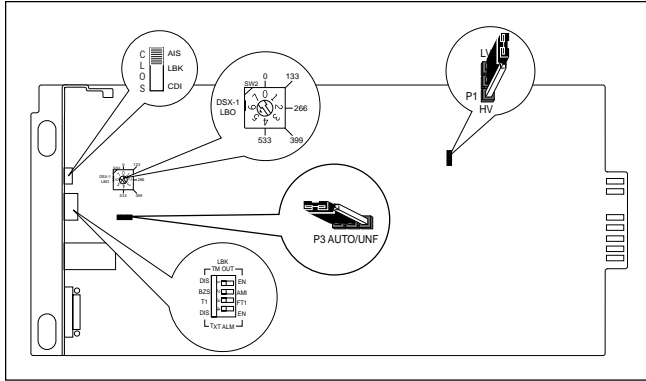
**Powering Options**

Using the jumper labelled “P1,” illustrated in Figure 2, the HTU-C can be optioned for two different span powering modes. By strapping for “LV” span powering mode, the HTU-C will provide span powering at less than -140 Vdc. This mode allows for span powering of circuits without HREs or with one HRE.

By strapping jumper P1 for the “HV” span powering mode, the HTU-C will provide span powering at -190 Vdc. This mode allows span powering of circuits with two HREs and an HTU-R.

## Framing

The HTU-C can be optioned to operate either in Auto Framed or Unframed mode via Jumper P3, illustrated in **Figure 2**. The default setting is Auto.



**Figure 2. HTU-C Switch Arrangement**

## Faceplate Indicators

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

## Shelf Population (based on power requirements)

**Table 6** can be used to determine the maximum allowable shelf population using the 3192 HTU-C.

**Table 5. Front Panel Indicators**

Indicator	Description
	<p><b>LP1</b> ..... Indicates five possible states of the quality of the HDSL signals on loop 1:</p> <ul style="list-style-type: none"> <li>Off ..... No synchronization of HTU-C and HTU-R on loop 1.</li> <li>Red ..... Poor signal quality on loop 1 (<math>&gt; 10^{-7}</math> BER).</li> <li>Yellow ..... Marginal signal quality on loop 1 (<math>\leq 2</math> dB margin above <math>10^{-7}</math> BER).</li> <li>Green ..... Good signal quality on loop 1 (<math>&gt; 2</math> dB margin above <math>10^{-7}</math> BER).</li> <li>Blinking ..... An error detected on either end of loop 1 will cause this LED to blink briefly.</li> </ul> <p><b>LP2</b> ..... Indicates five possible states of the quality of the HDSL signals on loop 2:</p> <ul style="list-style-type: none"> <li>Off ..... No synchronization of HTU-C and HTU-R on loop 2.</li> <li>Red ..... Poor signal quality on loop 2 (<math>&gt; 10^{-7}</math> BER).</li> <li>Yellow ..... Marginal signal quality on loop 2 (<math>\leq 2</math> dB margin above <math>10^{-7}</math> BER).</li> <li>Green ..... Good signal quality on loop 2 (<math>&gt; 2</math> dB margin above <math>10^{-7}</math> BER).</li> <li>Blinking ..... An error detected on either end of loop 2 will cause this LED to blink briefly.</li> </ul> <p><b>DSX</b> ..... Indicates the following three conditions:</p> <ul style="list-style-type: none"> <li>Off ..... Network-side DSX-1 signal is absent or is of a format that does not match the provisioning of the HDSL circuit.</li> <li>Blinking ..... Bipolar Violation (BPV), frame bit error (SF mode), or CRC error (ESF mode) detected at DSX-1 signal.</li> <li>On Solid ..... Network-side DSX-1 signal is present and synchronized.</li> </ul> <p><b>ALM</b> <sup>3</sup> ..... Indicates the following three conditions:</p> <ul style="list-style-type: none"> <li>Off ..... No alarm condition detected.</li> <li>Red ..... Alarm condition detected either locally (HTU-C), or locally and remotely (HTU-C and HTU-R).</li> <li>Yellow ..... Remote alarm condition detected.</li> </ul> <p><b>LBK</b> ..... Indicates three possible loopback states:</p> <ul style="list-style-type: none"> <li>Off ..... Unit is not in loopback or armed state.</li> <li>Blinking ..... The loopback arming sequence has been detected. In this state the unit is armed (ready for loopback) but not in loopback.</li> <li>On Solid ..... Local (HTU-C) loopback is active.</li> </ul>

**Table 6. 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.

**3. CONNECTIONS**

The 3192 HTU-C occupies one card slot in a CI Wescom 3192 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 edge connector wiring.

The HTU-C is capable of span powering the HTU-R by applying simplex current to the local loop. From 10 to 125 mA 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 or -190 volts with Loop 1 providing the negative voltage and Loop 2 the return (see **Figure 4**).

