DDM+ HDSL4 Transceiver Unit for the Central Office
Installation and Maintenance Practice

CONTENTS

TABLES

1. GENERAL

The ADTRAN DDM+ HDSL4 Transceiver Unit for the Central Office (DDM+ H4TU-C) is used to deploy an HDSL4 T1 circuit using 4-wire metallic facilities. The unit occupies one slot in a DDM+ chassis. **Figure 1** illustrates the DDM+ H4TU-C (P/N 1223403L2).

Revision History

This is the second release of this document. This release includes the new front panel of the unit.

Description

The DS1 or DSX-1 input signal is supplied from the network. The HDSL4 signals are provided to the local loop. The DDM+ H4TU-C works in conjunction with the H4TU-R and up to two H4Rs to provide a DS1 service on the local loop.

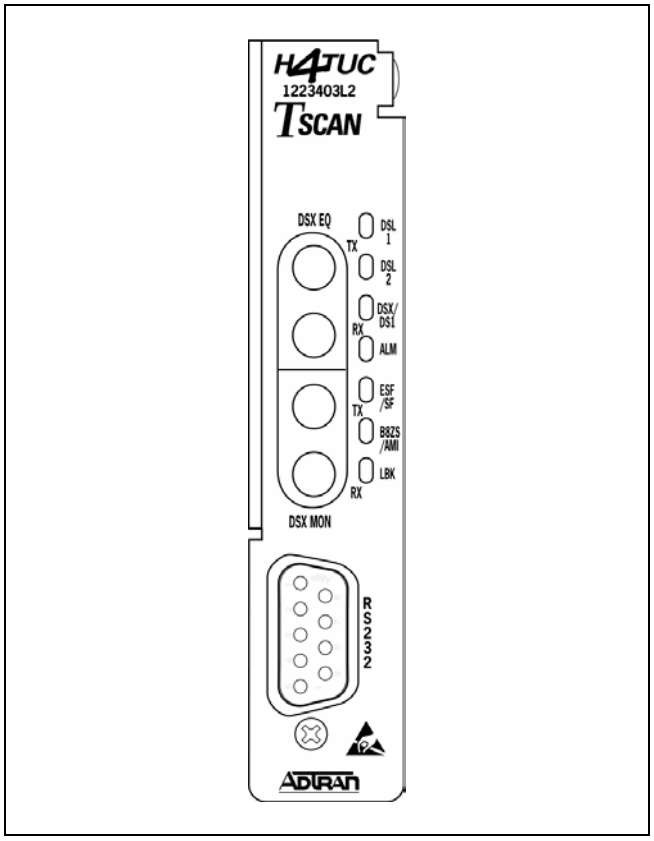


Figure 1. DDM+ H4TU-C

Table 1 shows the list versions of the HDSL4 unit for the remote end (H4TU-R) and the repeater (H4R) that work with the DDM+ H4TU-C.

Table 1. HDSL4 List Versions

Part Number	Description
122x424L1 or L2	T200 H4TU-R, Local Power
122x426L1 or L2	T200 H4TU-R, Span Power
122x441L1	T200 H4R
122x445L1	239 H4R

Note: x = any generic number

The DDM+ H4TU-C can be deployed in circuits consisting of one H4TU-C, one H4TU-R, and up to two H4Rs. System power and alarm bus connections are made through the backplane of the DDM+ chassis.

TScan

The DDM+ H4TU-C is equipped with TScan™, which provides data retrieval and diagnostic capabilities for remote management of DS1 circuits. TScan allows provisioning, performance, and event history information to be retrieved by the test center via the Facility Data Link (FDL). In addition, TScan can be used to determine the nature and location of faults on DS1 trouble circuits. TScan is accessible only through the remote test center.

TScan is a patent-pending, single-ended, diagnostic routine residing on a host server at the central test facility. TScan issues commands and retrieves data via FDL from the H4TU-C. TScan performs the following functions (see **Figure 2**):

- Detection and location of an open, one or both conductors
- Detection and location of a short between Tip and Ring
- Detection and location of a ground fault from either or both conductors
- Detection of foreign voltage
- H4TU-C self diagnostics
- Ability to remotely detect the presence or absence of a ground connection in the remote mount.

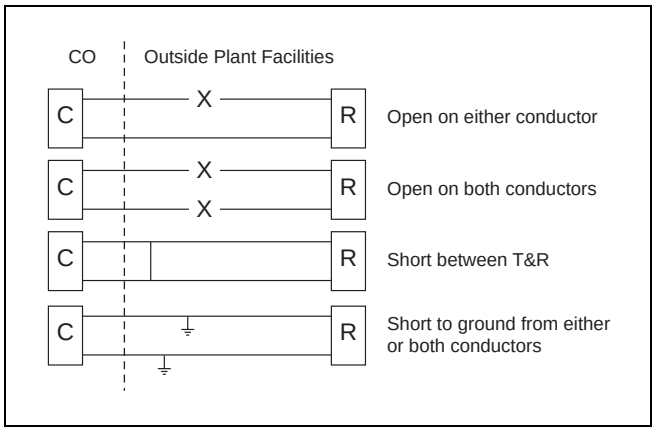


Figure 2. TScan Diagnostics

TScan allows operators to integrate these capabilities across multiple computing platforms with existing operating systems.

NOTE

For implementation of TScan please contact your local ADTRAN sales representative.

Compliance

Table 2 shows the compliance codes for the DDM+ H4TU-C. The DDM+ H4TU-C is to be installed in a restricted access location and in a Type “B” or “E” enclosure only.

WARNING

Up to –200 VDC may be present on telecommunications wiring. The DSX-1 interface is intended for connection to intra-building wiring only. Ensure chassis ground is properly connected.

Table 2. Compliance Codes

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

The DDM+ H4TU-C provides span powering voltage (negative only with respect to ground, –190 VDC nominal, GFI protection < 5 mA) and meets all requirements of Bellcore GR-1089-CORE (Class A2) and ANSI T1.418-2002. This product is NRTL listed to the applicable UL standards.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by ADTRAN could void the user’s authority to operate this equipment.

2. INSTALLATION

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

After unpacking the DDM+ H4TU-C, inspect it for damage. If damage has occurred, file a claim with the carrier, then contact ADTRAN Customer Service. Refer to the *Warranty and Customer Service* section for further information. If possible, keep the original shipping container for returning the DDM+ H4TU-C for repair or for verification of shipping damage.

CAUTION

Electronic modules can be damaged by ESD. When handling modules, wear an antistatic discharge wrist strap to prevent damage to electronic components. Place modules in antistatic packing material when transporting or storing. When working on modules, always place them on an approved antistatic mat that is electrically grounded.

Instructions for Installing the Module

To install the DDM+ H4TU-C, perform the following steps:

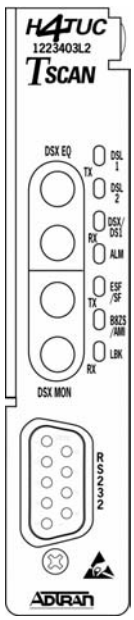
1. If present, remove the Access Module Blank from the appropriate access module slot of the DDM+ chassis.
2. Hold the DDM+ H4TU-C by the front panel while supporting the bottom edge of the module.
3. Align the module edges to fit in the lower and upper guide grooves for the access module slot.
4. Slide the module into the access module slot. Simultaneous thumb pressure at the top and at the bottom of the module will ensure that the module is firmly positioned against the backplane of the chassis.

When the DDM+ H4TU-C first powers up, it runs the power up self-tests. Once the power up self-test is complete, the status LEDs will reflect the true state of the hardware.

Front Panel LEDs

The DDM+ H4TU-C provides LED indicators mounted on the front panel of the unit which provide the status of the HDSL circuit. See **Table 3** for a listing of the front panel LEDs and their indications.

Table 3. Front Panel LED Indicators

Front Panel	Label	Condition	Description
	**DSL 1/ DSL 2**	Green Red	DSL Loop 1 and Loop 2 synchronized, no errors detected, and signal margin ≥ 3 dB. No DSL Loop 1/ Loop 2 synchronized, errors detected, or signal margin < 3 dB.
	DSX/DS1	Green Red	DSX-1 signal is present, and no errors being detected. In framed mode, denotes loss of framing or loss of sync at the DSX/DS1 input; in unframed mode, denotes loss of signal at DSX/DS1 input.
	ALM	Off Red Yellow	No active alarm present. Loss of DSX-1 signal to the unit. Loss of DS1 signal to the remote.
	ESF/SF	Off Yellow Green	Unit is provisioned for unframed data. Unit is provisioned for ESF data. Unit is provisioned for SF data.
	B8ZS/AMI	Yellow Green	Unit is provisioned for B8ZS line code. Unit is provisioned for AMI line code.
	LBK	Off Yellow	Unit is not in loopback. Unit is in loopback (network and/or customer).

3. PROVISIONING

There are no configuration switches for the H4TU-C. Configuration is performed via software. For more information, refer to the *Control Port Operation (HDSL4)* section of this practice.

The provisioning settings can be viewed and manipulated through management access via the front panel RS-232 port. **Table 4** lists the available provisioning options and their factory default settings.

