3192 H2TU-C
2-Wire HDSL (HDSL2)
Transceiver Unit for the Central Office
Installation and Maintenance

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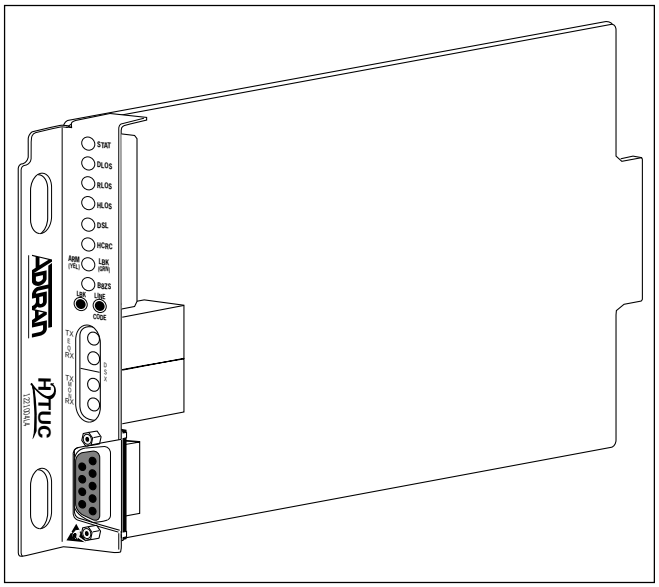


Figure 1. ADTRAN 3192 H2TU-C

1. GENERAL

The ADTRAN 3192 HDSL2 Transceiver Unit, illustrated in **Figure 1**, for the Central Office (H2TU-C), P/N 1221004L4, is the Central Office (CO) unit used to deploy an HDSL2 T1 circuit using 2-wire metallic facilities. The unit occupies one slot in a CI Wescom® 3192 Office Repeater Bay.

DSX-1 signals are provided to and received from the network while HDSL2 signals are provided to the local loop. The ADTRAN H2TU-C works in conjunction with the ADTRAN H2TU-R and H2R to provide a DS1 service up to 24,000 feet on the local loop.

NOTE

Local practices may preclude use of HDSL2 Range Extenders (H2R).

Description

This H2TU-C works with multiple list versions of the HDSL2 Unit for the Remote end (H2TU-R) and HDSL2 Repeater (H2R) some of which are listed below:

Part Number	Description
1221026L1	T200 H2TU-R
1221026L6	T200 H2TU-R MON
1221026L5	T200 H2TU-R B
1221026L7	T200 H2TU-R S
1221045L4	239 H2R
1221041L4	T200 H2R

The H2TU-C can be deployed in circuits consisting of one H2TU-C and one H2TU-R. When deployment requires an H2R, the H2TU-C can be deployed with one H2R and one H2TU-R.

System power and alarm bus connections are made through the backplane of the shelf. DSX-1 and HDSL2 signals are connected through the wire-wrap pins or the 64-pin shelf connectors related to each individual slot.

The H2TU-C contains an onboard fuse. If the fuse opens, it causes the STAT LED to be OFF. This fuse is not field replaceable.

The H2TU-C uses a DC-to-DC converter to derive its internal logic and span powering voltages from the -48 VDC office supply. Span powering voltages meet all requirements of Class A2 voltages as specified by Bellcore GR-1089-CORE.

Revision History

This is the second issue of this practice. The Provisioning Screen has been updated to include the default values, and the text has been revised.

2. INSTALLATION

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

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

The H2TU-C plugs directly into standard CI Wescom 3192 office repeater shelves. The unit may be plugged into any of the first 28 slots of the 3192 Shelf. No installation wiring is required.

An eight-position rotary switch (SW1) located on the board is used to configure line buildout. **Figure 2** shows the location of this switch. A definition of the switch is shown in **Table 1**. Configuration must be performed by manually selecting the option switch. Manual configuration should be performed before installing the unit into the shelf.

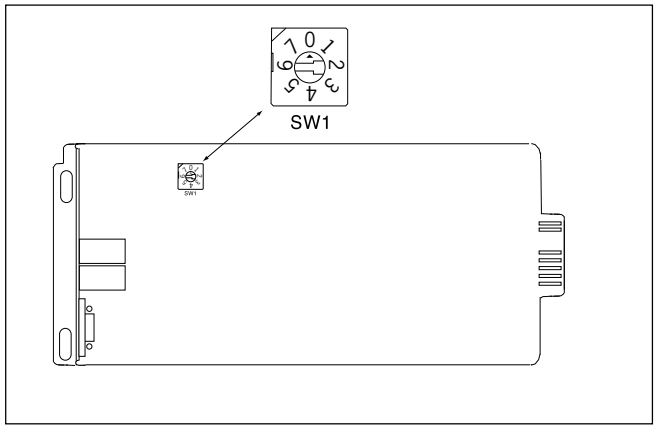


Figure 2. H2TU-C Switch Arrangement

Table 1. Rotary Switch (SW1) Option Settings [1]

Switch	Function	Description
SW1	DSX-1 Line Buildout	This rotary switch is used to select operation of the line buildout equalizer in series with the DSX-1 output.
SW1-0	0	Line length from 0-133 feet of ABAM cable (default)
SW1-1	133	Line length from 133-266 feet of ABAM cable
SW1-2	266	Line length from 266-399 feet of ABAM cable
SW1-3	399	Line length from 399-533 feet of ABAM cable
SW1-4	533	Line length from 533-655 feet of ABAM cable

[1] The H2TU-C transfers the local configuration to the H2TU-R when circuit synchronization is achieved. The H2TU-R then sets its configuration to match the H2TU-C.

Compliance Codes

Table 2 shows the Compliance Codes for the 3192 H2TU-C. The 3192 H2TU-C complies with the requirements covered under UL 1459 third edition and is intended to be installed in an enclosure with an Installation Code (IC) of "B" or "E."

Table 2. Compliance Codes

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

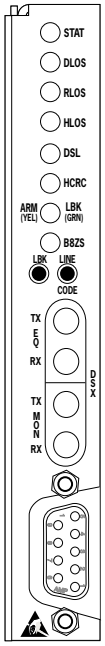
NOTE

This product is intended for installation in Restricted Access Locations only.
Input current at maximum load is 0.7 A at -48 VDC.
Maximum output at overcurrent condition is 165 mA at -190 VDC.

Faceplate Indicators

The H2TU-C has eight faceplate LEDs which indicate operational status “at-a-glance” troubleshooting.
Table 3 defines these LEDs.

