T200 H2TU-R, Local Power
High-bit-rate Digital Subscriber Line Remote Unit
Installation and Maintenance

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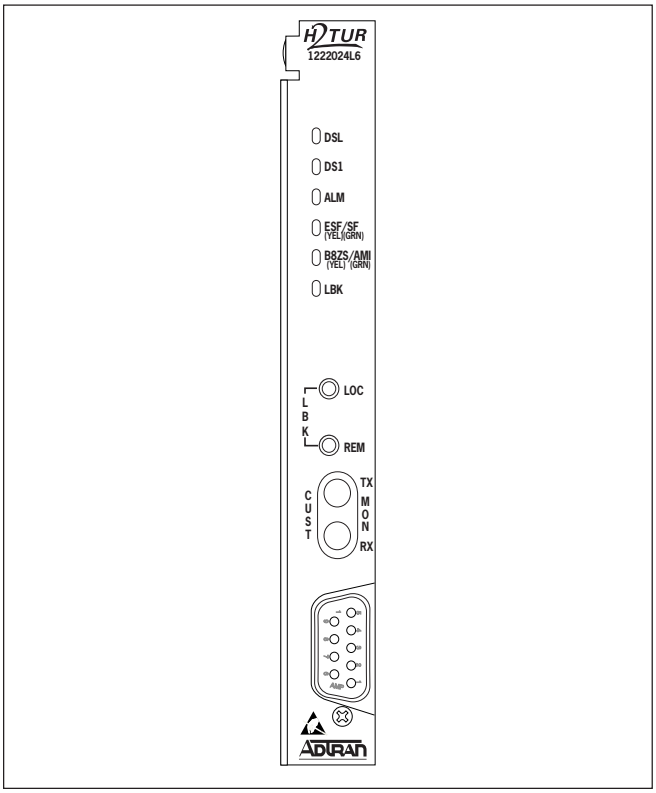


Figure 1. ADTRAN T200 H2TU-R MON

1. GENERAL

The ADTRAN 2-Wire T200 HDSL2 Transceiver Unit for the Remote end (H2TU-R), ADTRAN P/N 1222024L6, is a network terminating unit used to deploy an HDSL2 T1 circuit using 2-wire metallic facilities. The H2TU-R is illustrated in **Figure 1**. The H2TU-R is a T200 mechanics card which will fit T200 or T400 mechanics enclosures. The H2TU-R can be housed in the ADTRAN standalone metal enclosure (P/N 1242034LX) or the T200 Dual-Mount Enclosure (P/N 1245034L1). Refer to the appropriate ADTRAN practice for more information. The T200 H2TU-R card can also plug into the ADTRAN HR12 HDSL remote shelf (P/N 1242007LX), or the ADTRAN HR4 HDSL remote shelf (P/N 1242008L1). In all applications the H2TU-R must be installed in NEBS compliant and UL listed enclosures to ensure full compliance with this unit.

This version of the H2TU-R works with multiple list versions of the HDSL2 transceiver unit for the central office (H2TU-C), as listed here.

Unit Number	Description
1221001LX	220/E220 H2TU-C
1221003LX	DDM+ H2TU-C
1221004LX	3192 H2TU-C
1221006L6	T200 H2TU-C
1222001LX	2nd Gen 220/E220 H2TU-C
1222003LX	2nd Gen DDM+ H2TU-C
1222004LX	2nd Gen 3192 H2TU-C
1181111LX	Total Access H2TU-C
1181112LX	2nd Gen Total Access H2TU-C

The H2TU-R can be deployed in circuits using one H2TU-C.

The H2TU-R terminates local loop HDSL2 signals originating from the Central Office (CO) H2TU-C unit and transforms the HDSL2 signal into traditional T1 signals to be delivered to the customer.

This unit is intended for Local Power Only (-24 Vdc to -48 Vdc). If a span power unit is needed, refer to P/N 1222026L6.

Revision History

This is the initial release of this document. Future revisions to this document will be explained in this subsection.

2. INSTALLATION

After unpacking the unit, inspect it for damage. If damage is noted, file a claim with the carrier, then contact ADTRAN. See *Warranty and Customer Service*.

Remote Provisioning

This H2TU-R can be used to provision the entire HDSL2 circuit via the craft interface.

The settings on the H2TU-C are encoded and transmitted to the H2TU-R once the circuit has achieved synchronization. There are no switch settings on the H2TU-R.

Compliance Codes

Table 1 shows the Compliance Codes for the H2TU-R. The H2TU-R complies with the requirements covered under UL 60950 third edition and is intended to be installed in an enclosure with an Installation Code (IC) of "B" or "E."

CAUTION

Voltages up to -200 Vdc may be present on the telecommunications wiring.

NOTE

This product is intended for installation in Restricted Access Locations only.

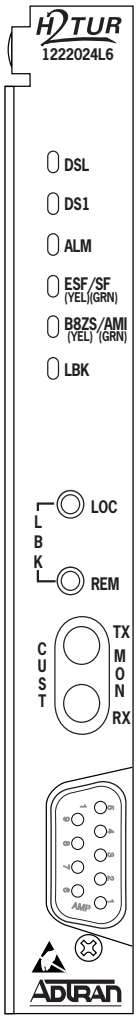
Table 1. Compliance Codes

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

Front Panel Indicators

There are six front panel mounted status indicators, described in **Table 2**.

Table 2. Front Panel Indicators



Indicator	Description
DSL	Indicates HDSL2 signal quality on the Loop is in one of the following five states *Off* ..... No synchronization of H2TU-C and H2TU-R *Red* ..... Poor signal quality on Loop (≥ 10^{-7} BER) *Yellow* ..... Marginal signal quality on Loop (≤ 2 dB margin above 10^{-7} BER) *Green* ..... Good signal quality on Loop (> 2 dB margin above 10^{-7} BER) *Blinking* ..... Detected error on either end
DS1	Indicates three possible conditions: *Off* ..... Customer-side DS1 signal is absent or is of a format that does not match the HDSL2 circuit provisioning *Blinking* ..... Detected error on the DS1 interface *Green* ..... Customer-side DS1 signal is present and synchronized
ALM	Indicates three possible alarm conditions: *Off* ..... No alarm condition detected *Red* ..... Detected local alarm condition (H2TU-R) *Yellow* ..... Detected remote alarm condition (H2TU-C)
ESF/SF	Indicates three possible framing modes: *Yellow* ..... Indicates DS1 is provisioned for ESF framing mode *Green* ..... Indicates DS1 is provisioned for SF framing mode *Off* ..... Indicates DS1 is provisioned for Unframed operation
B8ZS/AMI	Indicates two possible line codes: *Yellow* ..... Indicates DS1 is provisioned for B8ZS coding *Green* ..... Indicates DS1 is provisioned for AMI coding
LBK	Indicates three possible loopback conditions: *Off* ..... Unit is not in loopback or armed state *Yellow* ..... Active local customer, network or bidirectional loopback at the H2TU-R *Blinking* ..... Unit is armed but not in active loopback condition

Front Panel Buttons

Two loopback (LBK) buttons are accessible from the front panel. The REM loopback button controls a customer loopback at the H2TU-C. The LOC loopback button controls a bidirectional loopback at the H2TU-R. See **Table 3** for details.

Front Panel DS1 Monitor Jack

The H2TU-R provides DS1 monitoring bantam jacks. These jacks provide a nonintrusive monitor point for DS1 traffic to and from the customer. For more details, see Section 4 of this practice.

Table 3. Front Panel Loopback Buttons

Switch Label	Function
REM	Pressing this button changes the H2TU-C customer loopback state as follows: • If the H2TU-C *is not* in loopback, pressing REM *activates* a customer loopback. • If the H2TU-C *is* in loopback, pressing REM *deactivates* the loopback.
LOC	Pressing this button changes the H2TU-R bidirectional loopback state as follows: • If the H2TU-R *is not* in loopback, pressing LOC *activates* the bidirectional loopback. • If the H2TU-R *is* in loopback, pressing LOC *deactivates* the bidirectional loopback.

3. CONNECTIONS

All connections of the H2TU-R are made through card edge connectors. **Table 4** gives the card edge pin assignments for the H2TU-R circuit pack.