Table 4. Provisioning Options

Provisioning Option	Option Settings	Default Settings
1. DSX-1 Line Build Out	0-133 ft., 133-266 ft., 266-399 ft., 399-533 ft., 533-655 ft.	0 to 133 ft.
2. DSX-1/DS1 Line Code	B8ZS, AMI	B8ZS
3. DSX-1/DS1 Framing	SF, ESF, Unframed, Auto	ESF
4. Force Frame Conversion [1]	Disabled, Enabled	Disabled
5. Smartjack Loopback	Disabled, Enabled	Enabled
6. Loopback Time Out	None, 120 Min	120 Minutes
7. Latching Loopback Mode [2]	T1 (Disabled), FT1 (Enabled)	T1 (Disabled)
8. DS1 Tx Level	0 dB, -7.5 dB, -15 dB	0 dB
9. Span Power	Enabled, Disabled	Enabled
10. Customer Loss Indicator [3]	AIS, Loopback, AIS/CI	AIS/CI
11. Performance Reporting Messages	None, SPRM, NPRM, AUTO (both)	AUTO
12. Loop Attenuation Alarm Threshold	0 (Disabled), 1-99 dB	34 dB
13. SNR Margin Alarm Threshold	0 (Disabled), 1-15 dB	04 dB
14. Remote Provisioning	Disabled, Enabled	Enabled
15. Shelf Alarm	Disabled, Enabled	Enabled

[1] The forced frame format conversion (FFFC) mode sets the H2TU-C to ESF and the H2TU-R to SF. This mode should be used to force SF (DS1 from customer) to ESF (DSX-1 to network) conversion in the absence of network-provided ESF framing.

[2] Latching Loopback Mode

- T1 — When optioned for T1 mode, the unit does not respond to DDS Latching Loopback codes.
- FT1 — DDS Latching Loopback operation is supported. The H4TU-C and any H4R units which are in the HDSL circuit are treated as identical Tandem Data ports and the HTU-R is treated as a different Tandem Data port.

  NOTE: When operating in FT1 mode and during periods of T1 loss of signal, LOS, or T1 AIS from the customer CI, the HDSL system will send in the network direction from the HTU-C a Fractional DS1 idle signal consisting of a repeating 7E (HEX) byte payload within a framed/unframed T1 signal. In addition, when optioned for FT1 mode, the setting for Customer Loss Response is ignored.

[3] Customer Loss Indicator

- AIS — Send AIS to network upon T1 loss of signal or T1 AIS from customer.
- LPBK — HTU-R initiates a network loopback upon T1 loss of signal or T1 AIS from customer.
- AIS/CI — HTU-R sends customer disconnect indication upon loss of signal, loss of synchronization, or receipt of T1 AIS from customer.

  NOTE: The CI 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 milli-second code burst of 7E (HEX).

Span Powering Options

The DDM+ H4TU-C uses a DC-to-DC converter to derive its internal logic and span powering voltages from the –48 VDC office supply. The DDM+ H4TU-C can span power an H4TU-R and up to two H4Rs as listed above.

The DDM+ H4TU-C is default enabled for span powering mode. The DDM+ H4TU-C can be set to have span power disabled when the H4TU-R is locally powered and no H4Rs are on the circuit.

CAUTION

Disabling the span power removes all voltage from the HDSL2 loop. This will result in an absence of sealing current which could have an adverse effect on circuit continuity over an extended period of time.

The DDM+ H4TU-C is capable of span powering the H4TU-R and two H4Rs by applying –190 VDC power to the local loop. The span powering voltage is less than –200 volts with GFI protection to less than 5 mA. The span powering supply is current limited to approximately 150 mA.

Refer to **Figure 3**. The differential span power output voltage is measured between Loop 1 and Loop 2 (reference to Loop 1) and is typically –185 VDC. Loop 1 will show a typical voltage of –6 VDC with respect to ground potential, while the Loop 2 potential is typically –191 VDC with respect to ground potential.

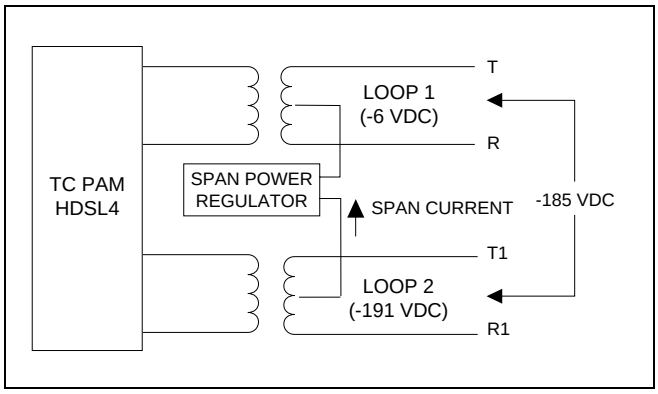


Figure 3. DDM+ H4TU-C Span Powering Diagram

H4TU-C Alarm Outputs

Each H4TU-C has a built-in fuse for the –48 VDC power feed. If this fuse blows, a shelf alarm will be activated. All front panel LED indicators will be *off*. This fuse is not intended to be replaced in the field. A blown fuse indicates the card has malfunctioned and should be replaced.

In order to avoid a shelf alarm, the H4TU-C element can be provisioned to have the external alarms disabled. This will disable all DSX and DS1 alarms.

4. HDSL4 SYSTEM TESTING

The ADTRAN HDSL4 system provides the ability to monitor the status and performance of the DSX-1 signals, DS1 signals, and HDSL4 loop signals. Detailed performance monitoring is provided via management access of the front panel RS-232 port. These features are valuable in troubleshooting and isolating any system level problems that may occur at installation or during operation of the HDSL4 system. The following subsections describe additional testing features.

H4TU-C Bantam Jacks

The front panel of the DDM+ H4TU-C contains metallic splitting bantam jacks for both nonintrusive (monitoring) and intrusive (terminating) DSX-1 test access. See **Figure 4** for details for specific jacks.

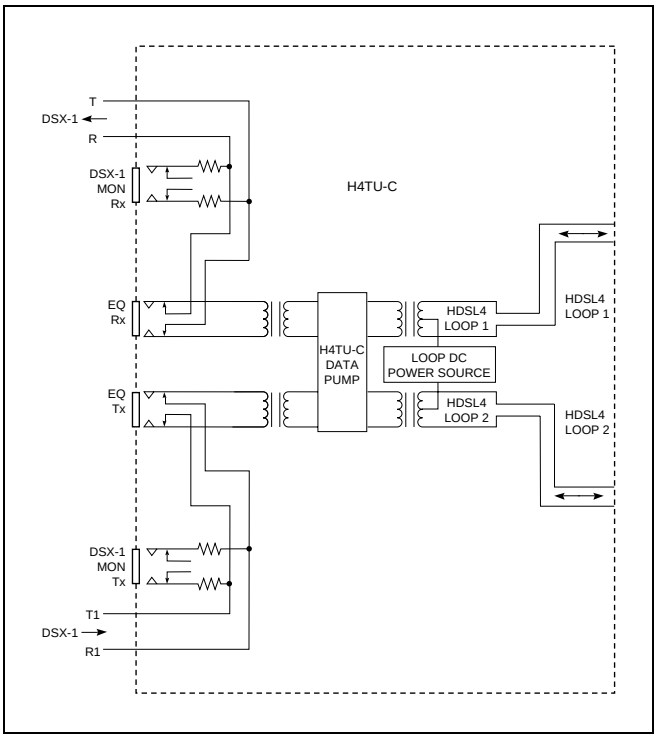


Figure 4. H4TU-C Bantam Jack Arrangement

H4TU-C Loopbacks

The H4TU-C responds to two different loopback activation processes.

- First, loopbacks may be activated using the craft interface of the DDM+ H4TU-C. The Loopbacks and Test screen, which provides for the H4TU-C and H4TU-R loopbacks, is described in the *Control Port Operation (HDSL4)* of this practice.
- Second, the DDM+ H4TU-C responds to the industry standard patterns for HDSL4 loopbacks. A detailed description of these loopback sequences is given in *Appendix A*, *HDSL4 Loopbacks*.

This unit is transparent to framing. If a framed or unframed loopback control sequence is sent, the unit will initiate the proper loopback command (Refer to Table A-1 in *Appendix A*.)

The loopback condition imposed in all cases is a logic level loopback at the point within the DDM+ H4TU-C where the DSX-1 signal passes into the HDSL4 modulators. **Figure 6** depicts all of the loopback locations possible with ADTRAN HDSL4 equipment.

In addition to network-side loopbacks, the DDM+ H4TU-C provides customer-side loopbacks initiated by using either the terminal control port or in-band loop codes. (See *Appendix A*). In this mode, an AIS signal is supplied to the network.

5. CONTROL PORT OPERATION (HDSL4)

The DDM+ H4TU-C provides a front panel-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 5**.