Table 3. Front Panel Indicators



LABEL	CONDITION	DESCRIPTION
STAT	*Off*	Indicates a loss of power or a blown fuse.
	Blinking Green	The unit is in the process of acquiring HDSL2 synchronization.
	Solid Green	Normal operation: HDSL2 synchronization is achieved.
DLOS	*Off*	DSX-1 signal is present at the H2TU-C.
	Red	Loss of DSX-1 signal into the H2TU-C.
RLOS	*Off*	DS1 signal is present at the H2TU-R.
	Red	Loss of DS1 signal into the H2TU-R from the CPE.
HLOS	*Off*	Normal operation: HDSL2 synchronization on the Loop.
	Blinking Red	GFI or overcurrent condition detected.
	Solid Red	Loss of HDSL2 synchronization on the Loop.
DSL	*Off*	Unit is in the process of acquiring HDSL2 synchronization, or HDSL2 synchronization has been lost as evidenced by the *Red* HLOS indicator.
	Green	Normal operation: Indicates good signal quality on the Loop. No routine maintenance or verification is required.
	Yellow	Marginal operation: Indicates marginal signal quality on the Loop. Degraded conditions suggest verification of key HDSL2 parameters. For details, refer to the Troubleshooting Guide in subsection 8 of this practice.
	Red	Alarm condition: Indicates poor signal quality on the Loop. Requires prompt troubleshooting of HDSL2 circuit, including verification of pulse attenuation, insertion loss, and other parameters. For details, refer to the Troubleshooting Guide in subsection 8 of this practice.
	Blinking	Pulse attenuation (ATTEN on Span Status Screen) is above the recommended threshold for quality service. If the pulse attenuation is 30 dBor below, the DSL LED will remain solid. As described above, the signal quality (margin) on the Loop is indicated by the color of the DSL LED. For instance, if the signal quality on the Loop is good and the pulse attenuation is bad, the LED will *Blink Green*. If the signal quality is marginal and the pulse attenuation is good, the LED will be *Solid Yellow*.
HCRC	*Off*	Normal operation: No HDSL2 CRC errors detected within the last 30 minutes on the Loop (no local loop trouble).
	Blinking Yellow	One or more HDSL2 CRC errors are being detected on the Loop (local loop trouble).
	Yellow	Four or more HDSL2 CRC errors have occurred on the Loop within the last 30 minutes. After four HDSL2 CRC errors occur, the HCRC LED will remain *Yellow* for 30 minutes. If no HDSL2 CRC errors occur in a rolling 30 minutes, the HCRC LED will extinguish.
ARM/LBK	*Off*	Unit is not in the armed or loopback state.
	Yellow	Arming sequence has been detected. In this state, the unit is armed (ready for loopback), but not in loopback.
	Green	A loopback is active on this specific unit.
B8ZS	*Off*	Indicates AMI line code.
	Green	Indicates B8ZS line code.

3. CONNECTIONS

The 3192 H2TU-C occupies one card slot in a CI Wescom 3192 Office Repeater Bay. Access to power and alarm signals is provided to the card through the backplane of the shelf. DSX-1 and HDSL2 loop signals are connected to the wire-wrap pins or mass termination shelf connectors corresponding to the slot the unit occupies. See **Figure 3** for H2TU-C edge connection wiring.

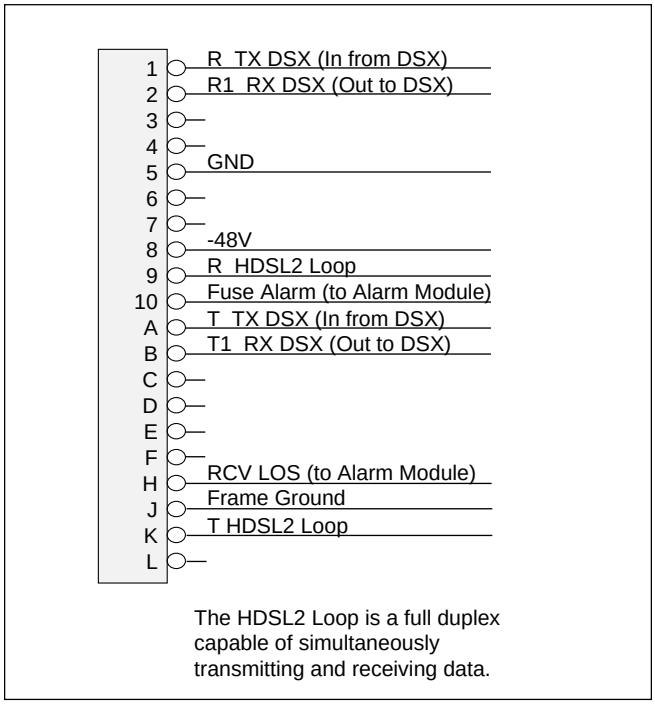


Figure 3. H2TU-C Edge Connector Wiring

The H2TU-C is capable of span powering the H2TU-R by applying simplex current to the local loop. From 10 to 150 *m*A of current is coupled onto the HDSL2 span to power the H2TU-R and H2R when deployed (**see Figure 4**).

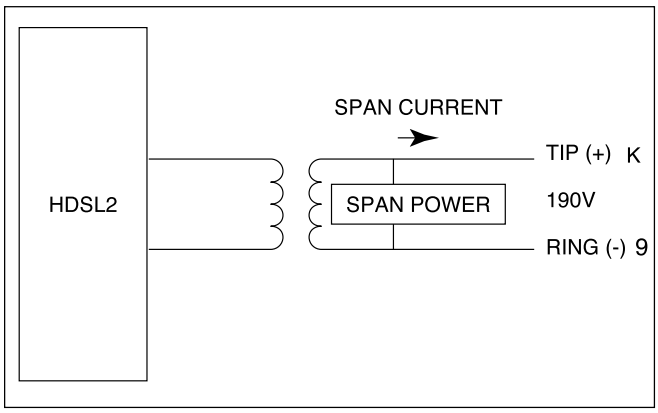


Figure 4. H2TU-C Span Powering Diagram

H2TU-C Alarm Outputs

Pin 10 of the H2TU-C edge connector interface provides a fuse alarm signal that connects -48 VDC to this pin in the presence of a blown fuse. This indicates the card has malfunctioned and should be replaced. Upon a blown fuse condition, the STAT (Status) LED will be OFF. Pin H of the H2TU-C edge connector interface provides a receive loss of signal (RCV LOS) indication that connects -48 VDC to this pin when RCV LOS is detected.

4. HDSL2 SYSTEM TESTING

The ADTRAN HDSL2 system provides the ability to monitor the status and performance of the DSX-1 signals, DS1 signals, and HDSL2 loop signals. Detailed performance monitoring is provided by the faceplate mounted RS-232 Control Port. These features are valuable in troubleshooting and isolating any system level problems that may occur at installation or during operation of the HDSL2 system. The following subsections describe additional testing features.