Table 4. Card Edge Pin Assignments

Pin	Designation	Description
1	CH GND	Chassis ground
5	DS1-T1	DS1 receive out tip (to customer interface)
7	H1-T	HDSL2 Loop tip (facility)
11	CH GND	Chassis ground
12	GND	Ground for protection switching
13	H1-R	HDSL2 Loop ring (facility)
15	DS1-R1	DS1 receive out ring (to customer interface)
17	-48VR	-48 Vdc Return
20	VCC	+5 Vdc for protection switching
27	CH GND	Chassis ground
35	-48VR	-48 Vdc
40	PROT-1	Control line for protection switching
49	DS1-R	DS1 transmit in ring (from customer interface)
55	DS1-T	DS1 transmit in tip (from customer interface)

When the circuit pack is installed in any of the H2TU-R enclosures, all connections are made through the enclosure backplanes. See the following ADTRAN documents for more information:

- 61242007L1-5, HR12 Installation/Maintenance
- 61242008L1-5, HR4 Installation/Maintenance
- 61242034L3-5, T400 Single-Mount High Voltage Installation/Maintenance
- 61245034L1-5, T200 Dual-Mount Installation/ Maintenance

ADTRAN's T200 Dual-Mount housing (P/N 1245034L1) is required when using the T200 H2TU-R for HDSL2 Loop Support System (H-LSS ™).

NOTE

Ensure chassis ground is properly connected for either standalone or shelf-mounted applications.

4. HDSL2 SYSTEM TESTING

The T200 H2TU-R provides diagnostic, loopback, and signal monitoring capabilities.

The six front panel LEDs provide diagnostics for HDSL2 loops, DS1 signals, alarms, provisioning and loopbacks. See section 2 of this practice for details.

The H2TU-R provides local and remote loopback capabilities via the loopback switches on the front panel.

The DS1 MON jacks provides a nonintrusive access for DS1 signal monitoring.

DS1 MON Bantam Jacks

The jack labeled "MON" provides a nonintrusive access point for monitoring the transmit and receive signals at the DS1 interface point.

In general, the monitoring jacks provide a non-intrusive tap onto a signal line that permits the connection of test equipment to monitor the characteristics of that signal. For example, the DS1 MON jack on the H2TU-R could be used to connect to a bit error rate tester to monitor for synchronization, test patterns, etc. **Figure 2** is an illustration of specific jack detail.

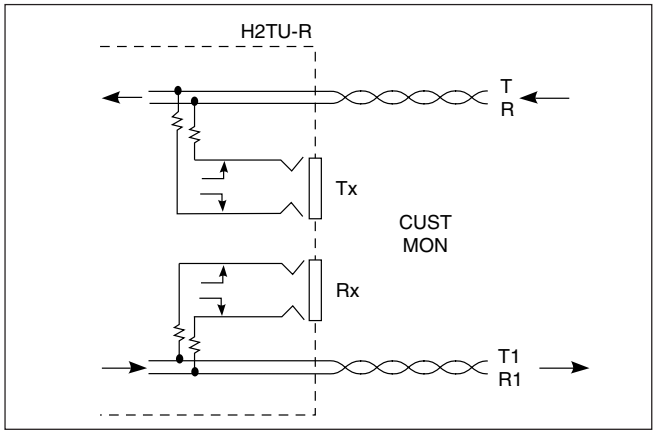


Figure 2. H2TU-R MON Diagram

H2TU-R Network Loopbacks

The H2TU-R responds to multiple loopback activation processes. The loopback position is a logic loopback located within the H2TU-R internal HDSL transceiver. See **Figure 3**.

First, manual loopback activation may be accomplished using the control port of the H2TU-C. Refer to the ADTRAN H2TU-C Installation and Maintenance practice (P/N 61222001LX-5) or other H2TU-C practices for more information.

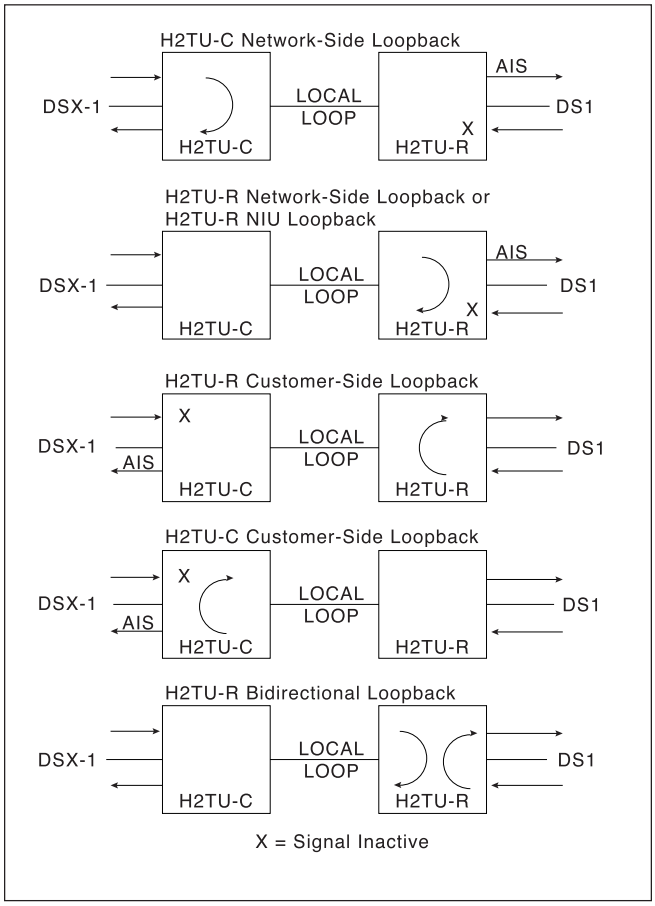


Figure 3. HDSL2 Loopbacks

Second, the H2TU-R will respond to the industry defacto HDSL2 loopback codes as designated in the ANSI document T1E1.4/92. A synopsis of the method described by ANSI is presented in *Appendix A*.

Third, the H2TU-R will respond to manual loopback activation by pressing the LOC LBK button on the faceplate. This will activate a bidirectional loopback at the H2TU-R.

Finally, the H2TU-R responds to T1 Network Interface Unit (NIU) loopback codes as described in Bellcore TR-TSY-000312 if the H2TU-R is optioned for NIU loopbacks. The NIU loopback codes are as follows:

In-band Codes:	Loop up	11000
	Loop down.....	11100
ESF Codes:	Loop up	0001 0010 1111 1111
	Loop down.....	0010 0100 1111 1111

Receiving the in-band codes for more than five seconds or the ESF codes for four consecutive repetitions will cause the appropriate loopback action.

The H2TU-R will respond to the loop up codes by activating the NIU loopback from either the disarmed or armed state. The loop down codes will return the H2TU-R to the normal state from the armed or loop up state.

Refer to Appendix A for more details on loopbacks and loopback arming sequences.

Figure 3 illustrates all of the possible loopback locations of the ADTRAN HDSL2 equipment.

Customer Loopbacks

In addition to the loopbacks in the direction of the network, the H2TU-R may also be looped back in the direction of the customer using the terminal control port of the H2TU-C or the LOC LBK switch on the front panel of the H2TU-R. The LOC LBK switch enables a bidirectional loopback. The H2TU-C can be looped to the customer using the REM LBK switch on the front panel of the H2TU-R. The H2TU-C and H2TU-R Customer Side Loopbacks are illustrated in Figure 3.

NOTE

Network and customer loopbacks are governed by the loopback time out option configured on the H2TU-C.

5. CONTROL PORT OPERATION

The H2TU-R 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 4**.

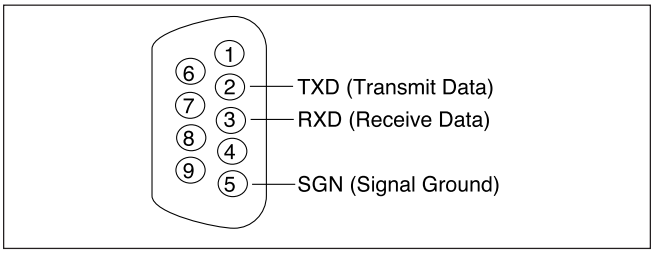


Figure 4. RS-232 (DB-9) Pin Assignments

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 dumb terminal, 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 HDSL2 unit may be disrupted, resulting in misplaced characters or screen timeouts.