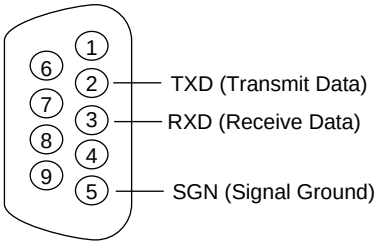


Figure 5. RS-232 (DB-9) Pin Assignments

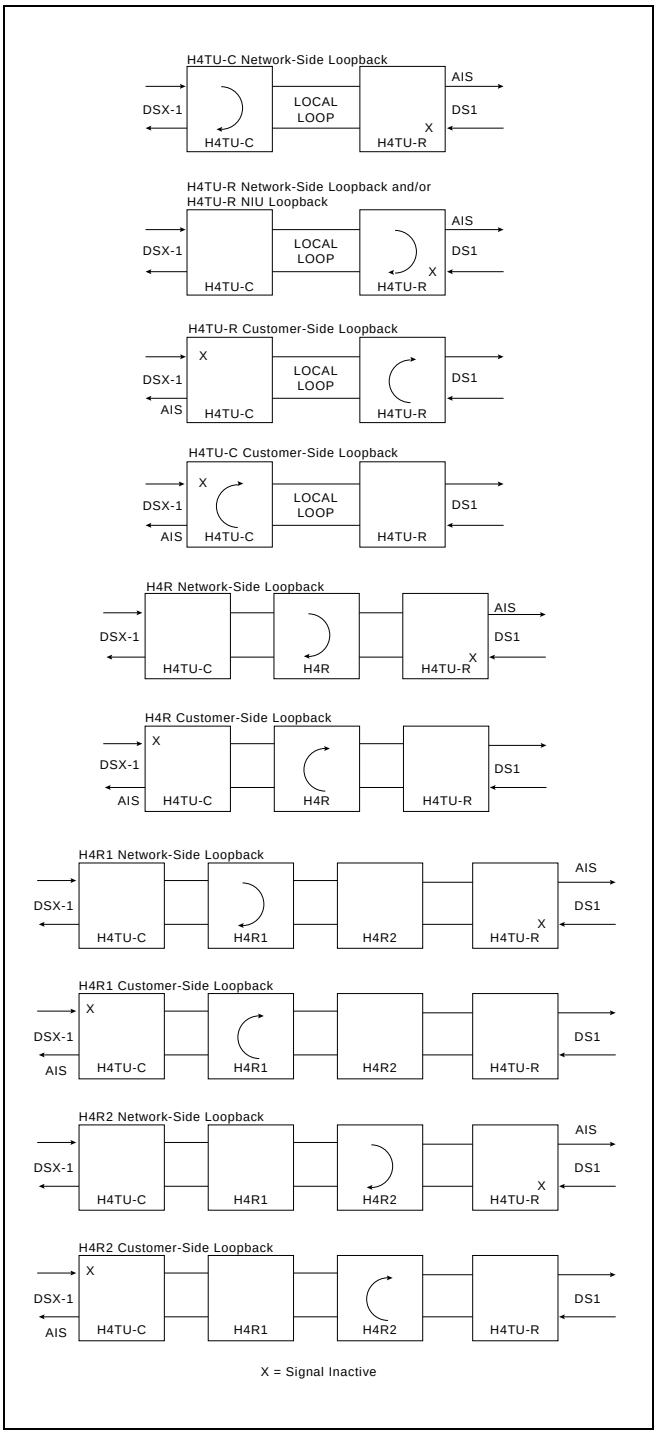


Figure 6. HDSL4 Loopbacks

The terminal interface can operate at data rates of 1.2, 2.4, 4.8, 9.6, and 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.

The DDM+ H4TU-C supports two types of terminal emulation modes. The manual update mode is a dumb terminal mode, allowing easy access to print screen and log file commands. This mode also includes a "3 SPACES TO UPDATE" message on the top of the terminal screen (press the spacebar three times to update the screen.) The real time update mode enables all screen highlighting and cursor placement. Print screen and log file commands are not available in this mode. The default terminal mode is real time update mode.

NOTE

Pressing CTRL+T while on any screen will toggle between manual and real time terminal modes.

NOTE

Pressing ESC while on any screen will go back to the previous screen.

NOTE

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 HDSL4 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 or the occurrence of screen time outs. These symptoms are not disruptive to the operation of the circuit and are avoidable if the power saving options are disabled or removed.

Operation

The screens illustrated in the following section apply to an HDSL4 circuit deployed with the ADTRAN HDSL4 technology. The circuit includes an H4TU-C, up to two H4Rs and an H4TU-R. Other configurations are possible (such as use of another vendor's equipment) and their displays will vary slightly from those shown in this section.

For abbreviations used in the screen diagrams, see **Table 5**.

Table 5. Screen Abbreviations

Abbreviation	Definition
SF	Superframe Format
ESF	Extended Superframe Format
B8ZS	Bipolar with 8 Zero Substitution
AMI	Alternate Mark Inversion
LBO	Line Build Out
BPV	Bipolar Violation
NIU	T1 Network Interface Unit
S/N	Serial Number
15M	15-Minute Period
24H	24-Hour Period

A terminal session is initiated by entering multiple spacebar characters which are used by the H4TU-R to determine the speed of the terminal. Once the speed has been determined, an HDSL4 Main Menu is presented as illustrated in **Figure 7** on the next page.

This HDSL4 Main Menu provides access to detailed performance and configuration information. The Operation, Administration, Maintenance, and Provisioning (OAM&P) screens are available as listed on the HDSL4Main Menu (**Figure 7**). To access a particular menu item, press the number associated with that item, and press ENTER.

The HDSL4 Unit Information screen (**Figure 8**) provides detailed product information on each component in the HDSL4 circuit. This screen also displays contact information for ADTRAN Technical Support, Internet site, and address.

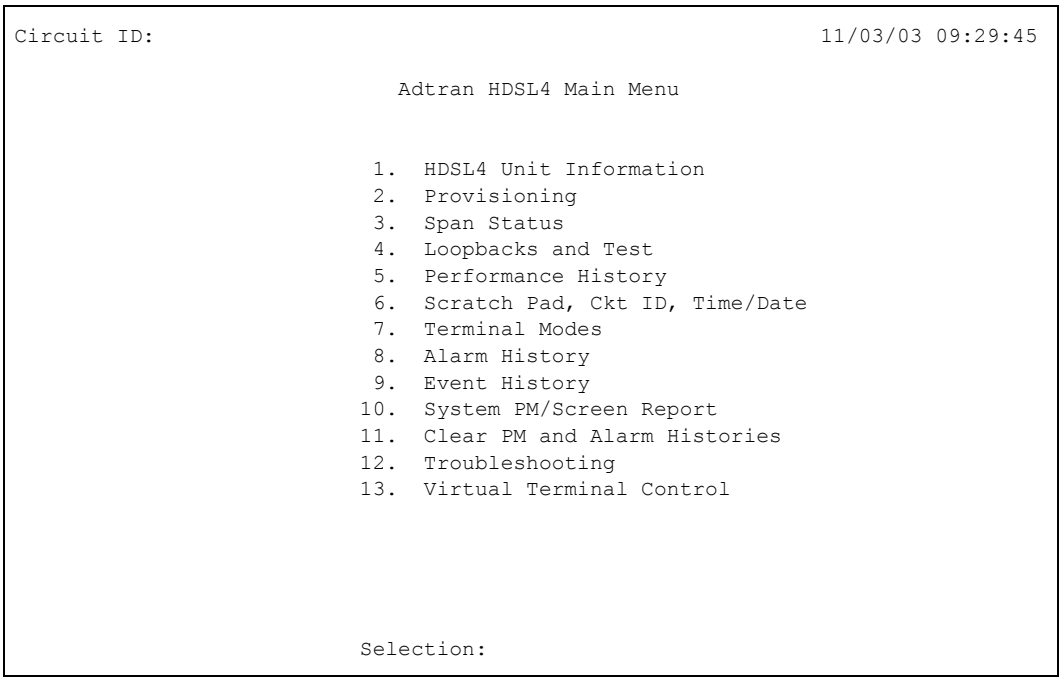


Figure 7. HDSL4 Main Menu

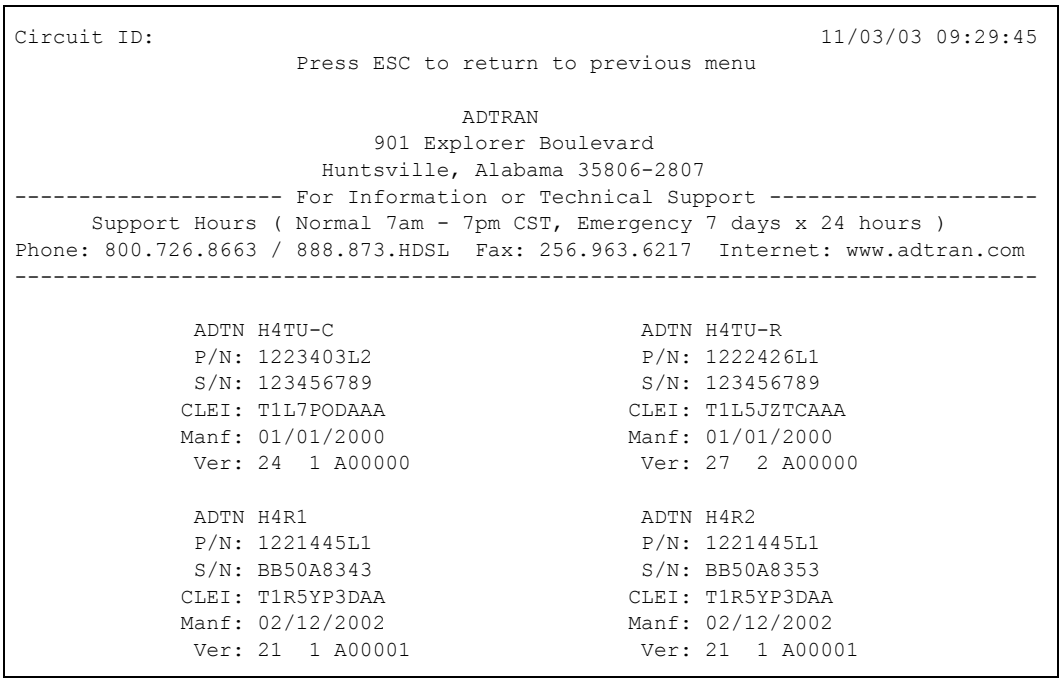


Figure 8. Unit Information Screen

The Provisioning menu (**Figure 9**) displays current provisioning settings for the HDSL4 circuit. Options that can be changed from this screen are labeled with a number (for example, "1" for DSX-1 Line Build Out). To change a particular option setting, select the appropriate number, and a new menu will appear with a list of the available settings.

The options shown in Table 4 are available when the circuit is terminating using an ADTRAN H4TU-R (P/N 1223426L2). Some settings may differ when using different H4TU-Rs.