H2TU-C Bantam Jacks

The front panel of the H2TU-C contains both monitoring and metallic splitting Bantam jacks. 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 DSX-1 monitor jack can be used to connect to a bit error rate tester to monitor for synchronization, test patterns, etc. The EQ (equipment) jacks provide an intrusive, signal interrupting access to the local loop.

Figure 5 illustrates the complete Bantam jack arrangement and details for specific jacks.

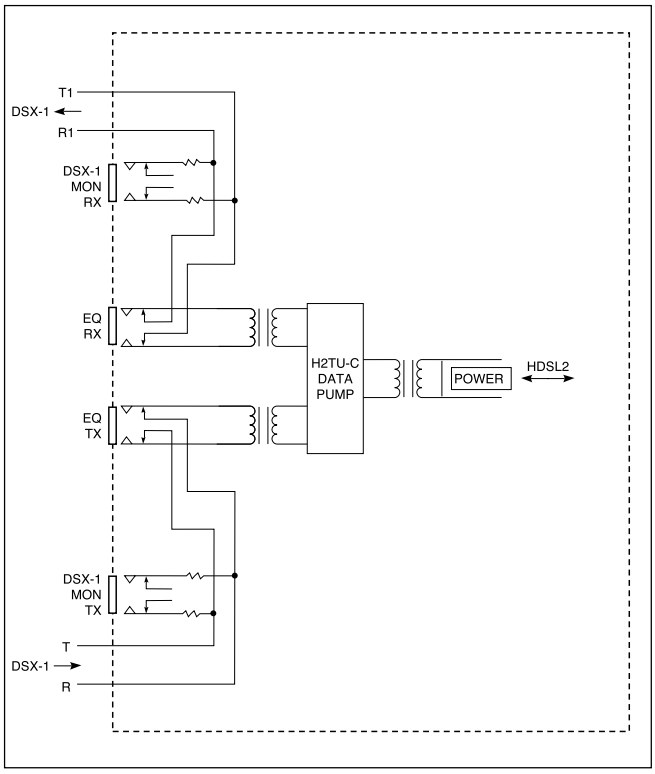


Figure 5. H2TU-C Bantam Jack Arrangement

H2TU-C Loopbacks

The H2TU-C responds to three different loopback activation processes. First, loopbacks may be activated using the craft interface. The Loopback and Test Commands Screen which provides for the H2TU-C, H2TU-R, and H2R loopbacks are described in subsection 6, Figure 13 of this practice.

Second, the H2TU-C responds to the industry *defacto* standard for HDSL2 loopbacks. A detailed description of these loopback sequences is given in Appendix A, Table A-1.

Third, the H2TU-C responds to loopbacks initiated using the LBK push-button located on the faceplate of the unit. See subsection 5 of this practice for details.

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

The loopback condition imposed in all three cases is a logic level loopback at the point within the H2TU-C where the DSX-1 signal passes into the HDSL2 modulators. **Figure 6** depicts all of the loopback locations possible with ADTRAN HDSL2 equipment.

In addition to network-side loopbacks, the H2TU-C provides customer-side loopbacks initiated by using either the terminal control port or inband loop codes (see Appendix A). In this mode, an AIS signal is supplied to the network.

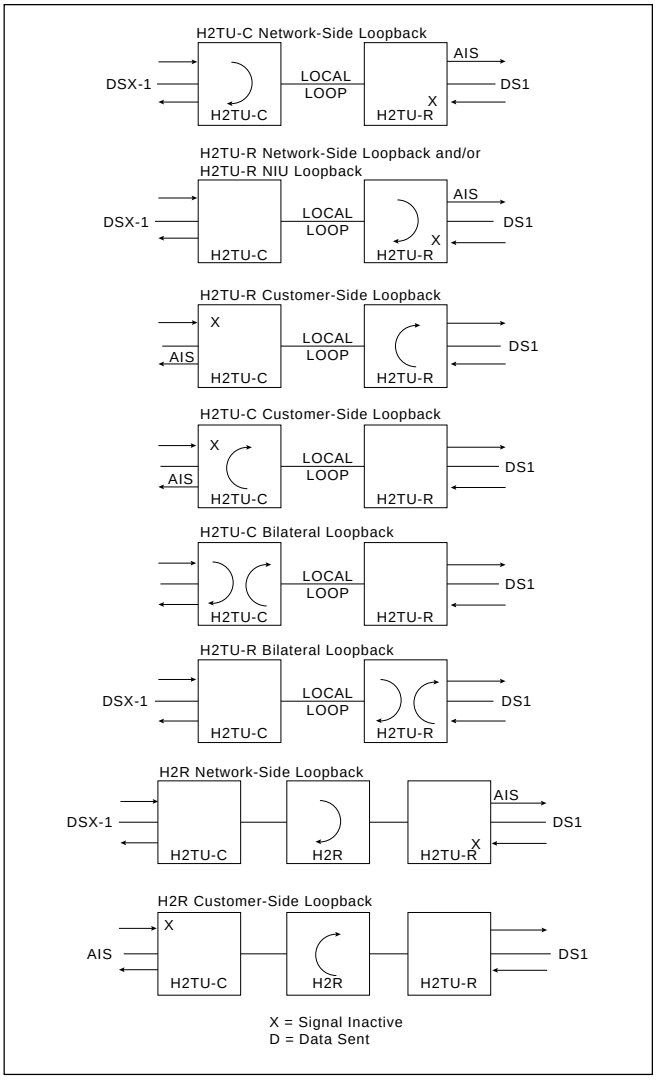


Figure 6. HDSL2 Loopbacks

5. FRONT PANEL OPERATION

The front panel contains two push-button switches on the faceplate. These are labeled LBK and LINE CODE.

The LBK push-button controls a bidirectional loopback at the H2TU-C. Pressing the button causes a bidirectional loopback to occur. If the bidirectional loopback is active, pressing the button a second time will disable the loopback. A push-button loopback can be released by sending the loopdown code (3 in 5), or the loopback will automatically timeout based on the loopback timeout (default setting of 120 minutes).

The LINE CODE push-button controls the line code settings for the circuit. Pressing the push-button toggles the line code setting between AMI and B8ZS. A front panel LED labeled B8ZS will reflect the setting.

6. CONTROL PORT OPERATION

The H2TU-C provides a faceplate-mounted DB-9 connector that supplies an RS-232 interface for connection to a craft interface terminal. The pinout of the DB-9 is illustrated in **Figure 7**.