Operation

For abbreviations used in the screen diagrams, see **Table 5**. The H2TU-C also provides a Performance Data Definitions Screen, which gives performance monitoring related abbreviations, see Figure 14.

The screens illustrated in Figures 5 through 18 apply to an HDSL2 circuit deployed with ADTRAN's HDSL2 technology. The circuit includes an H2TU-C and an H2TU-R. Other configurations are possible (i.e. other vendor's equipment) 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 H2TU-R to determine the speed of the terminal. Once the speed has been determined, an HDSL2 Main Menu is presented, as illustrated in **Figure 5**.

Table 5. Screen Abbreviations

Abbreviation	Definition
NET	Network (DSX-1)
CUST	Customer (DS1)
LOS	Loss of Signal
SF	Superframe Format
ESF	Extended Superframe Format
B8ZS	Bipolar with 8 Zero Substitution
AMI	Alternate Mark Inversion
ATTEN	Pulse attenuation on HDSL2 loop
MARGIN	Signal-to-noise margin in dB above 10^{-7} Bit Error rate
LBO	Line Build Out
BPV	Bipolar Violations DSX/....Second in which a bipolar violation occurrs
NIU	T1 Network Interface Unit
S/N	Serial Number
15M	Fifteen-Minute period
24H	Twenty-Four-Hour period

```
CIRCUIT ID:                                              01/01/00 00:00:40


                          Adtran HDSL2 Main Menu

                        1.  HDSL2 Unit Information
                        2.  Provisioning
                        3.  Span Status
                        4.  Loopbacks and Test
                        5.  Performance History
                        6.  Circuit ID, Time/Date
                        7.  Terminal Modes
                        8.  Alarm History
                        9.  Event History



                        Selection:
```

Figure 5. Main Menu Screen

The Main Menu provides access to detailed performance and configuration information. Selecting the corresponding number or letter can access the following screens:

1. HDSL2 Unit Information
2. Provisioning
3. Span Status
4. Loopbacks and Test
5. Performance History
6. Circuit ID, Time/Date
7. Terminal Modes
8. Alarm History
9. Event History

The HDSL2 Unit Information Screens, illustrated in **Figure 6**, provides detailed product information on each component in the HDSL2 circuit. This Screen also displays contact information for ADTRAN Technical Support, Internet Site, and address.

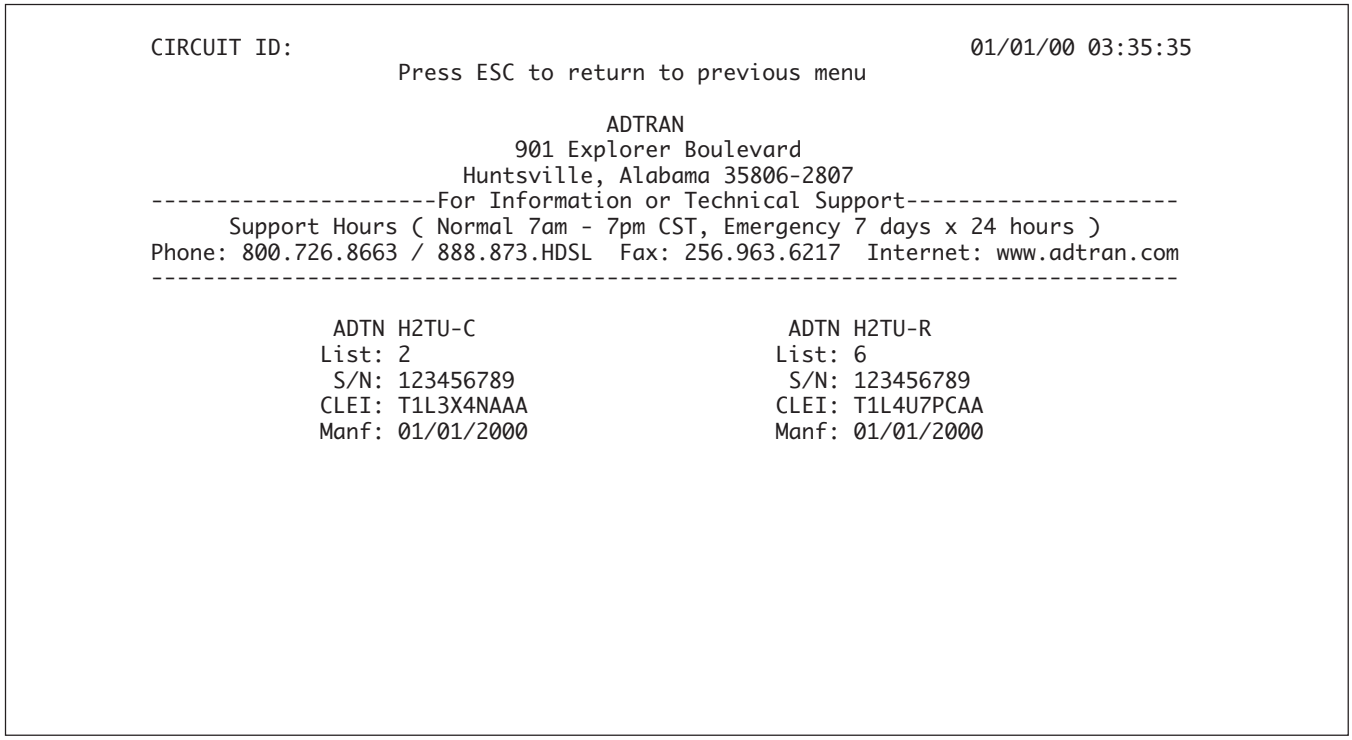


Figure 6. HDSL2 Unit Information Screen

The Provisioning Screen, illustrated in **Figure 7**, displays the current provisioning settings for the HDSL2 circuit.

The Span Status Screen, illustrated in **Figure 8**, provides quick access to status information for each HDSL2 receiver in the circuit.