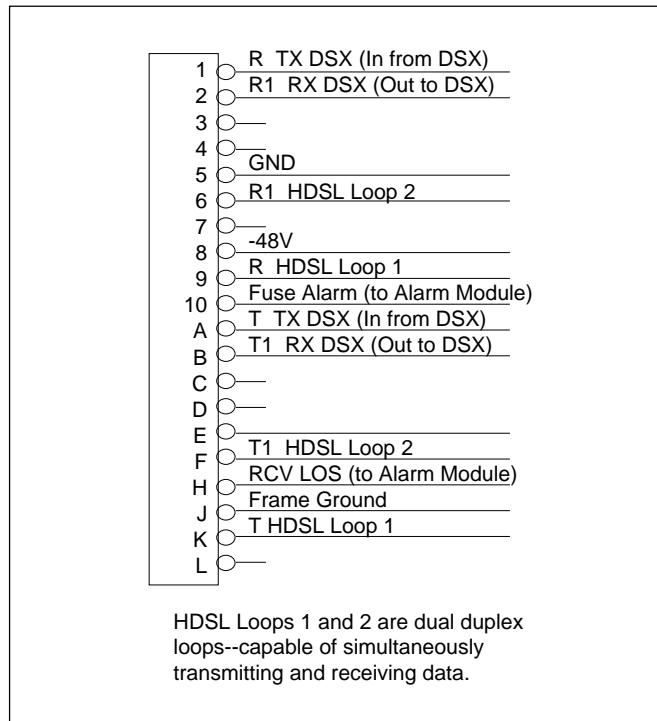
**Alarm Connections**

The following alarm signals are connected to the 3192 Alarm Module.

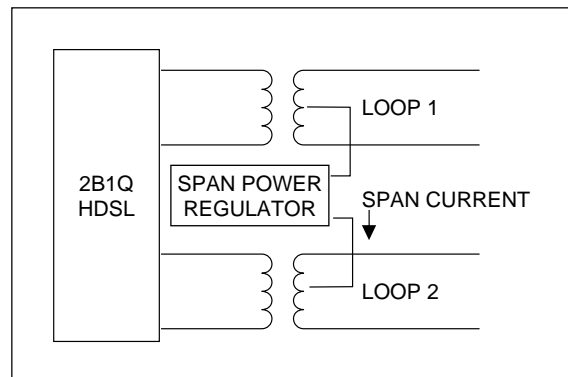
Pin	Label	Function
H	RCV LOS	Loss of Signal alarm <sup>2</sup>
10	FUSE ALARM	Fuse alarm of -48V supply

<sup>2</sup> The LOS alarm will be activated if and only if sealing current has been present on the HDSL loops.

Alarm processing is actually performed by the 3192 Alarm Module. Refer to the 3192 Alarm Module documentation for further information.



**Figure 3. HTU-C Edge Connector Wiring**



**Figure 4 HTU-C Span Powering Diagram**

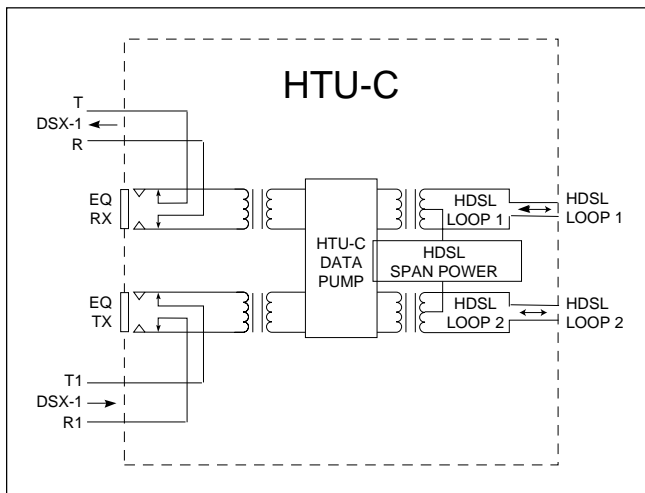
## 4. HDSL SYSTEM TESTING

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. 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 5** shows access provided by the DSX EQ bantam jacks.