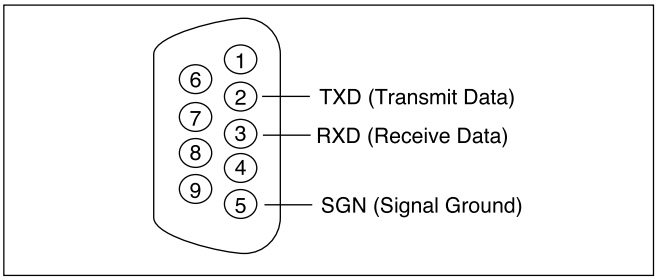


Figure 7. RS-232 (DB-9) Pin Assignments

The terminal interface operates at data rates from 1.2 kbps to 19.2 kbps. A terminal session is initiated by entering multiple space bar characters, which are used by the H2TU-C to determine the rate of the terminal. The asynchronous data format is fixed at 8 data bits, no parity, and 1 stop bit.

NOTE

When operating in Virtual Terminal Mode, the terminal baud rate should be 4.8 kbps or higher.

The H2TU-C supports two types of terminal emulation modes. The Manual Update Mode is a dumb terminal mode, where the user can use print screen and log files commands easily. This mode also includes a "3 SPACES TO UPDATE" message on the top of the terminal screen (press the space bar 3 times to update the screen).

NOTE

Pressing "CTRL" and "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.

The Real-Time Update Mode is a VT-100 terminal mode. This 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

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 4**.

Table 4. Screen Abbreviations

Abbreviation	Definition
ES	Errored Seconds DSX/DS1 SF ..... Second in which a BPV or frame bit error occurs. ESF ..... Second in which a BPV or CRC error occurs. HDSL2 ..... Second in which a CRC error occurs.
SES	Severely Errored Seconds DSX/DS1 SF ..... Second in which 1544 BPVs or 8 frame bit errors occurs. ESF ..... Second in which 1544 BPVs or 320 CRC errors occur. HDSL2 ..... Second in which 165 CRC errors occurs.
UAS	Unavailable Seconds DSX/DS1 ..... Second in which there is a loss of signal or sync. HDSL2 ..... Second in which there is a loss of signal or sync.
SF	Superframe format
ESF	Extended Superframe format
B8ZS	Bipolar with 8 Zero Substitution
AMI	Alternate Mark Inversion
LOS	Loss of Signal
ATTEN	Pulse Attenuation
LBO	Line Buildout
BPV	Bipolar Violation DSX/DS1 ..... Second in which a bipolar violation occurs.
NIU	T1 Network Interface Unit
S/N	Serial Number
15M	Fifteen-Minute period
24H	Twenty-Four-Hour period

The screens illustrated in Figures 8 through 22 are for an HDSL2 circuit deployed with ADTRAN's HDSL2 technology. The circuit includes a H2TU-C and a H2TU-R. This scenario was chosen for inclusiveness of functionality. However, other configurations are possible and their displays will vary slightly from those shown in this section.

A terminal session is initiated by entering multiple space bar characters, which are used by the H2TU-C to determine the speed of the terminal. Once the speed has been determined, the Introductory Menu will appear, illustrated in **Figure 8**.

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

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

```
CIRCUIT ID:                                              01/01/00 00:21:31

                              Adtran HDSL2 Main Menu


                            1.  HDSL2 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









                            Selection:
```

Figure 8. ADTRAN Main Menu Screen

The HDSL2 Unit Information Screen, illustrated in **Figure 9,** 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.

The Provisioning Screen, illustrated in **Figure 10**, displays the current provisioning settings for the HDSL2 circuit. To change a particular option setting, select the appropriate number and a new menu will appear with a list of the available settings.