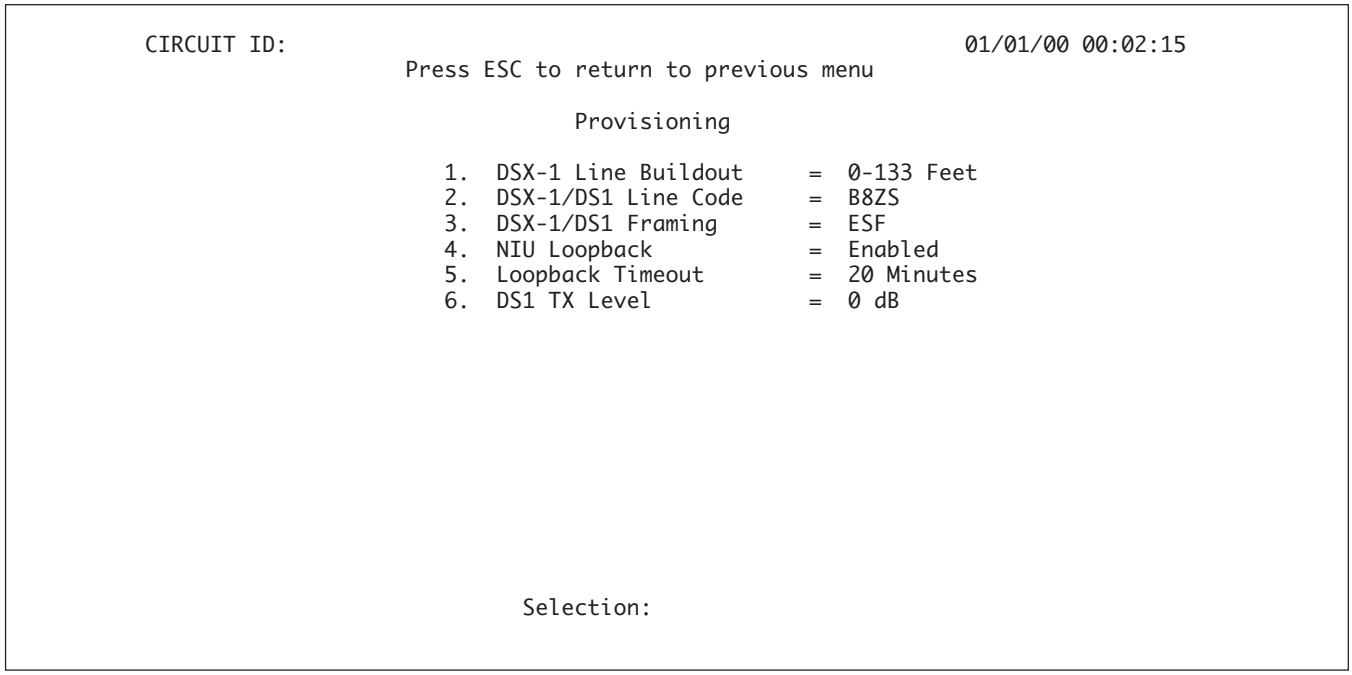


Figure 7. Provisioning Screen

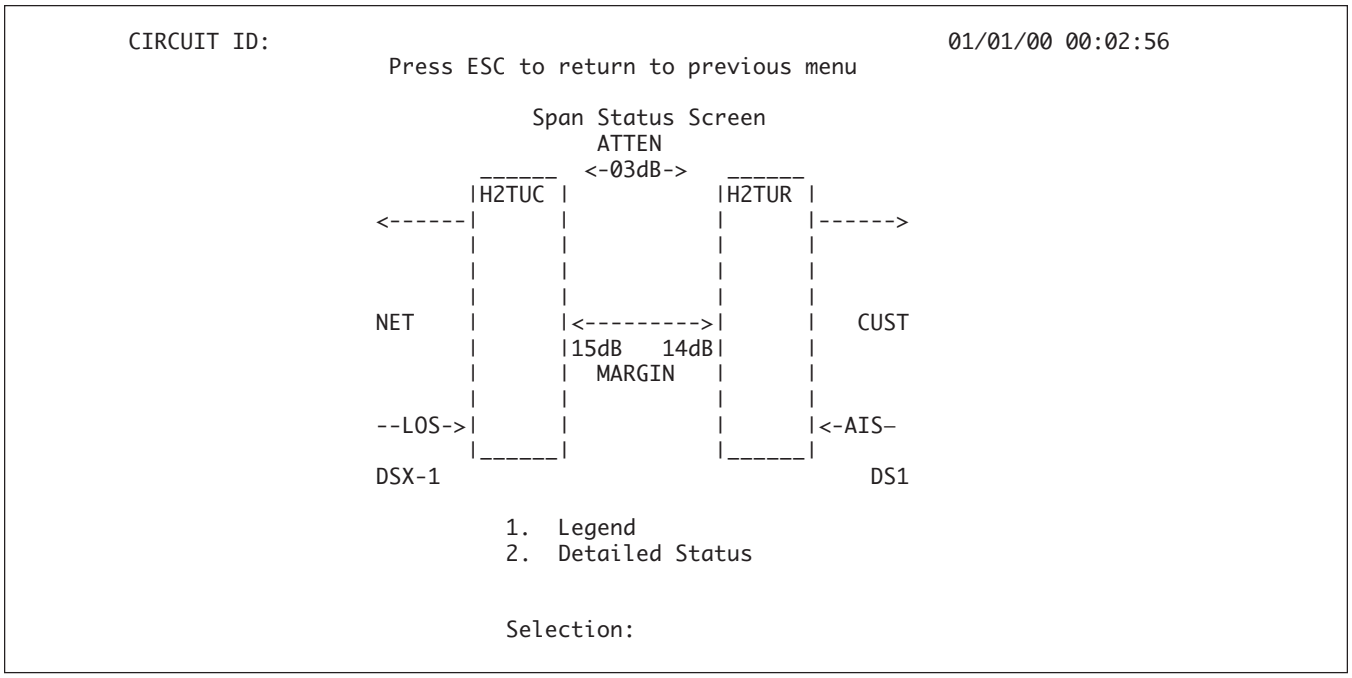


Figure 8. Span Status Screen

The Detailed Status selection from the System Status Menu, illustrated in **Figure 9**, displays the T1 and HDSL2 status for each receiver point. The Legend selection provides a description of the messages that are used on the Status Screens. A key to the information provided on these screens is shown below. There is also a Zero Registers selection, which applies only to error indicators displayed on the status screen.

Figure 10 illustrates the Loopback and Test Commands Screen, which provides the user with the ability to evoke or terminate all available HDSL2 loopbacks. Each HSDL2 circuit component can be looped toward the network or customer from this screen. It also provides a self-test option to perform a self-diagnostic of the H2TU-C and H2TU-R. A Loop down ALL units command is available in lieu of the Self-Test Option when any loopback is active.