**Figure 5. HTU-C Bantam Jack Arrangement**

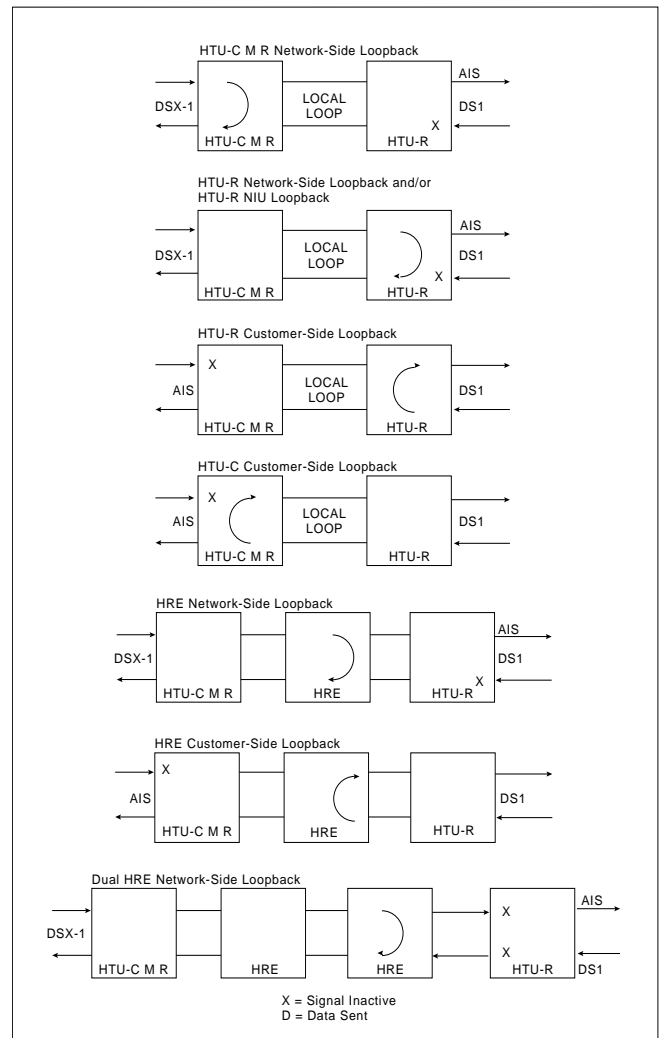
### HTU-C Loopbacks

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 of this practice.

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

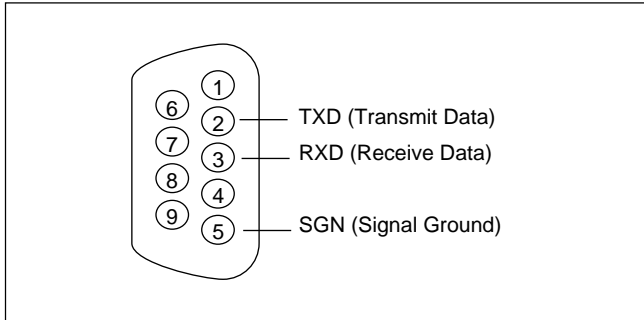
In addition to network-side loopbacks, the HTU-C provides customer-side loopbacks initiated by using either the terminal control port or in-band loopback control code sequences (refer to Appendix A of this practice). In this mode, either an AIS signal or customer data is supplied to the network.



**Figure 6. HDSL Loopbacks**

## 5. CONTROL PORT OPERATION

The HTU-C provides a faceplate-mounted DB-9 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.

### 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.**

### Operation

For abbreviations used in the screen diagrams, see **Table 7**.

**Table 7. 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, 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 8**.

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 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 and HTU-R. Type "H" once to view the HRE Current System Status screen for the HRE #1; type "H" a second time to view the Current System Status screen for HRE #2. The HRE Current System Status screen is illustrated in **Figure 10A**.

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. The HRE Performance History screen is illustrated in **Figure 11A**.

Type the letter "Z" at the Current System Status screen in order to reset the current performance registers to zero on both 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 and HTU-R.

```
LOSS ..... Pulse Attenuation Measurement 3
SYNC ..... HDSL Loop 1 and Loop 2 Sync
              Status
ES 15M/24H .... Errored Seconds 4
SES 15M/24H ... Severely Errored Seconds 4
UAS 15M/24H .. Unavailable Seconds 4
```

<sup>3</sup> 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.

<sup>4</sup> 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 (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
- $0 \leq$  Margin  $\leq 2$  (Yellow) ..... Marginal Loop Quality
- Margin  $> 2$  (Green) ..... Good Loop Quality

The HDSL Loopback and Self-Test Option screens are illustrated in **Figures 12** and **13**. Loopbacks and Self-Test may be evoked or terminated using these screens. A status of current loopback conditions is also provided.

The Provisioning screen, illustrated in **Figure 14**, contains a display of 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 marked with an asterisk (\*).

The Troubleshooting Display, illustrated in **Figure 15**, 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.

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	0[X] 7 0[X]	CLEI:	0[X] 7 0[X]
MANF: 07/98	0[X] 6 0[X]	MANF: /	0[X] 6 0[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

```

CIRCUIT ID: Circuit XXXXX                                02/01/99 11:14:38
LOOP #1 <NETWORK> LOOP #2                                CURRENT SYSTEM STATUS    LOOP #1 <CUSTOMER> LOOP #2
----- HTU-C -----                                     ----- HTU-R -----
  02 dB          02 dB          <-- LOSS          -->          32 dB          32 dB
  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
000/00012      000/00012      <-- UAS  15M/24H -->      000/00016      000/00016
      LOOPBACKS INACTIVE                                     LOOPBACKS INACTIVE

HTU-C SIGNAL QUALITY      DSX-1          DS1          HTU-R SIGNAL QUALITY
[X] 9 [X]                  -----
L[X] 8 L[X]                ESF  <- FRAME ->  ESF
0[X] 7 0[X]                B8ZS <- CODE  ->  B8ZS
0[X] 6 0[X]                0-133 <- LBO  ->  0 dB
P[X] 5 P[X]                N/A   <- NIU  ->  YES
[X] 4 [X]                00001 <- BPV  ->  00001
1[X] 3 2[X]               00001 <- ES   ->  00001
[X] 2 [X]                00000 <- SES  ->  00001
[X] 1 [X]                00000 <- UAS  ->  00000
[X] 0 [X]                NONE  <- ALARMS ->  NONE
      SEALING CURRENT PRESENT
Press "Z" to zero registers, "M" for Main Menu
"H" for HDSL Range Extender #1 (HRE) View.