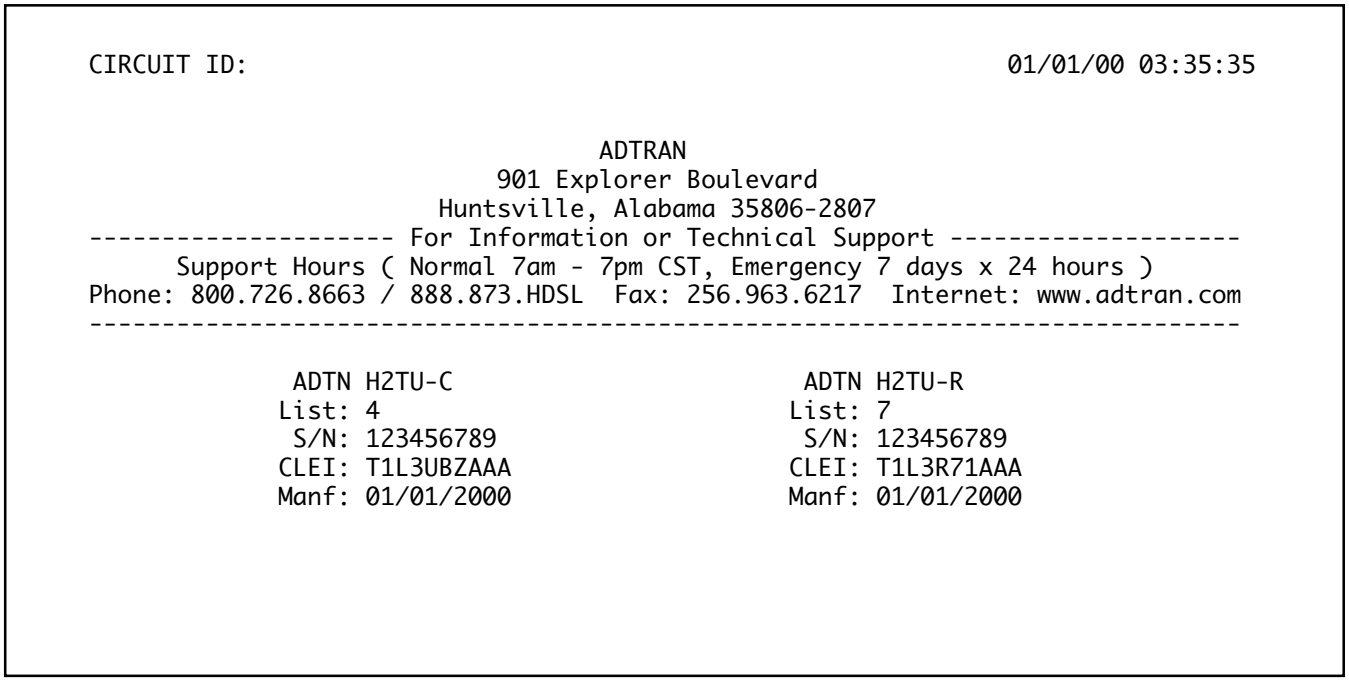


Figure 9. HDSL2 Unit Information Screen

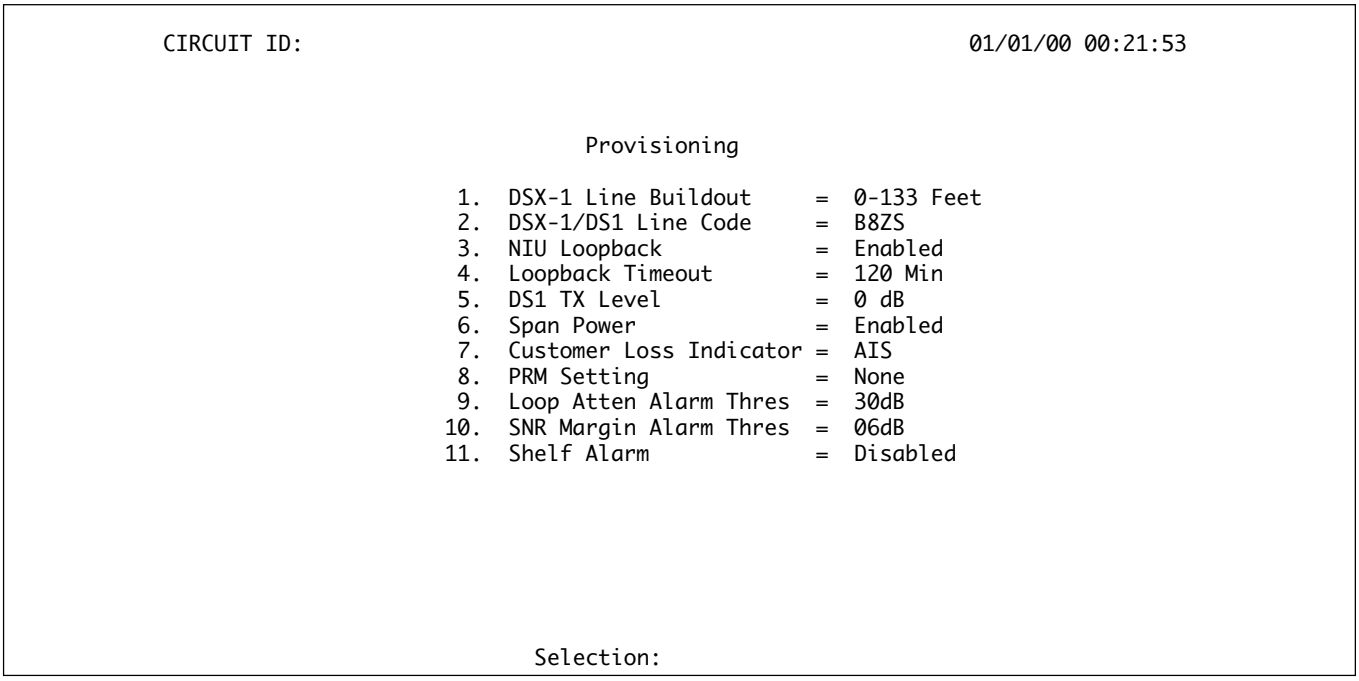


Figure 10. Provisioning Screen

The Span Status Screen, illustrated in **Figure 11**, provides quick access to status information for each HDSL2 receiver in the circuit. The Legend selection provides a description of the messages that are used on the Status Screens.

The Detailed Status selection from the Span Status Menu, illustrated in **Figure 12**, displays the HDSL2 and T1 status for each receiver point. From this screen, all registers can be zeroed (which requires confirmation), and MIN/MAX can be reset.

```
CIRCUIT ID:                                                  01/01/00 00:22:14


                            Span Status Screen
                                 ATTEN
                          ______  <-23dB->   ______
                         |H2TUC |            |H2TUR |
                  <------|      |            |      |------>
                         |      |            |      |
                  NET    |      |<---------->|      |   CUST
                         |      |13dB   13dB|      |
                  ------>|      |  MARGIN    |      |<------
                  DSX-1  |______|            |______|    DS1




                              1.  Legend
                              2.  Detailed Status


                              Selection:
```

Figure 11. Span Status Screen

```
CIRCUIT ID:                                                  01/01/00 00:24:21


                          Detailed HDSL2 and T1 Status

                              HDSL2 RECEIVER DATA
                                H2TU-C    H2TU-R

                               --------  --------
                MARGIN(CUR/MIN/MAX): 13/00/16  13/00/17
                     ATTEN(CUR/MAX):  23/23     23/23
                           ES 15MIN:   001       000
                          SES 15MIN:   000       000
                          UAS 15MIN:   061       014

                               T1 RECEIVER DATA
                           DSX-1                DS1
                          -------              -------
                  FRAMING:     ESF                  ESF
                LINE CODE:     B8ZS                 B8ZS
                ES-P/ES-L:    000/000              000/000        1. Zero Registers
               SES-P/SES-L:   000/000              000/000        2. Restart Min/Max
               UAS-P/UAS-L:   000/000              000/027
                    ALARMS:    NONE                 NONE             Selection:
```

Figure 12. Detailed HDSL2 and T1 Status Screen

Figure 13 illustrates the Loopback and Test Commands Screen, which provides the user with the ability to invoke or terminate all available HDSL2 loopbacks. Each HDSL2 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.

The Performance History Screens, illustrated in **Figure 14** and **Figure 15** 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.