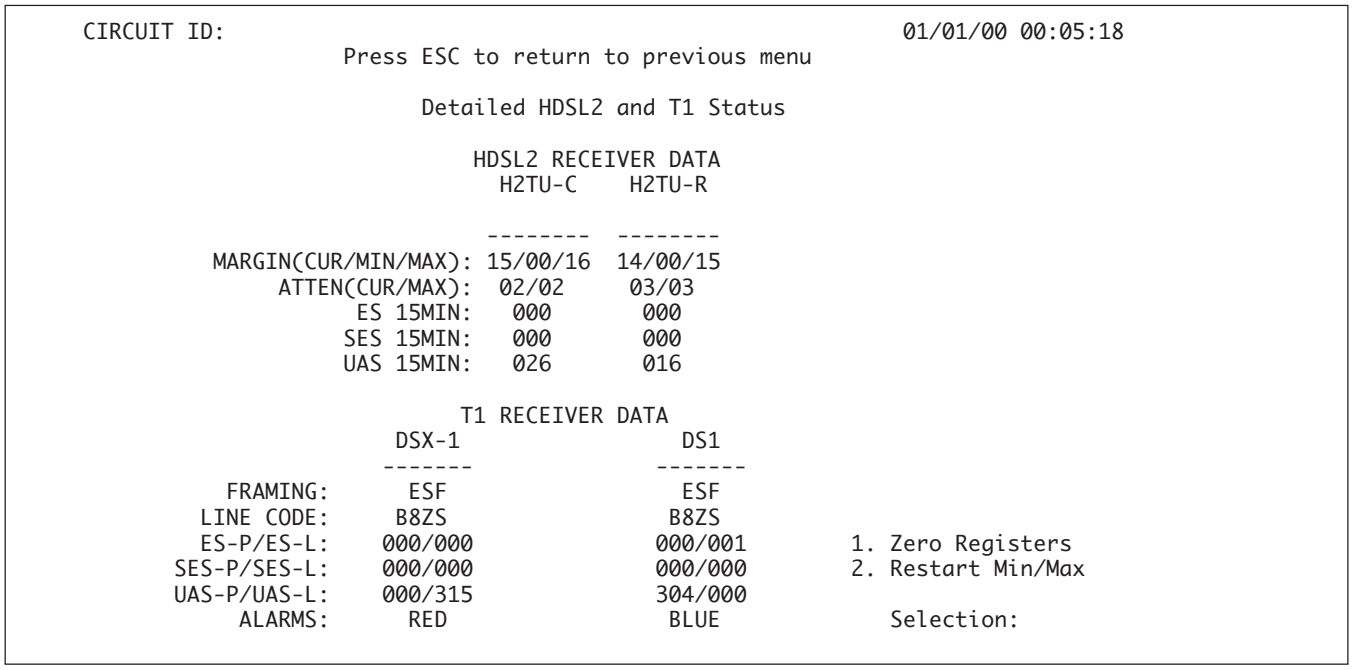


Figure 9. Detailed System Status Screen

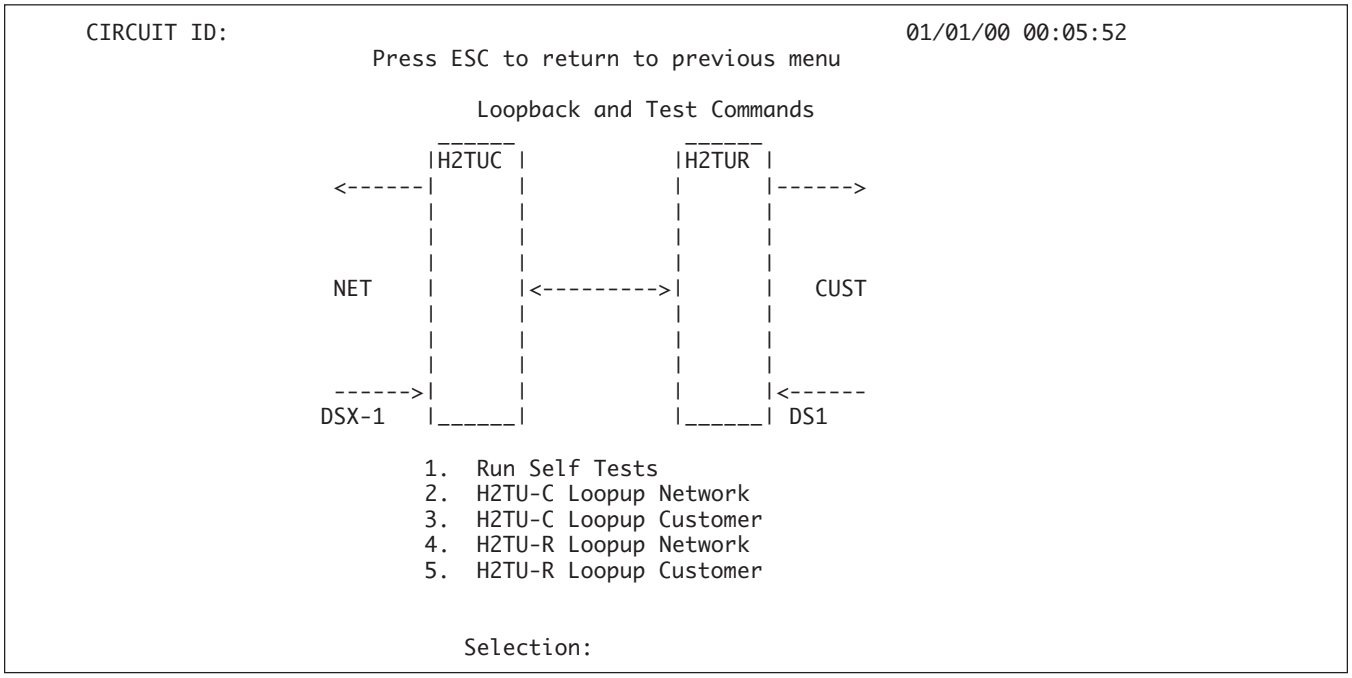


Figure 10. Loopback and Test Commands Screen

The Performance History Screens, illustrated in **Figure 11** and **Figure 12**, display the historical HDSL2 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 last 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 7 days of 24-hour interval data.

The user is prompted to select a module and interface to view the corresponding performance data. Line (L) and Path (P) related data can be viewed.

```
CIRCUIT ID:                                                  01/01/00 00:06:35
                  Press ESC to return to previous menu

        Menu            24 Hour H2TUC DSX-1 Performance Data

  1.  Definitions             ES-P  SES-P UAS-P CV-P
  2.  Reset Data              00000 00000 00000 0000000
  3.  15 Min Data       12/31 ----- ----- ----- -------
  4.  24 Hr Data        12/30 ----- ----- ----- -------
  5.  Line Data         12/29 ----- ----- ----- -------
  6.  Path Data         12/28 ----- ----- ----- -------
  7.  H2TUC DSX-1       12/27 ----- ----- ----- -------
  8.  H2TUC LOOP        12/26 ----- ----- ----- -------
  9.  H2TUR LOOP        12/25 ----- ----- ----- -------
 10.  H2TUR DS1

                                                  _ _ _         _ _ _
                                              --7-->|     |       |     |---->
                                                    |  C  |<-8--9->|  R  |
                                              <-----|_ _ _|       |_ _ _|<-10-
                         Selection:
```

Figure 11. 24-Hour Performance History Path Data Screen

```
CIRCUIT ID:                                                  01/01/00 00:08:15
                  Press ESC to return to previous menu

        Menu          15 Minute H2TUC DSX-1 Performance Data

  1.  Definitions               ES-L  SES-L UAS-L CV-L
  2.  Reset Data                000   000   492   00000
  3.  15 Min Data         00:00 ---   ---   ---   -----
  4.  24 Hr Data          23:45 ---   ---   ---   -----
  5.  Line Data           23:30 ---   ---   ---   -----
  6.  Path Data           23:15 ---   ---   ---   -----
  7.  H2TUC DSX-1         23:00 ---   ---   ---   -----
  8.  H2TUC LOOP          22:45 ---   ---   ---   -----
  9.  H2TUR LOOP          22:30 ---   ---   ---   -----
 10.  H2TUR DS1           22:15 ---   ---   ---   -----
                          22:00 ---   ---   ---   -----
                          21:45 ---   ---   ---   -----
                          21:30 ---   ---   ---   -----
                          21:15 ---   ---   ---   -----

                                                  _ _ _         _ _ _
  F.  Forward                                 --7-->|     |       |     |---->
                                                    |  C  |<-8--9->|  R  |
                         Selection:           <-----|_ _ _|       |_ _ _|<-10-
```

Figure 12. 15-Minute Performance History Line Data Screen

Figure 13 and **Figure 14** display the Performance Data Definitions Screens.

```
CIRCUIT ID:                                                  01/01/00 03:38:08
                          Performance Data Definitions


H2TUC, H2TUR, and H2R LOOP Related:     HDSL2 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
  UAS-L   Unavailable Seconds             >10 cont. SES-Ls
  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 13. Performance Data Definitions Screen, Loop Related

```
CIRCUIT ID:                                                  01/01/00 03:38:27
                          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
  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 14. Performance Data Definitions Screen, Path Related

Figure 15 illustrates the Circuit ID, Time/Date Screen. 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 as MMDDYY (for example, enter January 31, 2000, as “013100”).

This unit includes two terminal emulation modes. The desired terminal mode can be selected from the Terminal Modes Screen, illustrated in **Figure 16**. Additionally, pressing “CTRL” and “T” while on any screen can toggle the two terminal modes.

The default terminal emulation mode is the Real Time Update Mode (VT100). This mode provides real time updating of HDSL2 circuit conditions and provisioning options as changes occur. While in Real Time Update mode, the unit is anticipating baud poll responses from the terminal.

```
CIRCUIT ID:                                                  01/01/00 03:39:40
                    Press ESC to return to previous menu




          New Circuit ID =


                New Date =   /  /    (MM/DD/YY)
                New Time =   :  :    (HH:MM:SS)



                     Press TAB to skip to next entry field.

                        Press ENTER to set new Circuit ID.
```

Figure 15. Circuit ID, Time/Date Screen

```
CIRCUIT ID:                                                  01/01/00 00:40:53
                     Press ESC to return to previous menu

                  TERMINAL MODES MENU

    MANUAL UPDATE MODE:

    * You can print or log screens
    * No text is highlighted
    * “3 SPACES TO UPDATE” appears at the top of each screen,
       reminding you to press the spacebar 3 times to update the screen
    * There is a delay between screen changes & updates
    * After 30 min. of no interaction, a new baud rate search is begun
    * Ignores input until screen is finished printing.

    REAL-TIME UPDATE MODE:

    * Faster of the two modes
    * You cannot print screens to a log file
    * Highlighting is enabled
    * Recommended for daily operation


              Press CTRL+T to toggle update modes on any screen.
```

Figure 16. Terminal Modes Menu Screen

The second terminal emulation mode is Manual Update Mode which allows the user to manually update the provisioning option screens. This mode supports efficient print screen and log file utilities for storage of key provisioning parameters, alarm or performance history and current system status. “3 SPACES TO UPDATE” appears at the top of each screen. By pressing the space bar 3 times the screen will be refreshed and will reflect the most current circuit conditions and provisioning options.