```

Figure 10. Current System Status Screen

```

CIRCUIT ID: Circuit XXXXX                                02/01/99 11:15:34
LOOP #1 <NETWORK> LOOP #2                                CURRENT SYSTEM STATUS    LOOP #1 <CUSTOMER> LOOP #2
----- HRE #1 -----                                     ----- HRE #1 -----
  00 dB          00 dB          <- LOSS          ->          31 dB          30 dB
  YES            YES            <- SYNC          ->          YES            YES
000/00000      000/00000      <- ES   15M/24H ->      000/00000      000/00001
000/00000      000/00000      <- SES  15M/24H ->      000/00000      000/00000
000/00012      000/00012      <- UAS  15M/24H ->      000/00016      000/00012
      LOOPBACK INACTIVE                                     LOOPBACK INACTIVE
      HRE CUST PAIRS REVERSED

HRE#1 NET SIGNAL QUALITY  N = NETWORK SIDE RECEIVER  HRE#1 CUST SIGNAL QUALITY
[X] 9 [X]                  C = CUSTOMER SIDE RECEIVER
L[X] 8 L[X]
0[X] 7 0[X]
0[X] 6 0[X]
P[X] 5 P[X]
[X] 4 [X]
1[X] 3 2[X]
[X] 2 [X]
[X] 1 [X]
[X] 0 [X]

|HTUC| LOOP1 |HRE1| LOOP1 |HTUR|
|-----N| |C-----|
|-----N| |C-----|
|-----N| |C-----|
|-----N| |C-----|
|-----N| |C-----|
|-----N| |C-----|
|-----N| |C-----|
|-----N| |C-----|
|-----N| |C-----|
|-----N| |C-----|