The Span Status Screen (**Figure 10**) provides quick access to status information for each HDSL4 receiver in the circuit.

```
Circuit ID:                                              11/03/03 09:29:45
                    Press ESC to return to previous menu


                              Provisioning

                    1.  DSX-1 Line Buildout     =  0-133 ft
                    2.  DSX-1/DS1 Line Code     =  B8ZS
                    3.  DSX-1/DS1 Framing       =  ESF
                    4.  Forced Frame Conversion =  Disabled
                    5.  Smartjack Loopback      =  Enabled
                    6.  Loopback Timeout        =  120 Min
                    7.  Latching Loopback Mode  =  T1 (Disabled)
                    8.  DS1 TX Level            =  0 dB
                    9.  Span Power              =  Enabled
                   10.  Customer Loss Indicator =  AIS/CI
                   11.  PRM Setting             =  AUTO
                   12.  Loop Atten Alarm Thres  =  34dB
                   13.  SNR Margin Alarm Thres  =  04dB
                   14.  Remote Provisioning     =  Enabled
                   15.  Shelf Alarm             =  Enabled
                    D.  Restore Factory Defaults

                          Selection:
```

Figure 9. Provisioning Menu

```
CIRCUIT ID:ABC123                                        11/03/03 09:29:45
                    Press ESC to return to previous menu

                              Span Status Screen


      _______         _______         _______                   _______
NET  |       |       |       |       |       |                 |       |  CUST
     |       |       |       |       |       |                 |       |
----->|       |-------|       |-------|       |-----------------|       |----->
     |       |       |       |       |       |                 |       |
     |       |       |       |       |       |                 |       |
<-----|       |-------|       |-------|       |-----------------|       |<-----
     |       |       |       |       |       |                 |       |
DSX-1|_______|       |_______|       |_______|                 |_______|   DS1
      H4TUC           H4R 1           H4R 2                     H4TUR


                                  1.  View Detailed Status


                                Selection:
```

Figure 10. Span Status Screen

The Detailed Status Screen (**Figure 11**), accessed from the Span Status menu displays the HDSL4 status for each receiver point.

The Loopbacks and Test Commands menu (**Figure 12**) provides the user with the ability to invoke or terminate all available HDSL4 loopbacks.

Each HDSL4 circuit component can be looped toward the network or customer from this screen. Unit self tests can also be initiated from this screen.

```
CIRCUIT ID:ABC123                                          11/03/03 09:29:45
                      Press ESC to return to previous menu

                            Detailed Status Screen

                   LOOP 1                          LOOP 2
               MARGIN       ATTEN              MARGIN       ATTEN
Interface   (CUR/MIN/MAX) (CUR/MAX)         (CUR/MIN/MAX) (CUR/MAX)
---------   ------------- ---------         ------------- ---------
H4TUC         17/00/17      00/00             17/00/17      00/00
H4R1 NETW     17/00/17      00/00             17/13/17      00/00
H4R1 CUST     17/17/17      00/00             17/00/17      00/00
H4R2 NETW     17/00/17      00/00             17/13/17      00/00
H4R2 CUST     17/17/17      00/00             17/00/17      00/00
H4TUR         17/00/17      00/00             17/00/17      00/00




                                    1. Reset Min/Max
                                    2. View Performance History
                                    Selection:
```

Figure 11. Detailed Status Screen

```
CIRCUIT ID:ABC123                                          11/03/03 09:29:45
                      Press ESC to return to previous menu

                           Loopbacks and Test Commands


      ______         ______         ______                       ______
NET  |      |       |      |       |      |                     |      |  CUST
     |      |       |      |       |      |                     |      |
----->|      |-------|      |-------|      |---------------------|      |----->
     |      |       |      |       |      |                     |      |
     |      |       |      |       |      |                     |      |
<-----|      |-------|      |-------|      |---------------------|      |<-----
     |      |       |      |       |      |                     |      |
DSX-1|______|       |______|       |______|                     |______|   DS1
      H4TUC          H4R 1          H4R 2                        H4TUR

        1.  Run Self Tests                    7.  H4R1  Loopup  Cust
        2.  H4TU-C  Loopup  Net               8.  H4R1  Loopup  Net
        3.  H4TU-C  Loopup  Cust              9.  H4R2  Loopup  Cust
        4.  H4TU-R  Loopup  Net
        5.  H4TU-R  Loopup  Cust
        6.  H4R1  Loopup  Net

                           Selection:
```

Figure 12. Loopbacks and Test Commands Menu

The Performance History screens (**Figure 13** and **Figure 14**) are used to select and display the historical HDSL4 and T1 performance data in several different registers. At each 15-minute interval, the performance information is transferred to the 15-minute performance data register.

This unit stores performance data in 15-minute increments for the previous 24-hour period. At each 24-hour interval, the performance data is transferred into the 24-hour performance data registers. This unit stores up to 31 days of 24-hour interval data.

```
CIRCUIT ID:ABC123                                          11/03/03 09:29:45
                    Press ESC to return to previous menu

          Menu                15 Minute H4TUC DSX-1 Performance Data

     1.  Definitions              ES-L  SES-L LOSS-L CV-L
     2.  Reset Data               000   000   000    00000
     3.  15 Min Data        14:15 000   000   000    00000
     4.  60 Min Data        14:00 000   000   000    00000
     5.  24 Hr Data         13:45 000   000   000    00000
     6.  Line Data          13:30 000   000   000    00000
     7.  Path Data          13:15 000   000   000    00000
     8.  H4TUC DSX-1        13:00 000   000   000    00000
     9.  H4TUR LOOP         12:45 000   000   000    00000
    10.  H4TUR LOOP         12:30 000   000   000    00000
    11.  H4TUR DS1
    12.  H4R #1 NETW
    13.  H4R #1 CUST
    14.  H4R #2 NETW
    15.  H4R #2 CUST
                          | C |     |#1 |     |#2 |               | R |
                       -8->|   |-----|   |-----|   |---------------|   |--->
                           |   |9  12|   |13 14|   |15           10|   |
                          <---|   |-----|   |-----|   |---------------|   |<-11
                           |___|     |___|     |___|               |___|
                          Selection:
```

Figure 13. 15-Minute Performance Data Screen

```
CIRCUIT ID:ABC123                                          11/03/03 09:29:45
                    Press ESC to return to previous menu

          Menu                24 Hour H4TUC LOOP Performance Data
                                   LOOP 1            LOOP 2
     1.  Definitions           ES-L  SES-L UAS-L ES-L  SES-L UAS-L
     2.  Reset Data            00000 00000 00000 00000 00000 00000
     3.  15 Min Data      10/17 ----- ----- ----- ----- ----- -----
     4.  60 Min Data      10/16 ----- ----- ----- ----- ----- -----
     5.  24 Hr Data       10/15 ----- ----- ----- ----- ----- -----
     6.  Line Data        10/14 ----- ----- ----- ----- ----- -----
     7.  Path Data        10/13 ----- ----- ----- ----- ----- -----
     8.  H4TUC DSX-1      10/12 ----- ----- ----- ----- ----- -----
     9.  H4TUC LOOP       10/11 ----- ----- ----- ----- ----- -----
    10.  H4TUR LOOP
    11.  H4TUR DS1
    12.  H4R #1 CUST
    13.  H4R #1 CUS
    14.  H4R #2 NETW
    15.  H4R #2 CUST
                          | C |     |#1 |     |#2 |               | R |
                       -8->|   |-----|   |-----|   |---------------|   |--->
                           |   |9  12|   |13 14|   |15           10|   |
                          <---|   |-----|   |-----|   |---------------|   |<-11
                           |___|     |___|     |___|               |___|
                          Selection:
```

Figure 14. 24-Hour Performance Data Screen

Abbreviations used in the Performance History screens are defined in Performance Data Definitions screens, as in **Figure 15** and **Figure 16**.

Figure 15 shows the Line related definitions, and Figure 16 shows the Path related definitions.

```
Circuit ID:                                                  11/03/03 09:29:45


                          Performance Data Definitions

H4TUC, H4TUR, and H4R LOOP Related:     HDSL4 Framing
  ES-L    Errored Seconds                 CRC>=1 or LOSW>=1
  SES-L   Severely Errored Seconds        CRC>=50 or LOSW>=1
  UAS-L   Unavailable Seconds             >10 cont. SES-Ls

DS1 and DSX-1 Line Related:             Superframe and Extended Superframe
  ES-L    Errored Seconds                 (BPV+EXZ)>=1 or LOS>= 1
  SES-L   Severely Errored Seconds        (BPV+EXZ)>=1544 or LOS>=1
  LOSS-L  Loss of Signal Seconds          LOS>= 1
  PDVS-L  Pulse Density Violation Secs    EXZ>=1; >7 zeros if B8ZS, >15 if AMI
  B8ZS-L  B8ZS Seconds                    B8ZS coded signal received
  CV-L    Code Violation Count            (BPV+EXZ) count

NOTE: Reverse video indicates invalid data due to a terminal restart (or power
      cycle), a data register reset, or a system date or time change.


    N.  Next
    P.  Previous            Selection:
```

Figure 15. Performance Data Definitions Screen

```
Circuit ID:                                                  11/03/03 09:29:45


                          Performance Data Definitions

DS1 and DSX-1 Path Related:           Superframe           Extended Superframe
  ES-P    Errored Seconds               FE>=1 or             CRC>=1 or
                                         SEF>=1 or AIS>=1     SEF>=1 or AIS>=1
  SES-P   Severely Errored Seconds      FE>=8 or             CRC>=320 or
                                         SEF>=1 or AIS>=1     SEF>=1 or AIS>=1
  UAS-P   Unavailable Seconds           >10 cont. SES-Ps     >10 cont. SES-Ps
  SAS-P   SEF/AIS Seconds               SEF>=1 or AIS>=1     SEF>=1 or AIS>=1
  ES-PFE  Far End Errored Seconds       n/a                  PRM bits G1-G6,SE,
                                                              or SL=1, or RAI
  CV-P    Code Violation Count          FE count             CRC error count

NOTE: Under a UAS-P condition, ES-P and SES-P counts are inhibited.
      Under a SES-L or SES-P condition, the respective CV-L or CV-P count is
      inhibited.




    P.  Previous            Selection:
```

Figure 16. Performance Data Definitions Screen (Continued)

The Scratch Pad, Circuit ID, and Time/Date screen (**Figure 17**) provides a Scratch Pad for user-defined information that can be any alphanumeric string up to 50 characters in length. The Circuit ID can be any alphanumeric string up to 25 characters in length. The time should be entered using military time. (For example, enter 3:15 p.m. as "151500".) The date should be entered in the MMDDYY format. (For example, enter January 02, 2003, as "010203".)