The Alarm History Screen, illustrated in **Figure 17**, provides the user with a detailed alarm history and events log for the HDSL2 and T1 spans. This screen includes a time, date, first/last occurrence and count for each type of HDSL2 or T1 alarm.

```
CIRCUIT ID:                                                  01/01/00 00:41:34
                   Press ESC to return to previous  menu


                                T1 Alarm History
LOCATION   ALARM       FIRST                LAST                 CURRENT   COUNT
-------------------------------------------------------------------------------
H2TU-C    RED(LOS/LOF) 01/01/00  00:00:04   01/01/00  00:00:04   Alarm      001
 (DSX-1)  YELLOW(RAI)                                            OK         000
          BLUE(AIS)                                              OK         000

H2TU-R    RED(LOS/LOF)                                           OK         000
 (DS1)    YELLOW(RAI)                                            OK         000
          BLUE(AIS)    01/01/00  00:00:31   01/01/00  00:00:31   Alarm      001









-------------------------------------------------------------------------------
 1. T1 Alarm       2. HDSL2 Span                      C. Clear T1 Alarm
                            Selection:
```

Figure 17. Alarm History Screen

The Event History Screen, illustrated in **Figure 18**, provides a log history of HDSL2 circuit events. The following is a summary list of possible events:

- Circuit ID Change
- DS1 Transmit Level Option Change
- DSX/DS1 Alarm Type Active/Inactive
- DSX-1 Line Build Out Option Change
- Element Network/Customer Loop up/Loop down
- Event Log Reset
- External Alarm Blocking Change
- Framing Option Change
- H2TU-C/H2TU-R Powered Up
- HDSL2/T1 PM Registers Reset
- Line Code Option Change
- Loopback Time out Option Change
- Network Source Setting Change
- NIU Loopback Option Change
- Options were Auto Provisioned from SCU
- Protection Switching Option Changes
- Service State Setting Change
- Shelf Alarm Option Change
- Span Power Option Change
- Time/Date Changed From/To

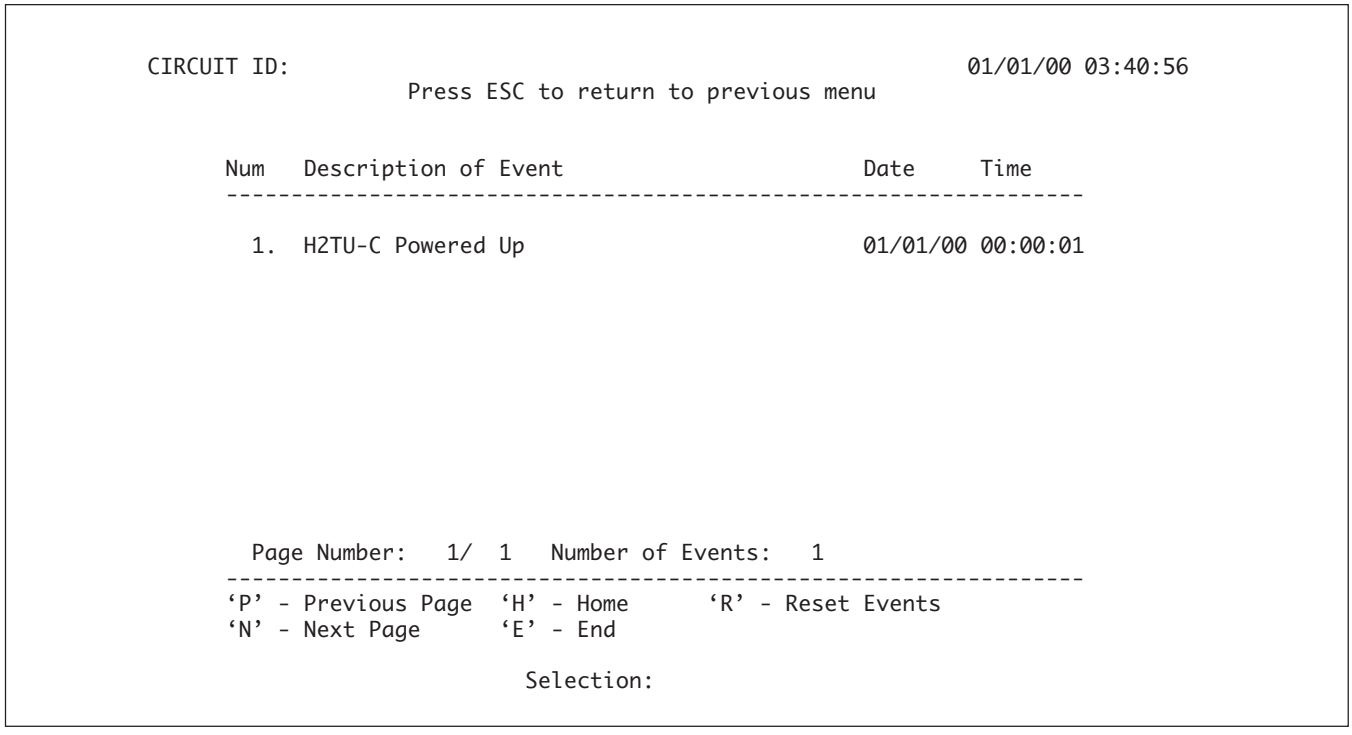


Figure 18. Event History Screen

6. HDSL2 DEPLOYMENT GUIDELINES

The ADTRAN HDSL2 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

   $12 - \{(3*L_{26})/(9-L_{BTAP})\}$ (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 19**.

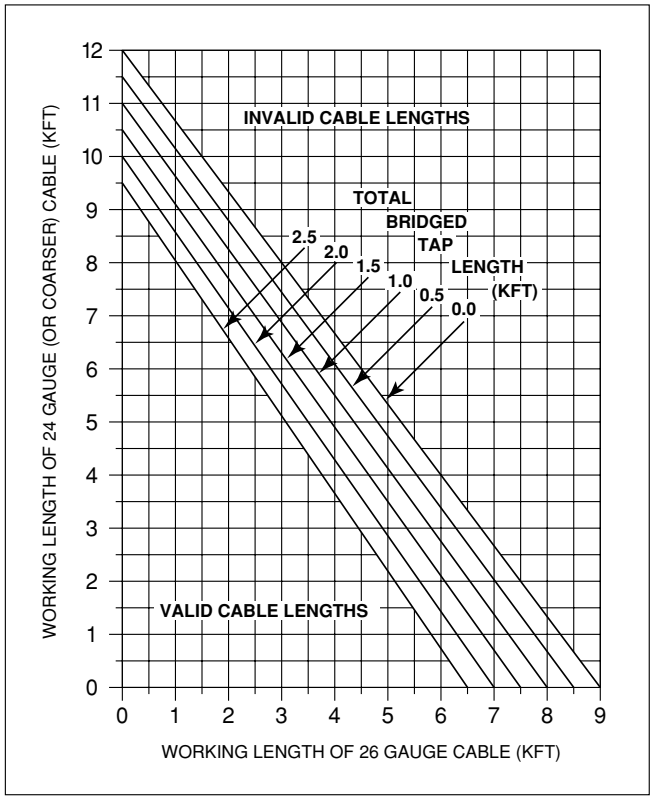


Figure 19. HDSL2 Deployment Guidelines

Loop loss per kft for other wire is summarized in **Table 6**.

Table 6. HDSL2 Loss Values (200 kHz cable loss in dB/kft at 135Ω)

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

Recommended maximum local loop loss information for PIC cable at 70°F, 135 Ω, resistive termination is provided in **Table 7**.

Table 7. Loop Insertion Loss Data

Frequency (Hz)	Maximum Loss (dB)
3,000	12.00
10,000	15.00
50,000	25.50
100,000	30.00
150,000	32.75
200,000	32.25
250,000	37.50
325,000	42.00

An approximation for the maximum amount of wideband noise on an HDSL2 local loop as measured by a 50 kb filter is ≤ 31 dBrn.

An approximation for the maximum level of impulse noise as measured using a 50 kb filter on an HDSL2 loop is ≤ 50 dBrn.

NOTE

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

For further information regarding deployment guidelines and applications, reference ADTRAN's Supplemental Deployment Information for HDSL/HDSL2 document, P/N 61221HDSLL1-10.

7. TROUBLESHOOTING PROCEDURES

Use **Table 8** to troubleshoot the ADTRAN H2TU-R.

8. MAINTENANCE

The ADTRAN H2TU-R requires no routine maintenance. In case of equipment malfunction, use the faceplate Bantam jack connector 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 And Product Support (CAPS) Department.

9. PRODUCT SPECIFICATIONS

Table 9 lists the H2TU-R specifications.