```

Figure 10A. Current System Status Screen - HRE

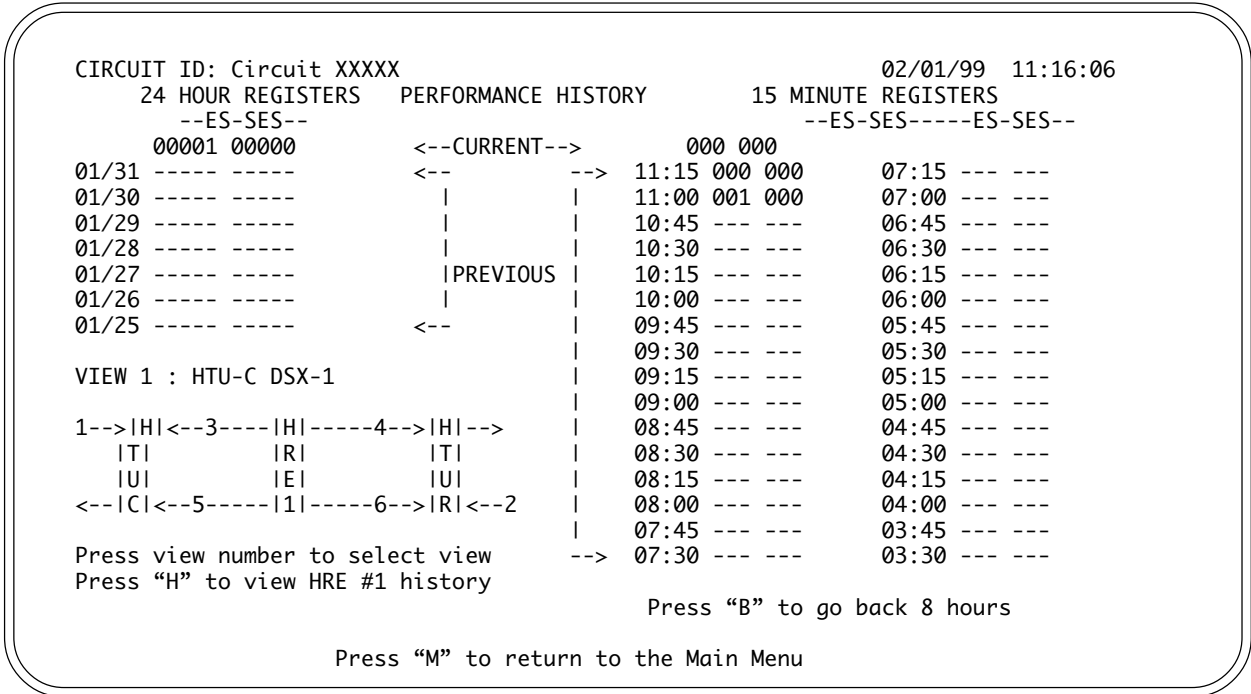


Figure 11. Performance History Screen

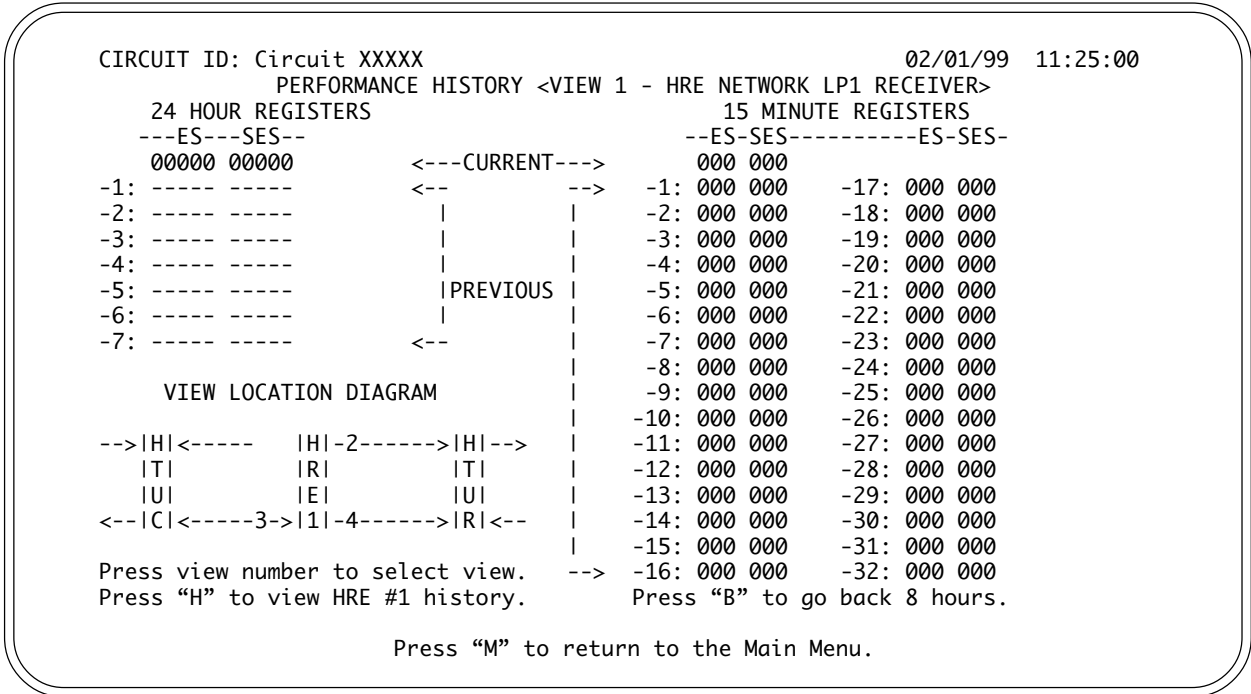
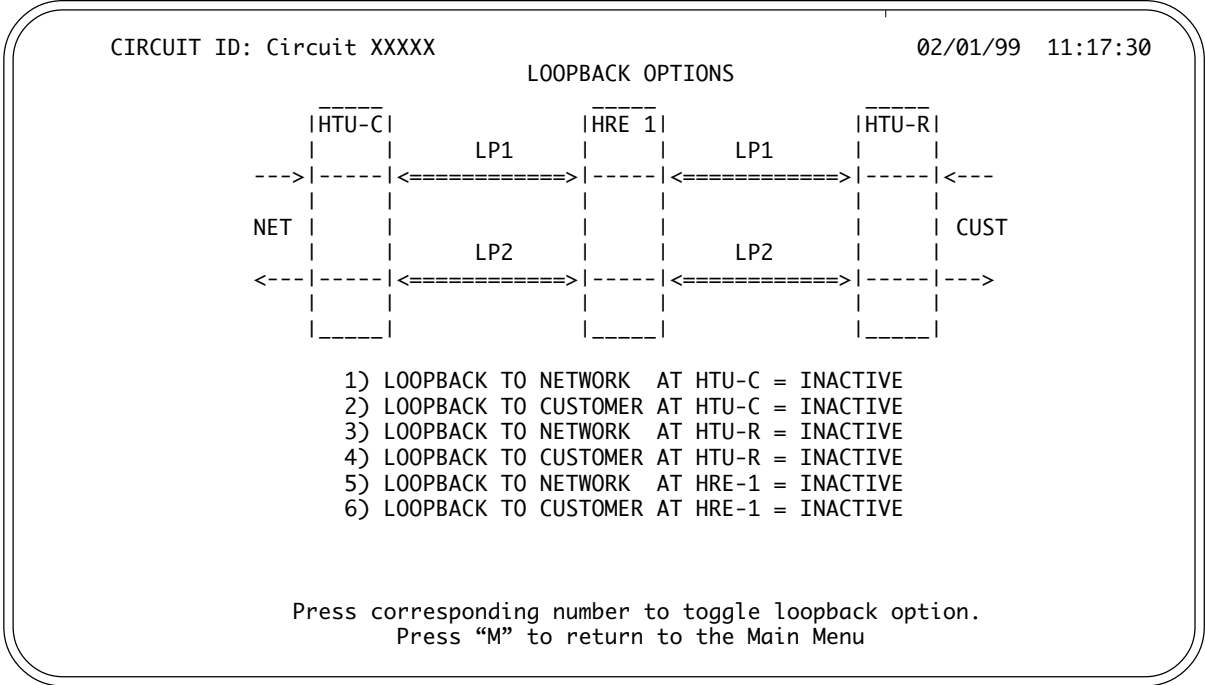
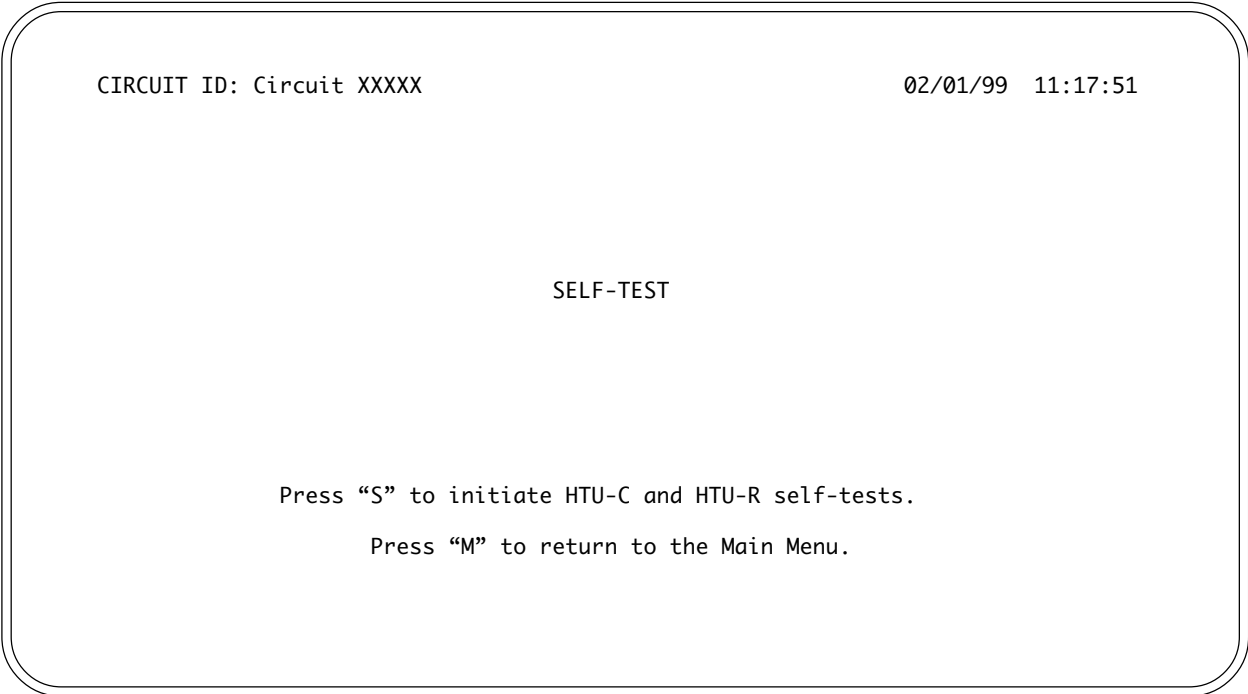