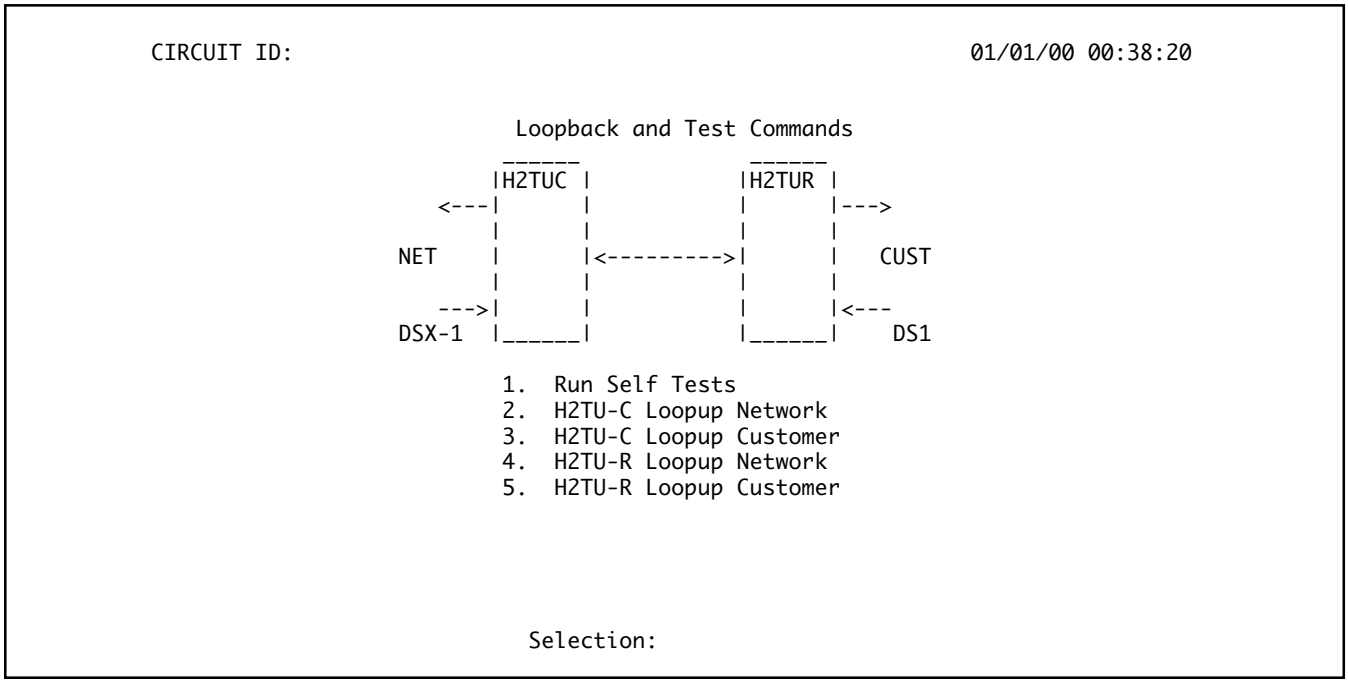


Figure 13. Loopback and Test Commands Screen

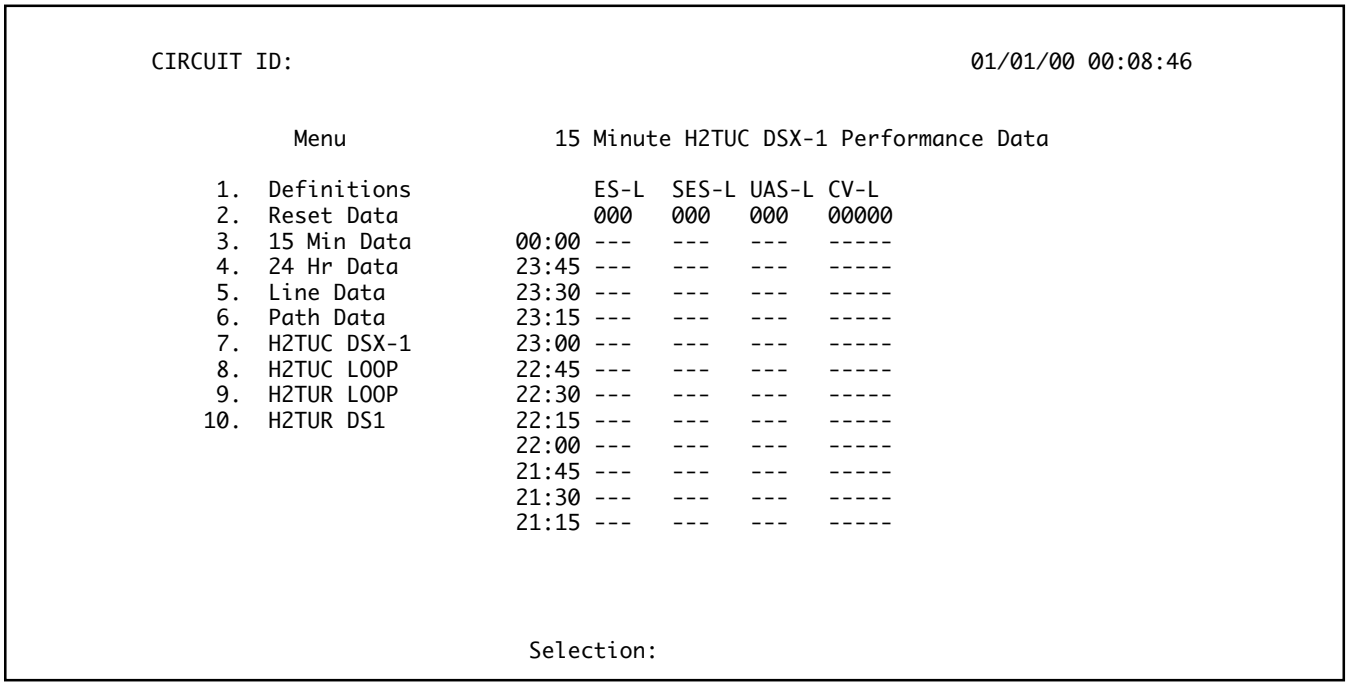


Figure 14. 15-Minute Performance History Line Data Screen

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 31 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) can be viewed.

Abbreviations used in the Performance History Screens are defined in the Data Definitions Screens, see **Figure 16** and **Figure 17**.

```
CIRCUIT ID:                                                  01/01/00 00:08:22


          Menu                  24 Hour H2TUC DSX-1 Performance Data

     1.  Definitions                 ES-L  SES-L UAS-L CV-L
     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            12/24 ----- ----- ----- -------
                              12/23 ----- ----- ----- -------
                              12/22 ----- ----- ----- -------




                                Selection:
```

Figure 15. 24-Hour Performance History Line Data Screen

```
CIRCUIT ID:                                                  01/01/00 00:27:30


                          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 16. Performance Data Definitions Screen

Figure 18 illustrates the Scratch Pad, Circuit ID, and Time/Date Screen. The Scratch Pad data 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 as MMDDYY (for example, enter January 01, 2000, as “010100”).

```
CIRCUIT ID:                                                  01/01/00 00:27:52


                          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 17. Performance Data Definitions Screen, Continued

```
CIRCUIT ID:                                                  01/01/00 00:30:40




   Current Scratch Pad:
      New Scratch Pad =


       New Circuit ID =


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


                    Press TAB to skip to next entry field.


                              Press ESC to Exit.
```

Figure 18. Scratch Pad, Circuit ID, and Time/Date Screen

This unit includes two terminal emulation modes. These modes are described on the Terminal Modes Screen, illustrated in **Figure 19**.

NOTE

Pressing "CTRL" and "T" while on any screen will toggle between Manual and Real-Time Terminal Modes.

The Manual Update Mode 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.

NOTE

When the H2TU-C is used with the 1221026L7, H2TU-R, a remote virtual terminal session is supported while accessing the terminal screens via the craft ports (DB-9) on the faceplate. When operating in Virtual Terminal Mode, the terminal baud rate should be 4.8 kbps or higher. The remote terminal session is automatically initiated if a terminal is connected to the H2TU-R and the HDSL2 loops are in sync with the H2TU-C. When a remote terminal session is in progress, the screens are not accessible from the H2TU-C. Once a remote terminal session is terminated, the screens are available at the H2TU-C. The remote terminal session is terminated by typing "CTRL" + "X" on the terminal at the H2TU-R. Alternatively, if there is no keyboard input at the H2TU-R's terminal for a period of 5 minutes, the remote session will timeout; and the screens will once again be available at the H2TU-C. After the 5 minute timeout, the remote terminal session can be reinstated at the H2TU-R by pressing the space bar several times.