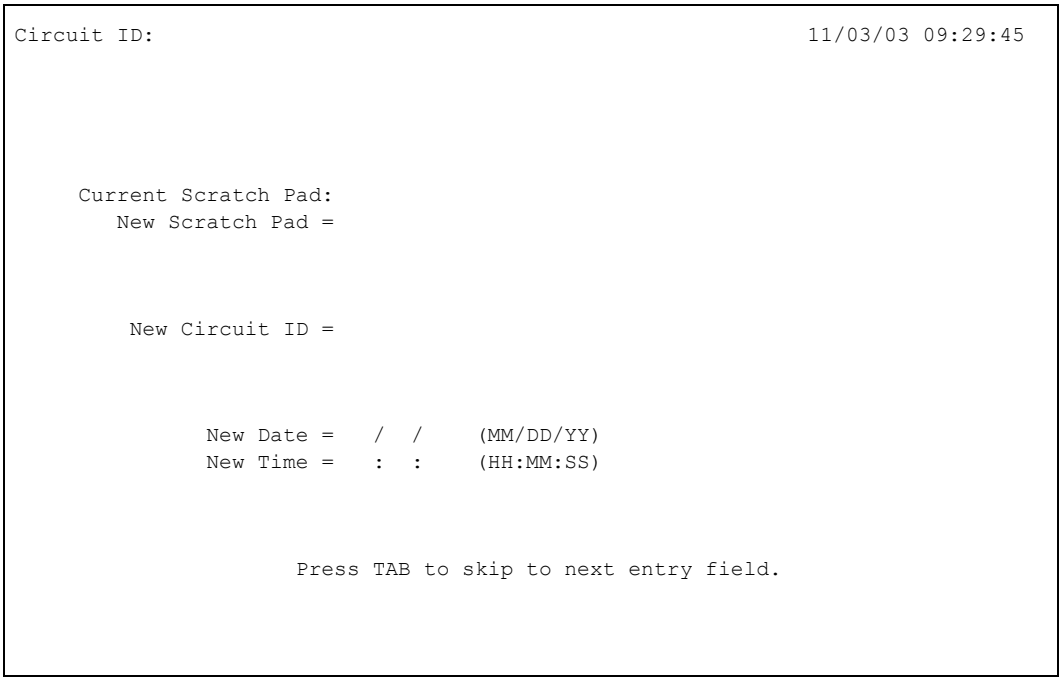


Figure 17. Scratch Pad, Circuit ID, and Time/Date Screen

The T1 Alarm History menu (**Figure 18**) and HDSL4 Span History menu (**Figure 19**) provide a detailed alarm history and events log for the HDSL4 and T1 spans. These screens include a time, date, first/last occurrence, and count for each type of HDSL4 or T1 alarm. A historical alarm log is also available in the System Alarm menu.

```
CIRCUIT ID:                                                  11/03/03 09:29:45
Press ESC to return to previous menu

                                  T1 Alarm History
  LOCATION   ALARM       FIRST                LAST              CURRENT   COUNT
  ------------------------------------------------------------------------------

  H4TU-C     RED(LOS/LOF) 01/01/00  00:00:05   01/01/00  00:00:05 Alarm      001
   (DSX-1)   YELLOW(RAI)                                          OK       000
             BLUE(AIS)                                            OK       000
  H4TU-R     RED(LOS/LOF) 06/01/03  23:46:22   06/01/03  23:46:22  Alarm    001
   (DS1)     YELLOW(RAI)                                          OK       000
             BLUE(AIS)                                            OK       000









 ------------------------------------------------------------------------------
        1. T1 Alarm             4. Span H4R1 to H4R2
        2. Facility Alarm       5. Span H4R2 to H4TU-R
        3. Span H4TUC to H4R1   C. Clear T1 Alarms
```

Figure 18. T1 Alarm History Menu

```
CIRCUIT ID:ABC123                                            11/03/03 09:29:45
                      Press ESC to return to previous menu

                              HDSL4 Span History
LOCATION    ALARM       FIRST                LAST              CURRENT   COUNT
------------------------------------------------------------------------------
SPAN C-H1   L1  LOS                                             OK         000
            L2  LOS                                             OK         000

H4TU-C      L1  MRGN                                            OK         000
            L2  MRGN                                            OK         000
H4R1 NET    L1  MRGN                                            OK         000
            L2  MRGN                                            OK         000

H4TU-C      L1  ATTEN                                           OK         000
            L2  ATTEN                                           OK         000
H4R1 NET    L1  ATTEN                                           OK         000
            L2  ATTEN                                           OK         000

------------------------------------------------------------------------------
    1. T1 Alarm             4. Span H4R1 to H4R2
    2. Facility Alarm       5. Span H4R2 to H4TU-R
    3. Span H4TUC to H4R1   C. Clear Span Alarms
                            Selection:
```

Figure 19. HDSL4 Span History Screen

The Event History screen illustrated in **Figure 20** provides a log history of HDSL4 circuit events.

The System PM/Screen Report option (**Figure 21**) offers four types of reports on performance monitoring. Selecting a report type will then display all the reports for that category on the screen at once, which is more efficient than stepping through the menus individually.

```
CIRCUIT ID:ABC123                                          11/03/03 09:29:45
                      Press ESC to return to previous menu

     Num   Description of Event                        Date     Time
     ------------------------------------------------------------------

  1.  H4TU-C Powered Up                                01/25/02 11:52:00









       Page Number:   1/  1   Number of Events:   1
    ------------------------------------------------------------------
     'P' - Previous Page  'H' - Home      'R' - Reset Events
     'N' - Next Page      'E' - End

                           Selection:
```

Figure 20. Event History Screen

```
                           1.  HDSL4 Unit Information
                           2.  Provisioning
                           3.  Span Status
                           4.  Loopbacks and Test
                           5.  Performance History
                           6.  Scratch Pad, Ckt ID, Time/Date
                           7.  Terminal Modes
                           8.  Alarm History
                           9.  Event History
                          10.  System PM/Screen Report
                          11.  Clear PM and Alarm Histories
                          12.  Troubleshooting
                          13.  Virtual Terminal Control

                            Selection: 10


       Enable data logging now.
Select Report Type or Press Escape to cancel:
  1)  Full System/History Report
  2)  Current Status Report
  3)  System Configuration Report
  4)  Alarm/Event History
```

Figure 21. System PM/Screen Report Option

The Clear PM and Alarm Histories screen (**Figure 22**) initializes data from performance monitoring and alarm histories. Selecting this option from the HDSL4 Main Menu displays the prompt:

```
This will clear the history data for
all elements in the circuit. Are you
sure (Y/N)?
```

Option 12 on the HDSL4 Main Menu displays the Troubleshooting screen (**Figure 23**). Helpful ADTRAN contact information along with two menu items appear on the bottom of this screen.

```
Circuit ID:                                                  11/03/03 09:29:45

                              Adtran HDSL4 Main Menu


                              1.  HDSL4 Unit Information
                              2.  Provisioning
                              3.  Span Status
                              4.  Loopbacks and Test
                              5.  Performance History
                              6.  Scratch Pad, Ckt ID, Time/Date
                              7.  Terminal Modes
                              8.  Alarm History
                              9.  Event History
                             10.  System PM/Screen Report
                             11.  Clear PM and Alarm Histories
                             12.  Troubleshooting
                             13.  Virtual Terminal Control

                This will clear the PM, Alarm, Span Status, and
               Troubleshooting Histories for all circuit elements.
                           Are you sure (Y/N)?

                              Selection:
```

Figure 22. Clear PM and Alarm Histories

```
Circuit ID:                                                  11/03/03 09:29:45
                      Press ESC to return to previous menu
                              Troubleshooting

For HELP based on detected problems, select Troubleshooting Guidance from the
list below. If further assistance is needed, contact ADTRAN Tech Support.









Hours: Normal 7am - 7pm CST                      1. Troubleshooting Guidance
       Emergency 7 days x 24 hours               2. General Information
Phone: 800.726.8663 / 888.873.HDSL
  Fax: 256.963.6217

                                          Selection:
```

Figure 23. Troubleshooting Screen

Selecting option 1 from the Troubleshooting screen causes the H2TU-C to read the operational status of the card and return Troubleshooting Guidance, or hints, as to the probable cause of the trouble, as shown in **Figure 24**.