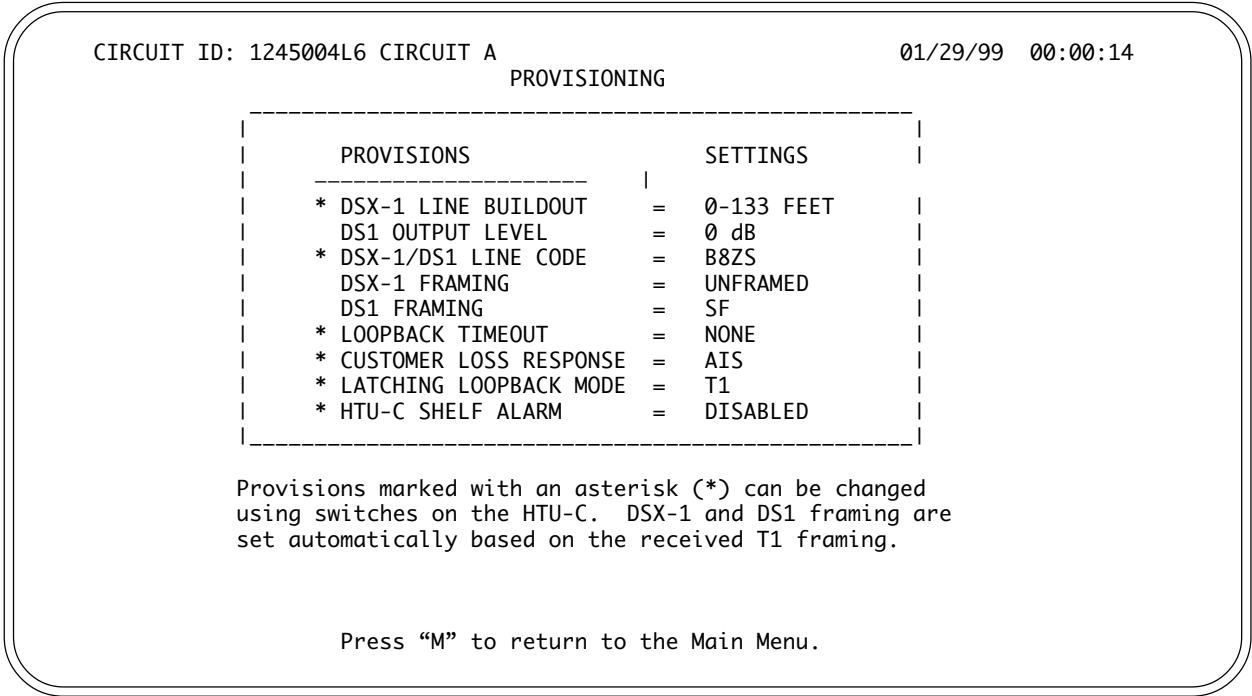
Figure 11A. Performance History Screen - HRE