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 00:31:01

                              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 19. Terminal Modes Screen

The Alarm History Screen, illustrated in **Figure 20**, provides the user with a detailed alarm history and events log for the HDSL2, T1 spans and the system alarm history. These screens include a time, date, first/last occurrence and count for each type of HDSL2, T1 and system alarm history.

The Event History Screen, illustrated in **Figure 21**, provides a log history of HDSL2 circuit events.

```
CIRCUIT ID:                                                  01/01/00 00:31:21


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

H2TU-R     RED(LOS/LOF)                                          OK         000
 (DS1)     YELLOW(RAI)                                           OK         000
           BLUE(AIS)                                             OK         000




-------------------------------------------------------------------------------
 1. T1 Alarm       2. HDSL2 Span    3. System Alarm    C. Clear T1 Alarm
                            Selection:
```

Figure 20. T1 Alarm History Screen

```
CIRCUIT ID:                                                  01/01/00 00:32:17


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

   1.  H2TU-C Powered Up                          01/01/00 00:00:01
   2.  DSX Line Buildout Option Change            01/01/00 00:00:01
   3.  H2TU-R Powered Up                          01/01/00 00:17:54









        Page Number:   1/  1   Number of Events:   3
      ------------------------------------------------------------------
      'P' - Previous Page  'H' - Home      'R' - Reset Events
      'N' - Next Page      'E' - End

                            Selection:
```

Figure 21. Event History Screen

7. HDSL2 DEPLOYMENT GUIDELINES

The ADTRAN HDSL2 system is designed to provide DS1-based services over loops designed to comply with the Carrier Service Area (CSA) guidelines. CSA deployment guidelines are given below.

1. All loops are non-loaded only.
2. For loops with 26-AWG cable, the maximum loop length including bridged tap lengths is 9 kft.
3. For loops with 24-AWG cable, the maximum loop length including bridged tap lengths is 12 kft.
4. Any single bridged tap is limited to 2 kft.
5. Total bridged tap length is limited to 2.5 kft.
6. The total length of multi-gauge cable containing 26-AWG cable must not exceed the following:
   $12 - \{(3*L^{26})/(9-L^{BTAP})\}$ (in kft)

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

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

This deployment criteria is summarized in the chart shown in **Figure 22**.

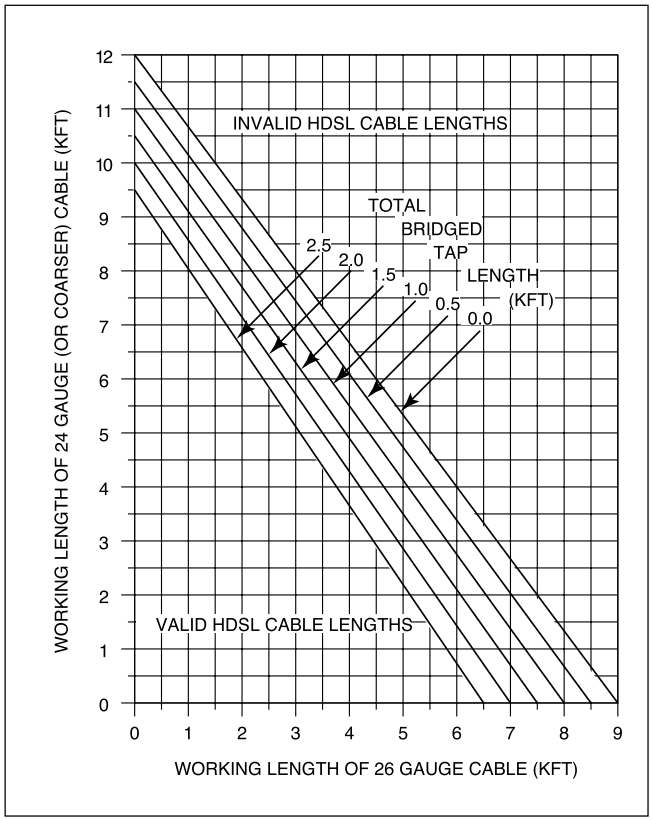


Figure 22. Deployment Guidelines

Loop loss per kft for other wire is summarized in **Table 5**.

Table 5. 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, 135Ω, resistive termination is provided in **Table 6**.

Table 6. Loop Insertion Loss Data

Frequency (Hz)	Maximum Loss (dB)
3,000	12.0
10,000	15.0
50,000	25.5
100,000	30.0
150,000	32.75
196,000	35.0
200,000	35.25
250,000	37.5
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.

Power Consumption

The 3192 H2TU-C current requirements vary depending on the number of span powered units included in the HDSL2 circuit. The configuration aid in **Table 7** can be used to determine maximum allowable shelf fill, while maintaining appropriate current drain.

8. TROUBLESHOOTING PROCEDURES

Table 8 is a troubleshooting guide for the 3192 H2TU-C.

9. MAINTENANCE

The ADTRAN 3192 H2TU-C requires no routine maintenance. In case of equipment malfunction, use the faceplate Bantam jacks to help locate the source of the problem.

ADTRAN does not recommend that repairs be performed in the field. Repair services may be obtained by returning the defective unit to the ADTRAN Customer Service RMA Department.

Table 7. Power Consumption Worksheet

Step 1	Enter size of use for shelf (Amps).	(A)	_____Amps
	(Size required for over current protection (i.e.,100%, 75%, 50%)	(B)	_____Amps
Step 2	Determine the mix of HDSL2 circuits in shelf. Percentage of circuits with an H2TU-R only.	(C)	_____%
Step 3	Determine the current draw of the HDSL2 circuits. Multiply (C) by 0.20 Amps (with no H2R)	(D)	_____Amps/unit
Step 4	Divide (B) by (D) to get the number of units per shelf.....		_____Units/shelf*

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

Table 8. Troubleshooting Guide

Condition: All front panel indicators are *off*. Solutions: 1. Verify that -48 VDC power is properly connected to the shelf. 2. Inspect the fuse and verify that it is not blown. 3. Insert the H2TU-C into a slot known to be in good working condition, and check the STAT indicator. 4. If Steps 1 and 2 pass, but Step 3 fails, replace the H2TU-C.
Condition: DSL LED is *yellow, red,* or *blinking*. Solutions: 1. Verify that loss (pulse attenuation) on Status Screen is ≤ 30 dB. 2. Verify that the loop conforms with CSA guidelines (not too long, etc.). 3. Verify that loop loss at 196 kHz is not greater than 35 dB. 4. Verify that noise on the HDSL2 loop is within acceptable limits (see subsection 7 of this practice). 5. If steps 1 through 4 pass and LED is *yellow*, good service can be assumed.
Condition: HLOS LED is *solid red*. Solution: Indicates loss of HDSL2 synchronization on the 2-wire loop. There is a potential problem with the cable pair that should be identified through basic troubleshooting procedures.
Condition: HCRC LED is *blinking yellow*. Solution: Errors are being taken on the HDSL2 loop. The craft interface will identify the source. BERT tests to the appropriate loopbacks should also reveal the source of the problem.