Selecting option 2 from the Troubleshooting screen accesses the General Information screen (**Figure 25**) that summarizes the deployment guidelines necessary to provision this HDSL4 circuit.

```
Circuit ID:                                                  11/03/03 09:29:45
                      Press ESC to return to previous menu
                        DSX-1 Loss of Signal (Red Alarm)

- Patch test set REC jack into H4TUC MON TX jack to verify integrity of
signal to the H4TUC from the network (verify test set in MON mode).

- If signal to H4TUC is missing, insert test set at DSX panel IN Jack connecting
toward H4TUC (to verify wiring between DSX and H4TUC shelf). Check H4TUC to
verify DSX-1 LOS alarm is cleared. This verifies TX(out) and RX(in) pairs are
not swapped.

- If signal from DSX OK, verify cross-connect wiring at DSX panel is turned over
(OUT to IN) and (IN to OUT).

-If DSX wiring OK, connect test set REC to the DSX MON, network side equipment,
to verify signal from network (verify test set to MON). If no signal,
troubleshoot office problems.

For Total Access cards verify the following:
- Provisioning>Network Source is configured correctly for Mux or DSX operation.
- Provisioning>Service State is not configured for OOS-Unassigned.
- Mux card is mapped correctly.
- Mux card is functioning correctly.
```

Figure 24. Troubleshooting Guidance

```
Circuit ID:                                                  11/03/03 09:29:45
                      Press ESC to return to previous menu


HDSL4 Loop Guidelines for optimum operation
------------------------------------------
   Non-loaded cable pair
   Single bridge tap < 2Kft
   Total bridge taps < 2.5Kft
   Power influence <= 80 dBrnC
   Longitudinal Balance >= 60dB (If using Wideband test at 196 Khz >= 40dB)
   Foreign DC Voltage (t-r,t-g,r-g) < 3VDC
   Loop Resistance <= 1000 ohms 1st segment
   Loop Resistance <= 920 ohms 2nd segment

The following guidelines are provided as a recommendation and may be superseded
by internal deployment guidelines
   Margin >= 6 dB
   Attenuation (1st Segment) H4TUC <= 30 dB, H4TUR/H4R <= 32 dB
   Attenuation (2nd or 3rd Segment) H4TUR/H4R <= 28dB
```

Figure 25. General Information Screen

Figure 26 shows the Virtual Terminal Session screen. Virtual Terminal (VT) allows control of the remote unit provisioning from the H4TU-C. Press option 1 from this screen to begin a user-initiated session with the remote unit. When the remote session is completed, Press CTRL+X to terminate the session.

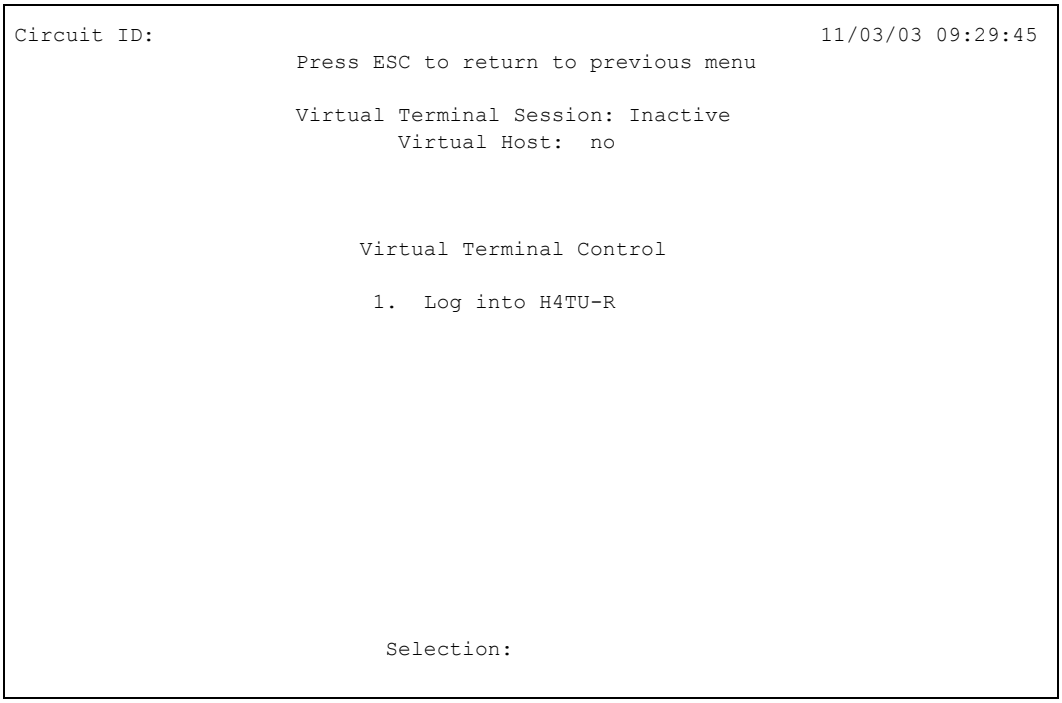


Figure 26. Virtual Terminal Session Screen

6. HDSL4 DEPLOYMENT GUIDELINES

The different segments of an HDSL4 circuit are defined in **Figure 27.**

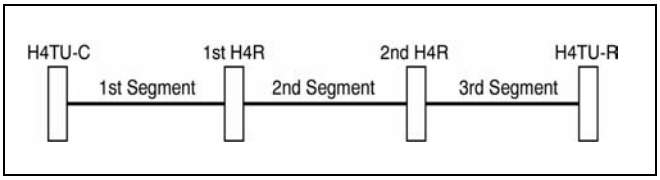


Figure 27. HDSL4 Circuit Segments

The ADTRAN HDSL4 system provides DS1-based services over loops designed to comply with the guidelines given below. These guidelines apply to the following circuit configurations:

- a single segment or an HDSL4 circuit with no H4Rs,
- a circuit having two segments (with one H4R), or
- a circuit having three segments (with two H4Rs).

The guidelines reflected herein are for worst-case scenarios, that is, for loops that contain a maximum amount of disturbers, noise, etc. Actual deployment guidelines may vary based on local policy. Refer to the guidelines to ensure optimum performance.

Designing a circuit with loop attenuation greater than the recommended maximum loss may result in compromised reliability of that loop. Follow the guidelines in this section to ensure that the circuit meets basic requirements:

1. All loops are nonloaded only.
2. Any single bridged tap is limited to 2 kft.
3. Total bridged tap length is limited to 2.5 kft.
4. Bridge tap within 1000 feet of units may affect performance of the circuit.
5. Loop Attenuation Limits. See **Table 6.**
6. DSL-Recommended Range Limits. See **Table 7** and **Table 8**.

NOTE

In three segment circuits (two H4Rs), individual segment resistance values *must be verified*.

Table 6. Attenuation Limits

	Recommended Maximum	
	Upstream	**Downstream**
1st segment	30 dB	32 dB
2nd and 3rd segment	28 dB	28 dB

Table 7. Range Limits: 26 Gauge / 70°F / PIC

26 Gauge	Recommended Maximum
1st segment	10,470 ft.
2nd segment	9,865 ft.
3rd segment	9,865 ft. (see note above)

Table 8. Range Limits: 24 Gauge / 70°F / PIC

26 Gauge	Recommended Maximum
1st segment	14,770 ft.
2nd segment	14,050 ft.
3rd segment	14,050 ft. (see note above)

7. Resistance Values. See **Table 9**.

   Each of the three segments associated with span powering two H4Rs and a H4TU-R must satisfy the DC resistance budgets in addition to the recommended loop attenuation requirements. In general, 22 and 19 AWG segments will be restricted by their loop attenuation while the DC resistance will restrict the segment reach for 26 and 24 AWG. When designing a dual H4R loop, the first segment should have lower DC resistance than the second segment.

   Single H4R spans do not require any restriction due to DC resistance.

NOTE

A circuit that otherwise meets attenuation and other requirements for cable reach will encounter span powering problems if resistance values are excessive.

The segment resistance ($\Omega_{segment}$) is determined using this equation:

$$\Omega_{segment} = L_{26} * \Omega_{26} + L_{24} * \Omega_{24} + L_{22} * \Omega_{22} + L_{19} * \Omega_{19}$$

where $L_{\#}$ is the length of # AWG cable (kft., excluding bridged taps) and Ω_{26} is the DC resistance of #AWG cable.

Table 9. Single Pair DC Resistance Value

Resistance (ohms/kft)				
AWG	**70°F**	**90°F**	**120°F**	**140°F**
19	16.465	17.183	18.261	18.979
22	33.006	34.446	36.606	38.046
24	52.498	54.789	58.225	60.516
26	83.475	87.117	92.581	96.223

Note: Interpolated between 70°F and 120°F data. Extrapolated from 70°F and 120°F data.

Once the resistance of each segment is confirmed, refer to **Figure 28** to decide if the H4TU-C is capable of span powering two H4Rs and one H4TU-R. Alternatively, the DSL Assistant program will automatically calculate this and report any violations.

To utilize the graph shown in Figure 28, perform the following steps:

a. Find the line on the graph that represents the known third segment resistance. These are the lines running diagonally across the graph labeled 300 - 1100 ohms. This line represents the upper limit for two H4Rs plus H4TU-R span powering.

b. Find the first segment resistance on the vertical axis.

c. Find the second segment resistance on the horizontal axis.

d. Find the instance where the two points from step b and step c meet on the graph.

The point found in step d must be below the upper limit line defined by the third segment measurement in step a. If the instance where these two points is above this line, the H4TU-C cannot span power two H4Rs and the H4TU-R.

Note that these measurements represent only one of the two HDSL4 pairs.