10. WARRANTY AND CUSTOMER SERVICE

ADTRAN will replace or repair this product within ten (10) years from the date of shipment if it does not meet its published specifications or fails while in service. (See ADTRAN *U.S. and Canada Carrier Networks Equipment Warranty,* 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 and availability
(800) 827-0807

ADTRAN Technical Support

Pre-sales Applications/Post-sales Technical Assistance
(800) 726-8663

Standard support hours:
Monday-Friday, 7 a.m. - 7 p.m. CST

Emergency support: 7 days/week, 24 hours/day

ADTRAN Repair/CAPS

Return for repair/upgrade
(256) 963-8722

Repair and Return Address:

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

Table 8. Troubleshooting Guide

Condition	Solution
All front panel indicators are *off*.	1. Make sure the H2TU-R is properly seated in the housing. 2. Verify that an adequate local power source is being used. 3. If Steps 1 and 2 pass, replace the H2TU-R.
Power is present and adequate, but loop sync is not available (DSL LED is *off*).	1. Verify that the loop conforms with CSA guidelines (not too long, etc.). 2. Verify that loop loss at 196 kHz is not greater than 35 dB. 3. Verify that noise on the HDSL2 loop is within acceptable limits (see section 6). 4. If Steps 1 through 3 pass and loop sync is still not available, replace the unit with one known to be in proper working condition.

Table 9. ADTRAN T200 H2TU-R Specifications

Loop Interface

Modulation Type	16-TC PAM
Mode	Full Duplex, Partially Overlapped, Echo Cancelling
Number of Pairs	One
Bit Rate	1.552 mpbs
Baud Rate	517.333k baud
Service Range	Defined by Carrier Service Area Guidelines
Loop Loss	35 dB maximum @ 196 kHz
Bridged Taps	Single Taps < 2 kft, Total Taps < 2.5 kft
Performance	Compliant with ANSI T1.418-2000 (HDSL2 Standard)
Return Loss	12 dB (50 kHz to 200 kHz)
Input Impedance	135 Ω
H2TU-C Tx Pwr (Data) Level	16.6 ± 0.5 dBm (0 to 450 kHz)
H2TU-C Tx Pwr (ACT) Level	16.3 + 0.5 dBm (0 to 350 kHz)
Maximum Loop Resistance	900 Ω per span

Customer Interface

DS1 (T1.403-compatible) (ITU-T I.431 compliant)	
DS1 Signal Output Level	0 or -15 dB
DS1 Input Signal Level	0 to -22.5 dB
DS1 Line Coding	AMI, B8ZS
DS1 Framing Format	SF, ESF, Unframed

Power

Maximum Heat dissipation (local power)...3.0 Watts

Clock Sources

Clock Sources	Internal, HDSL2 Loop Derived
Internal Clock Accuracy	± 25 ppm, (exceeds Stratum 4). Meets T1.101 timing requirements.

Tests

Diagnostics	Loopback (H2TU-R), initiated with HDSL2 in-band codes, initiated with T1 NIU in-band codes, initiated with H2TU-C command, initiated manually, H2TU-R control port. Self-Test.

Physical

Dimensions	5.5 in. High, 0.7 in. Wide, 6.0 in. Deep
Weight	< Approximately 6 oz.

Environment

Temperature	Operating (Standard): -40°C to +70°C; Storage: -40°C to +85°C
Relative Humidity	Up to 95 percent noncondensing

Compliance

UL Listed
Bellcore NEBS Level 3 (SR-3580)
FCC 47CFR Part 15, Class A

Part Number

H2TU-R T200 MON	1222024L6

Appendix A
HDSL2 Loopbacks

HDSL2 MAINTENANCE MODES

This appendix describes operation of the HDSL2 system with regard to detection of in-band and ESF facility data link loopback codes. The operation of the loopback commands in the ADTRAN HDSL2 system is compliant with the recommendation to ANSI recorded in T1E1.4/92. The HDSL2 network loopback points described below are shown in **Figures A-1** and **A-2**.

H2TU-C Loopback: A regenerative loopback of the DSX-1 signal toward the network.

H2TU-R Loopback: A regenerative loopback of the DS1 signal toward the network. This loopback is in addition to a separate Smartjack loopback. Separate activation sequences are provided for the H2TU-R and the Smartjack loopback initiation.

Upon deactivation of a loopback, the HDSL2 system will synchronize automatically.

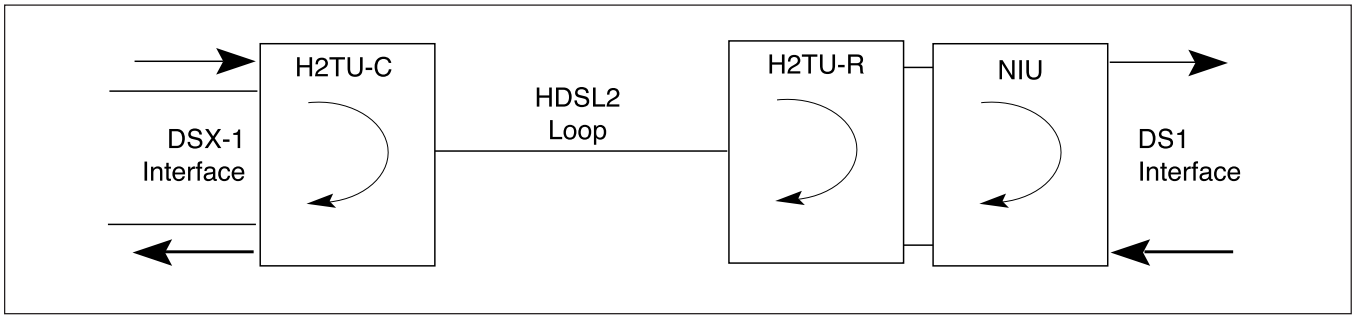


Figure A-1. HDSL2 Loopback Points

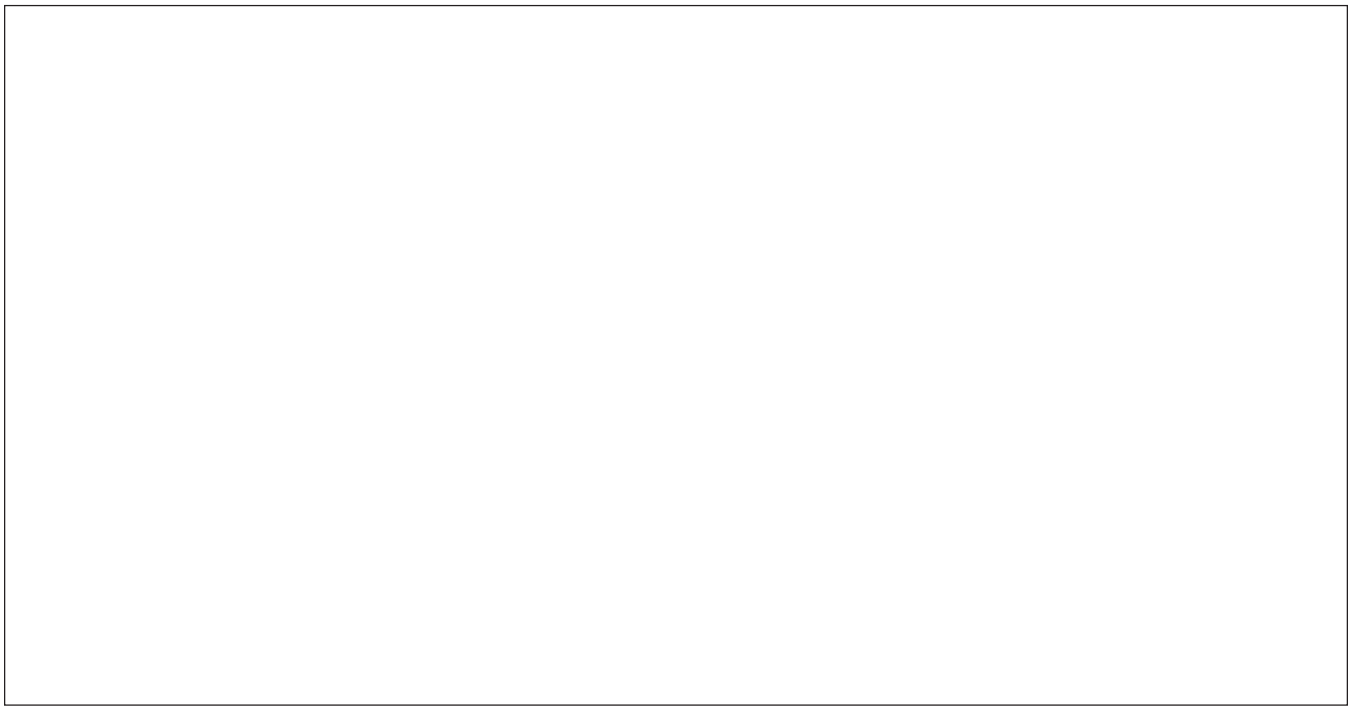


Figure A-2. HDSL2 Element State Diagram

Loopback Process Description

In general, the loopback process for the HDSL2 system elements is modeled on the corresponding DS1 system process. Specifically, the H2TU-C loopback is similar to an Intelligent Office Repeater loopback and the H2TU-R loopbacks are similar to an inline T1 Repeater loopback.