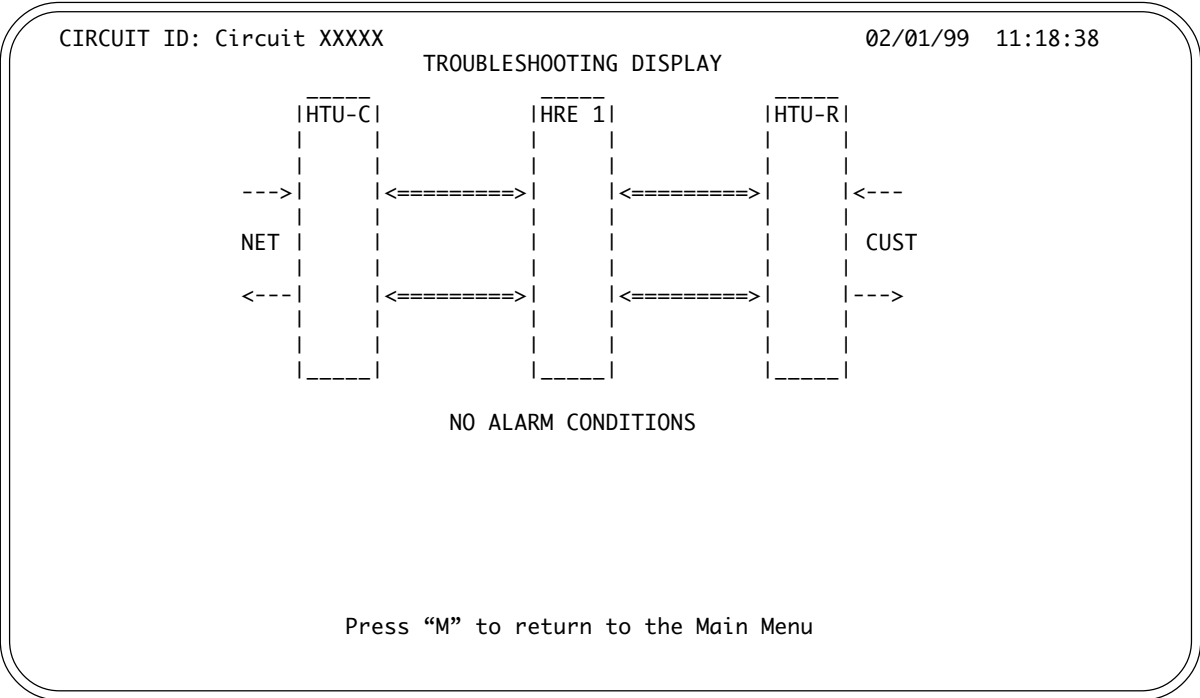
**Figure 12. Loopback Options Screen**



**Figure 13. Self-Test Options Screen**



**Figure 14. Provisioning Screen**



**Figure 15. Troubleshooting Display**

CIRCUIT ID: Circuit XXXXX

02/01/99 11:12:52

SET TIME/DATE/CIRCUIT ID

- 1) SET TIME
- 2) SET DATE
- 3) SET CIRCUIT ID

Choose an option by pressing the corresponding number.  
Press "M" to return to Main Menu.