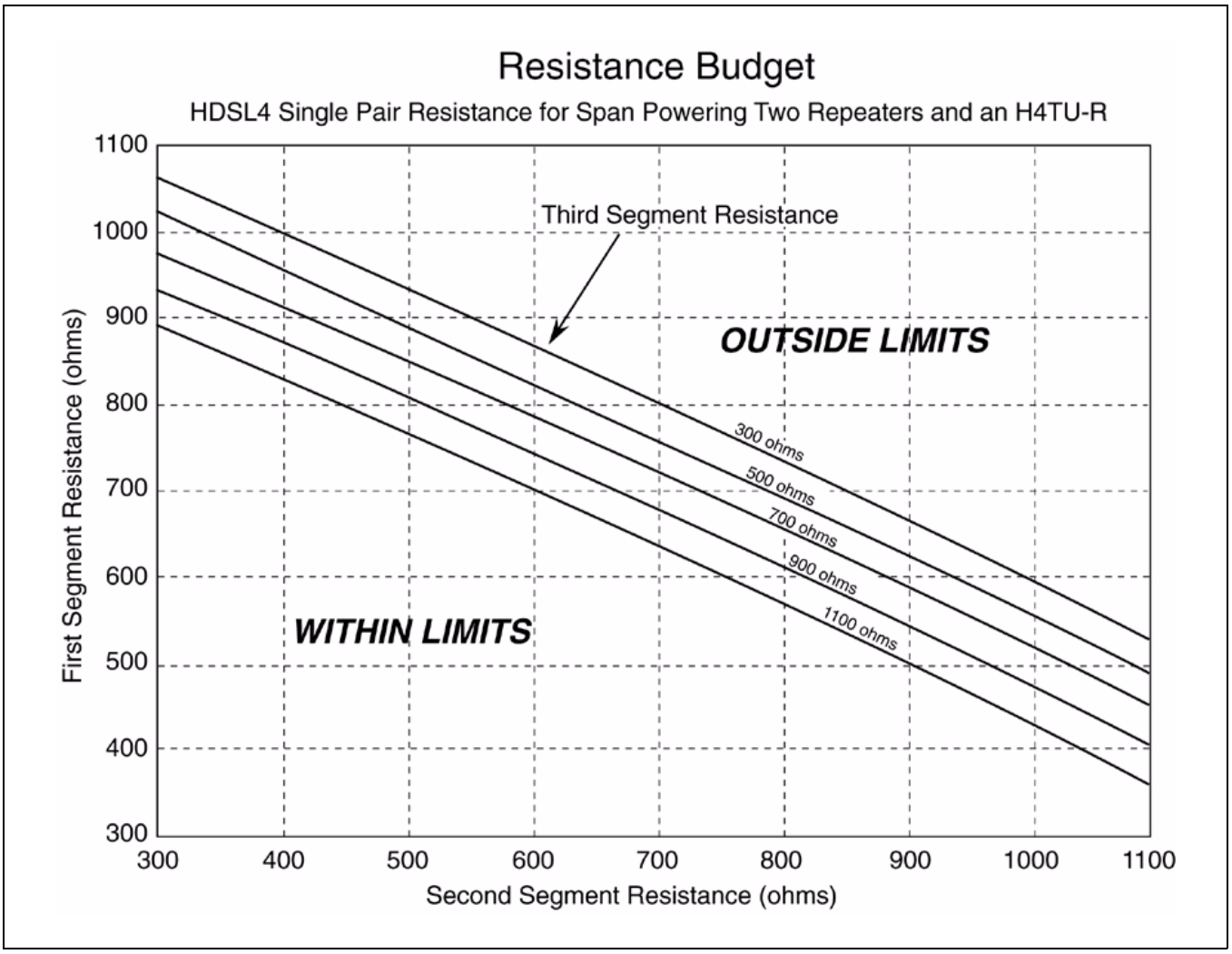


Figure 28. Resistance Budget Span Powering Two Repeaters

An example problem is illustrated in **Figure 29**. For this example, begin with three known measurements: 600 ohms first segment resistance, 700 ohms second segment resistance, and 900 ohms third segment resistance.

Refer to Figure 29 and the following steps to solve the example problem:

a. Find the 900 ohms third segment resistance line on the graph. This line is depicted in bold in Figure 29. This line is the upper span power limit.

b. Find the 600 ohms first segment resistance point on the vertical axis.

c. Find the 700 ohms second segment resistance point on the horizontal axis.

d. Find the instance on the graph where the points from step b and step c meet.

e. If this point is below the bold line defined in step a, a circuit with these parameters is capable of span powering two H4Rs and one H4TU-R.

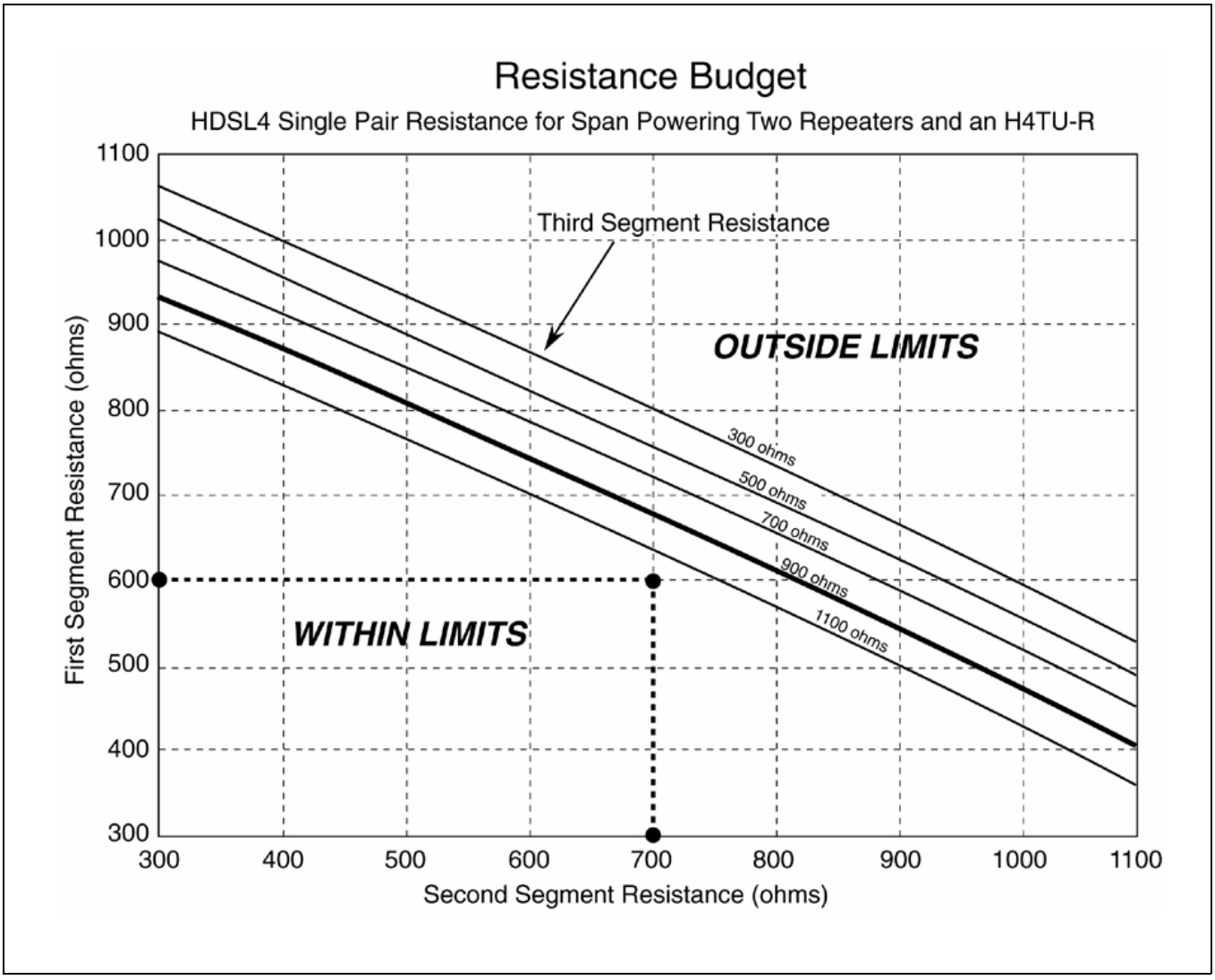


Figure 29. Resistance Budget Span Powering (Example)

7. MAINTENANCE

The DDM+ H4TU-C does not require routine maintenance for normal operation. In case of equipment malfunction, use the front panel bantam jack connectors to determine the source of the problem.

ADTRAN does not recommend that repairs be attempted in the field. Repair services may be obtained by returning the defective unit to ADTRAN. Refer to the *Warranty and Customer Service* section for further information.

8. SPECIFICATIONS

Specifications for the DDM+ H4TU-C are detailed in **Table 10**.

9. WARRANTY AND CUSTOMER SERVICE

ADTRAN will replace or repair this product within the warranty period if it does not meet its published specifications or fails while in service. Warranty information can be found at www.adtran.com/warranty.

U.S. and Canada customers can also receive a copy of the warranty via ADTRAN's toll-free faxback server at 877-457-5007.

- Request document 414 for the *U.S. and Canada Carrier Networks Equipment Warranty*.
- Request document 901 for the *U.S. and Canada Enterprise Networks Equipment Warranty*.

Refer to the following subsections for sales, support, CAPS requests, or further information.