Each HDSL2 system element is independently described by the state diagram shown in Figure A-2. The four states are disarmed, loop up, armed, and loop up/time out disable.

State transitions result from in-band and ESF Data Link sequences as well as time out operations. The sequences and time out values are as follows:

1. Arming Sequence (In-band and ESF)
2. Activation Sequence
3. Deactivation Sequence
4. Disarming Sequence (In-band and ESF)
5. Loop up Time out
6. Arming Time out

In-band control code sequences are transmitted over the DS1 link by either the *unframed* or *overwrite* method. The HDSL2 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.

States and State Transitions

A summary of time out and control sequences is given in **Table A-1**.

NOTE

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

The **Disarmed State** is the normal mode of operation. Each HDSL2 element is transparent to the data flow. However, the in-band data flow and the ESF data link are monitored for the arming sequence.

The in-band control code sequence used to simultaneously arm the loopback capability of all of the HDSL2 elements is the following 5-bit pattern:

Arm Sequence 11000

Note that this sequence is the standard NIU loop up code. If the NIU loopback feature for the HDSL2 circuit is enabled (see *H2TU-C Switch Options*), the arming sequence will activate the NIU loopback in the H2TU-R. If the NIU loopback feature is disabled and an external Smartjack NIU is present, the HDSL2 arming process will not interfere with NIU detection of the loop up code.

All other in-band sequences are ignored in the disarmed state.

The ESF Data Link sequence used to simultaneously arm the loopback capability of all of the HDSL2 elements is the following 16-bit pattern ESF data link sequence:

ESF Arm Sequence 0001 0010 1111 1111
for four repetitions

HDSL2 element arming and NIU loop up is performed as described for the in-band arming sequence.

All other ESF patterns are ignored in the disarmed state.

In the **Armed State**, the HDSL2 system element continues to be transparent to the data flow. However, the in-band data flow and ESF data link is monitored for disarming and activation codes. An arming time out value causes the automatic return of the HDSL2 element to the disarmed state.

Transition from Armed to Loop Up State: An in-band control code sequence is used to command a specific HDSL2 element to move from the armed state into the loop up state. Each HDSL2 element has a unique 16-bit activation control code sequence as shown in the following example.

H2TU-C Activation Sequence .. 1101 0011 1101 0011
H2TU-R Activation Sequence .. 1100 0111 0100 0010

Table A-1. HDSL2 Loopback Control Codes

Name	Code	Detection Time	Comments
Arming (In-band) Arming (ESF)	11000 0001 0010 1111 1111	5 Seconds 4 Repetitions	Signal sent in-band or over ESF data link. HDSL2 elements in disarmed state make transition to armed state. Detection of either code results in Smartjack loop up, if NIU loopback is enabled.
Activation (H2TU-C)	1101 0011 1101 0011	> 4 Seconds	Signal sent in-band. HDSL2 elements in armed state make transition to loop up state. Loop up state time out is programmable from the H2TU-C.
Activation (H2TU-R)	1100 0111 0100 0010	> 4 Seconds	
Deactivation (all HDSL2 elements)	1001 0011 1001 0011	> 5 Seconds	Signal sent in-band. HDSL2 element in loop up state makes transition to armed state.
Disarming (In-band) Disarming (ESF)	11100 0010 0100 1111 1111	5 Seconds 4 Repetitions	Signal sent in-band or over ESF data link. HDSL2 elements in any state make transition to disarmed state.
Arming Time out	N/A	2 Hours	
Loop up Time out	N/A	Programmable from H2TU-C: None, 20, 60, or 120 minutes	HDSL2 element in loop up makes transition to armed state.
Loopback Time out Override	1101 0101 1101 0110	>5 Seconds	Signal sent in-band. Sets Loopback Time out to NONE. Time out will return to previous value when pattern is removed. Arming pattern (11000) must precede this pattern.
Span Power Disable	0110 0111 0110 0111	>5 Seconds	Signal sent in-band. Disable span power of remotes. Span power will return when pattern is removed. Arming pattern (11000) must precede this pattern.

The designated HDSL2 element will loop up after receiving the proper activation sequence.

If the NIU loopback feature for the HDSL2 circuit is enabled (see *H2TU-C Switch Options*), the 5-bit in-band arming sequence (11000) or the 16-bit ESF data link sequence (0001 0010 1111 1111) will activate the NIU loopback in the H2TU-R.

Transition from Armed to Disarmed State: All HDSL2 elements can be commanded to move from the armed state into the disarmed state by the standard 5-bit in-band disarming sequence used for NIU Smartjack loop down. Each HDSL2 element must disarm after receiving the following code for 5 seconds per element:

Disarm Sequence 11100

The disarming process ensures race-free operation of HDSL2 element disarming and Smartjack loop down. Duration of the disarm sequence may need to exceed 24 seconds to allow detection and loop down of up to three HDSL2 elements and the Smartjack.

All HDSL2 elements can be commanded to move from the armed state into the disarmed state by the ESF DATA LINK disarming sequence used for NIU Smartjack loop down as follows:

ESF Disarm Sequence 0010 0100 1111 1111
for four repetitions per
element in loopback

The disarming process ensures race-free operation of HDSL2 element disarming and Smartjack loop down. Duration of the disarm sequence may need to exceed 16 repetitions to allow detection and loop down of up to three HDSL2 elements and the Smartjack. This sequence will loop down the Smartjack and the HDSL2 element.

All HDSL2 elements will automatically move from the armed state into the disarmed state when a default time out value of 2 hours is reached.

Arming Time Out ..... 2 Hours

Overriding Loopback Time Out:
If the units are armed and this pattern is sent, the loopback time out will be disabled. The time out option will be updated on the Provisioning Menu of the HTU-R (viewable through the RS-232 port) to "None". As long as the units remain armed, the time out will remain disabled. When the units are disarmed, the loopback time out will return to the value it had before the D5D6 code was sent.

Loopback Time Out Override 1101 0101 1101 0110

Disabling Span Power:

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.

Span Power Disable 1101 0101 1101 0110

In the **Loop Up State**, the selected HDSL2 element provides continuous loop up of the DS1 signal. However, the data flow is monitored for the in-band deactivation sequence, the in-band disarming sequence, and the ESF data link disarming sequence. Also, a loop up time out value causes automatic return to the armed state. All other control code sequences are ignored in the loop up state.

Transition from Loop Up to Armed State: Any HDSL2 element can be commanded to move from the loop-up state into the armed state by a single in-band 16-bit deactivate control code sequence. The same deactivation sequence as shown is used for all HDSL2 elements.

Deactivation Sequence 1001 0011 1001 0011

An HDSL2 element must loop down after receiving this deactivation sequence for at least 5 seconds.

Deactivation After Receiving Sequence for > 5 seconds

Duration of the deactivation sequence may need to exceed 18 seconds to allow detection and loop down of up to three HDSL2 elements. The deactivation sequence does not disarm the HDSL2 elements. They can still respond to activation sequence control codes.

All HDSL2 elements automatically move from the loop up state into the armed state when the selected loop up time out value is reached.

Loop Up Time Out ..... programmable from the H2TU-C at None, 20, 60, or 120 minutes

Transition from Loop Up to Disarmed State: All HDSL2 elements can be simultaneously commanded to move from the loop up state into the disarmed state by either the standard 5-bit in-band disarming sequence used for NIU Smartjack loop down, or by the ESF DATA LINK command, as described in *Transition from Armed to Disarmed State*.