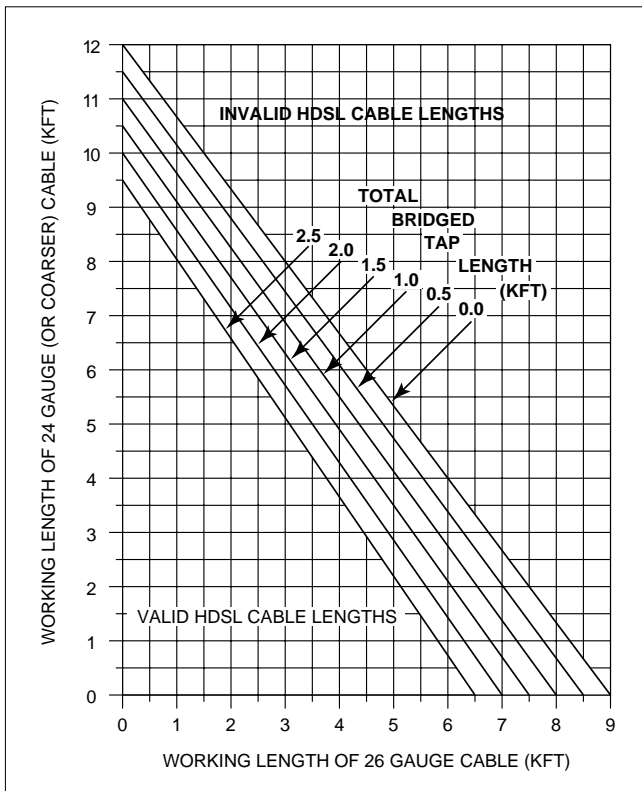
**Figure 16. Set Time/Date/Circuit ID**

## 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 8**.

**Table 8. HDSL Loss Values**  
(200 kHz cable loss in dB/Kft at 135 Ω)

Cable Gauge	Cable Type	Temperature		
		68 <sub>i</sub>	90 <sub>i</sub>	120 <sub>i</sub>
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 9**.

**Table 9. 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 dB<sub>rn</sub>.

An approximation for the maximum level of impulse noise as measured using a 50 kbps filter on an HDSL loop is ≤ 50 dB<sub>rn</sub>.

### 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<sup>-7</sup> BER.**



## 7. TROUBLESHOOTING PROCEDURES

**Table 10** is a troubleshooting guide for the 3192 HTU-C.

**Table 10. Troubleshooting Guide**

Condition	Solution
All front panel indicators are <i>Off</i> .	<ol style="list-style-type: none"><li>1. Verify that -48 Vdc power is properly connected to the shelf.</li><li>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 <i>On</i>.</li><li>3. If Step 1 passes, but Step 2 fails, replace the HTU-C.</li></ol>

## 8. MAINTENANCE

The ADTRAN 3192 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 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/Post-sale 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. HDSL 3192 HTU-C Specifications**

<b>Loop Interface</b>	
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 .....	135 Ω
Return Loss .....	20 dB (40 kHz to 200 kHz)
<b>Network Interface</b>	
<b>4-WIRE DSX-1</b>	
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 .....	Auto (ESF, SF), Unframed
DSX-1 Channelization .....	Channels 1-12 on HDSL Loop 1, Channels 13-24 on HDSL Loop 2
<b>Power</b>	
<i>Tested with the ADTRAN Low-Voltage HRE (P/N 1244041L2) and the ADTRAN Low Voltage HTU-R (1245021L1).</i>	
Total Power .....	-48 Vdc @ 200 mA with HTU-R -48 Vdc @ 300 mA with HTU-R and HRE -48 Vdc @ 510 mA with HTU-R and two HREs
HTU-C Power Dissipation .....	5.2 watts with HTU-R 6.2 watts with HRE and HTU-R 8.6 watts with two HREs and one HTU-R
Span Power .....	-137 V or -190 Vdc nominal for voltage and current limit at 125 mA +/-5% (internally generated)
Fusing .....	1.00 A (not field replaceable)
<b>Clock</b>	
Clock Sources .....	Internal, DSX-1 Derived
Internal Clock Accuracy .....	± 25 ppm (exceeds Stratum 4). Meets T1.101 timing requirements.
<b>Tests</b>	
Diagnostics .....	Self-Test, Local Loopback (HTU-C), Remote Loopback (HTU-R)
<b>Physical</b>	
CI Wescom Office Repeater Shelf-Mounted	
Dimensions .....	4.75" High x .69' Wide x 10.5" Deep
Weight .....	Less than 1 lb.
<b>Environment</b>	
Temperature .....	Operating (Standard): -40° to +70°C      Storage: -40° to +85°C
<b>Control Port</b>	
Interface .....	RS-232 (DB-9)
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
<b>Part Number</b>	
HTU-C 3192 Circuit Pack .....	1245004L6

# 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 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.	

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 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 <i>off</i> 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.