ADTRAN Sales

Pricing/Availability:
800-827-0807

ADTRAN Technical Support

Pre-Sales Applications/Post-Sales 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

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

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

Table 10. DDM+ H4TU-C Specifications

Specification	Description
Loop Interface	
Modulation Type:	16 TC PAM
Mode:	Full Duplex, Partially overlapped echo canceling
Number of Pairs:	2
Line Rate:	1.552 Mbps
Baud Rate:	261.333 k baud
Loop Loss:	See *HDSL4 Deployment Guidelines* section of this document.
Bridged Taps:	Single Taps < 2000 ft., Total Taps < 2500 ft.
Performance:	Compliant with T1.418-2000 (HDSL2 Standard, Issue 2)
H4TU-C Transmit Power (Data) Level:	14.1 ±0.5 dBm (0 to 400 kHz)
H4TU-C Transmit Power (Activation) Level:	14.1 ±0.5 dBm (0 to 307 kHz)
Input Impedance:	135 ohms
Maximum Loop Resistance:	1150 ohms (nonrepeatered circuit)
Return Loss:	12 dB (50 kHz to 200 kHz)
Network Interface	
DS1 Transmit Level:	0 dB (default), –7.5 dB, –15 dB
DSX-1 Line Build Out:	0-133 ft. ABAM (default) 133-266 ft. ABAM 266-399 ft. ABAM 399-533 ft. ABAM 533-655 ft. ABAM
DSX-1 Line Code:	B8ZS (default), AMI
Power *Tested with the ADTRAN H4TU-R (P/N 1223426L2) and H4R (P/N 1223445L1)*	
H4TU-C Total Power:	–48 VDC @ 200 mA with H4TU-R –48 VDC @ 330 mA with H4TU-R and one H4R –48 VDC @ 560 mA with H4TU-R and two H4Rs
H4TU-C Power Dissipation:	5.1 watts with H4TU-R 5.7 watts with H4TU-R and one H4R 7.1 watts with H4TU-R and two H4Rs
Span Power:	–190 VDC (Internally Generated) Class A2 Compliant, GFI Current Limited at < 5 mA, Loop Current Limited at 150 mA
Fusing:	1.00 A (not field-replaceable)
Clock	
Clock Sources: Internal Clock Accuracy:	Internal, DSX-1 Derived (with HDSL4 frame bit stuffing) ±25 ppm (Exceeds Stratum 4), Meets T1.101 Timing Requirements
Tests	
Diagnostics:	Self-Test, Local Loopback (H4TU-C), Remote Loopback (H4TU-R), Repeater Loopback (H4R)
Physical	
DDM+ Office Repeater Shelf-Mounted Weight:	< 1 lb.

Table 10. DDM+ H4TU-C Specifications (Continued)

Specification	Description
Environment	
Operating Temperature (Standard): Storage Temperature:	–40ºC to +70ºC –40ºC to +85ºC
Compliance	
UL 60950; GR-1089-CORE; GR-63-CORE; ANSI T1.418-2002; ANSI T1.102 (DS1 Interface)	
Part Number	
DDM+ HDSL4 Transceiver Unit for the Central Office:	1223403L2

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Appendix A
HDSL4 Loopbacks

HDSL4 MAINTENANCE MODES

This appendix describes operation of the HDSL4 system with regard to detection of inband and ESF facility data link loopback codes.

Upon deactivation of a loopback, the HDSL4 system will synchronize automatically.

Loopback Process Description

In general, the loopback process for the HDSL4 system elements is modeled on the corresponding DS1 system process. Specifically, the H4TU-C loopback is similar to an Intelligent Office Repeater loopback, and the H4TU-R loopbacks are similar to an in-line T1 Repeater loopback.

In-band control code sequences are transmitted over the DS1 link by either the insert or overwrite method. The HDSL4 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 greater is present.

Loopback Control Codes

A summary of control sequences is given in **Table A-1** and **Table 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. HDSL4 Loopback Control Codes

Type	Source[1]	Code[2,3]	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 (1111 1111 0001 1110)	Loopback data from network toward network at HTU-C.
	(C)	3F1E (0011 1111 0001 1110)	Loopback data from customer toward customer at HTU-C.
	(N)	FF04 (1111 1111 0000 0100)	Loopback data from network toward network at HRE1.
	(N)	FF06 (1111 1111 0000 0110)	Loopback data from network toward network at HRE2.
	(C)	3F04 (0011 1111 0000 0100)	Loopback data from customer toward customer at HRE1.
	(C)	3F06 (0011 1111 0000 0110)	Loopback data from customer toward customer at HRE2.
	(N)	FF02 (1111 1111 0000 0010)	Loopback data from network toward network at HTU-R.
	(C)	3F02 (0011 1111 0000 0010)	Loopback data from customer toward customer at HTU-R.
	(C)	FF48 (1111 1111 0100 1000)	Loopback data from customer toward customer at HTU-R.(FDL)
	(N)	FF48 (1111 1111 0100 1000)	Loopback data from network toward network at HTU-R. (FDL)
	(N/C)	1 in 3 (100)	Loopdown everything.
	(N/C)	FF24 (1111 1111 0010 0100)	Loopdown everything. (ESF-DL)

1. The Source column indicates from which side of the interface the control codes are sent. For example, an (N) indicates a network sourced code while a (C) indicates a customer sourced code.
2. All codes are in-band unless labeled ESF-DL.
3. All codes listed above must be sent for a minimum of 5 seconds to be detected and acted upon.

Table A-2. Loopback Control Codes

Function	Code (Hex / Binary)	Response
ARM (in-band) - also known as 2-in-5 pattern	11000 (binary)	If the pattern is sent from the network, the units will arm, and the H4TU-R will loop up if NIU Loopback is enabled.
ARM (ESF Data Link)	FF48 or 1111 1111 0100 1000 sent in the Facility Data Link	If the pattern is sent from the network, the units will arm, and the H4TU-R will loop up if NIU Loopback is enabled. When sent from the customer, the units will arm.
Disarm (in-band) - also known as 3-in-5 pattern	11100 (binary)	When sent from the network or customer, all units are removed from the armed state, and loopbacks will be released.
Disarm (ESF Data Link)	FF24 or 1111 1111 0010 0100 sent in the Facility Data Link	When sent from the network or customer, all units are removed from the armed state, and loopbacks will be released.
H4TU-C Loop Up [1,2]	D3D3 or 1101 0011 1101 0011	If armed, the H4TU-C will loop up, 2 seconds of AIS (all ones) will be transmitted, the looped data will be sent for 5 seconds, and then a burst of 231 logic errors will be injected. The burst of 231 logic errors will continue every 20 seconds as long as the D3D3 pattern is detected. When the pattern is removed, the unit will remain in loopback. If the pattern is reinstated, the injection of 231 logic errors will continue every 20 seconds.
Loop Down w/o Disarm	9393 or 1001 0011 1001 0011	When sent from the network, all units currently in loopback will loop down. Armed units will not disarm. In order to behave like a smartjack, the H4TU-R will not loop down from a network loopback in response to the 9393 pattern if NIU Loopback is enabled.
Loopback Query [1]	D5D5 or 1101 0101 1101 0101)	When the pattern is sent from the network, logic errors will be injected toward the network to indicate a loopback is present toward the network. The number of errors injected is determined by the nearest unit that is in loopback. As long as the pattern continues to be sent, errors are injected again every 20 seconds: H4TU-C 231 errors H4R1 10 errors H4R2 200 errors H4TU-R 20 errors
Loopback Time Out Override[1]	D5D6 or 1101 0101 1101 0110	If the units are armed or a unit is currently in loopback when this pattern is sent from the network, the loopback time out will be disabled. As long as the units remain armed, the time out will remain disabled. When the units are disarmed, the loopback time out will revert to the previous loopback time out setting. If any element is in network loopback a bit error confirmation will be sent. H4TU-C 231 errors H4R1 10 errors H4R2 200 errors H4TU-R 20 errors

Table A-2. Loopback Control Codes (Continued)

Function	Code (Hex / Binary)	Response
Span Power Disable[1]	6767 or 0110 0111 0110 0111	If the units are armed and 6767 is sent from the network, the H4TU-C will disable span power. If the pattern is sent from the network, the span power will be disabled as long as 6767 pattern is detected. Once the pattern is no longer received, the H4TU-C will reactivate span power. All units will then retrain and return to the disarmed and unlooped state.
First H4R Loop Up [1,2]	C741 1100 0111 0100 0001	If one or more H4Rs are present, the H4R closest to the H4TU-C will loop up toward the network, 2 seconds of AIS (all ones) will be transmitted, the looped data will be sent for 5 seconds, and then a burst of 10 logic errors will be injected. The burst of 10 logic errors will continue every 20 seconds as long as the C741 pattern is detected. When the pattern is removed, the unit will remain in loopback. If the pattern is reinstated, the injection of 10 logic errors will continue every 20 seconds.
Second H4R Loop Up [1,2]	C754 1100 0111 0101 0100	If two H4Rs are present, the second H4R from the H4TU-C will loop up toward the network, 2 seconds of AIS (all ones) will be transmitted, the looped data will be sent for 5 seconds, and then a burst of 200 logic errors will be injected. The burst of 200 logic errors will continue every 20 seconds as long as the C754 pattern is detected. When the pattern is removed, the unit will remain in loopback. If the pattern is reinstated, the injection of 200 logic errors will continue every 20 seconds.
H4TU-R Address 20 for Extended Demarc [1,2]	C742 1100 0111 0100 0010	If armed, the H4TU-R will loop up toward the network, 2 seconds of AIS (all ones) will be transmitted, the looped data will be sent for 5 seconds, and then a burst of 20 logic errors will be injected. The burst of 20 logic errors will continue every 10 seconds as long as the C742 pattern is detected. When the pattern is removed, the unit will remain in loopback. If the pattern is reinstated, the injection of 20 logic errors will continue every 10 seconds.

1. Units must be armed with 11000b or FF48h before this code will work.
2. Loopback and error injection will only occur if the in-band code is received by the unit that is to go into loopback. If another loopback blocks the in-band code from being transmitted to the unit that is to go into loopback, loopback and error injection will not occur.

Note: All codes listed above must be sent for a minimum of 5 seconds to be detected and acted upon.