10. PRODUCT SPECIFICATIONS

Product specifications are detailed in **Table 9**.

Table 9. 3192 H2TU-C Specifications

Loop Interface	
Modulation Type	16-TC PAM
Mode	Full Duplex, Partially Overlapped Echo Canceling
Number of Pairs	One
Line Rate	1.552 mbps
Baud Rate	517.333K baud
Service Range	Defined by Carrier Service Area Guidelines
Loop Loss	35 dB maximum @ 196 kHz
Bridged Taps	Single Taps < 2000 feet, Total Taps < 2500 feet
Performance	Compliant with T1.418-2000 (HDSL2 Standard)
H2TU-C Transmit Power (Data) Level	16.6 ±0.5 dBm (0 to 450 kHz)
H2TU-C Transmit Power (Activation) Level	16.3 ±0.5 dBm (0 to 350 kHz)
Input Impedance	135Ω
Maximum Loop Resistance	900Ω per span
Return Loss	12 dB (50 kHz to 200 kHz)
Network Interface	
DSX-1 Output Level	0 dB
DSX-1 Line Buildout	0-133 feet ABAM 134-266 feet ABAM 267-399 feet ABAM 400-533 feet ABAM 534-655 feet ABAM
DSX-1 Line Code	AMI, B8ZS
Power	
Tested with the ADTRAN H2TU-R (1221026L7).	
Total Power	-48 VDC @ 190 *m*A with H2TU-R
H2TU-C Power Dissipation	5.5 watts with H2TU-R
Span Power	-190 VDC (Internally Generated) current limited at 150 *m*A
Fusing	1.00 A (not field replaceable)
Clock	
Clock Sources	Internal, DSX-1 Derived (with HDSL2 frame bit stuffing)
Internal Clock Accuracy	± 25 ppm (exceeds Stratum 4). Meets T1.101 timing requirements.
Tests	
Diagnostics	Self-Test, Local Loopback (H2TU-C), Remote Loopback (H2TU-R)
Physical	
220/E220 Office Repeater Shelf-Mounted	
Dimensions	6" High x 5/8" Wide x 10" Deep
Weight	Less than 1 lb.
Environment	
Temperature	Operating (Standard) ..... -40° to +70° C Storage ..... -40° to +85° C
Part Number	
3192 H2TU-C	1221004L4

11. WARRANTY AND CUSTOMER SERVICE

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

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

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

ADTRAN Sales
Pricing/Availability
(800) 827-0807

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

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

ADTRAN Repair/CAPS
Return for Repair/Upgrade
(256) 963-8722

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

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.

Upon deactivation of a loopback, the HDSL2 system will synchronize automatically. Note that the synchronization process of the HDSL2 system upon deactivation of the H2R loopback could take up to 15 seconds, ensuring all system elements are synchronized.

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 a T1 Smart Jack loopback.

The unit can detect the loopback activation or deactivation code sequence *only* if an error rate of $1E^{-03}$ or better is present.

Loopback Control Codes

A summary of network and customer control sequences is given in **Table A-1**.

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. Inband Addressable Loopback Codes

Function / Code **Response**
Arm/ 11000 (also known as a 2-in-5 pattern) When sent from the network, the H2TU-C and H2R will arm and the H2TU-R will loop up towards the network. No AIS or errors will be sent as a result of this loopback. When sent from the customer, this code will only arm all of the units.
Arm/ FF48 (1111 1111 0100 1000) ESF facility datalink: ESF only; when sent from the network, all units will be armed and an H2TU-R network loopback will be activated. This code has no functionality when sent from the customer.
Disarm/ 11100 (also known as a 3-in-5 pattern) All units are removed from the armed state. If any of the units are in loopback when the 11100 pattern is received, they will loop down. The LBK LEDs will turn off on all units.
Disarm/ FF24 (1111 1111 0010 0100) ESF facility datalink: ESF only; disarms and/or loop down all units.
H2TU-C Loop-up / D3D3 (1101 0011 1101 0011) [1] If the units have been armed and no units are in loopback*, the H2TU-C will loop up towards the network (when sent from the network) or loop up towards the customer (when sent from the customer). 2 seconds of AIS (all 1s) will be sent, 5 seconds of data will pass, and then 231 bit errors will be injected into the DSX-1 signal. As long as the pattern continues to be sent, 231 errors will be injected every 20 seconds. When the pattern is removed, the unit will remain in loopback. If the pattern is reinstated, the injection of 231 bit errors will resume at 20-second intervals.
H2R Loop-up / C741 (1100 0111 0100 0001) [1] If an H2R is present and the units have been armed, the H2R will loop up towards the network (when sent from the network) or loop up towards the customer (when sent from the customer). 2 seconds of AIS (all 1s) will be sent, 5 seconds of data will pass, and then 10 bit errors will be injected into the DSX-1 signal. As long as the pattern continues to be sent, 10 errors will be injected every 20 seconds. When the pattern is removed, the unit will remain in loopback. If the pattern is reinstated, the injection of 10 bit errors will resume at 20-second intervals.
H2TU-R Address 20 for extended demarc / C754 (1100 0111 0101 0100) An H2TU-R network loopback is activated, and a 200-bit error confirmation is sent. 2 seconds of AIS (all 1s) will be sent, 5 seconds of data will pass, and then 200 bit errors will be injected into the DSX-1 signal. As long as the pattern continues to be sent, 200 errors will be injected every 10 seconds (when sent from the network) or every 20 seconds (when sent from the customer). The HDSL2 office unit will not block transmission of far end NIU loopback from the customer premise (H2TU-R).
Loopdown / 9393 (1001 0011 1001 0011) [2] All units currently in loopback will loop down and disarm from the armed state.
Query Loopback / D5D5 (1101 0101 1101 0101) [1] If the units are armed and the H2TU-C, H2R, or H2TU-R are in loopback, errors are injected into the DSX-1 signal upon detection of the query loopback pattern. As long as the pattern continues to be sent, errors are injected again every 20 seconds (10 seconds for H2TU-R). The number of errors injected each time depends on which unit is in loopback. 231 errors are injected if the H2TU-C is in loopback, 200 at a time if the H2TU-R is in loopback, and10 at a time if H2R is in loopback.
Query Loop Parameters/ DBDB (1101 1011 1101 1011)[1] If the units are armed and the H2TU-C is in network loopback, errors are injected into the DSX-1 signal upon detection of the query loop parameters pattern. As long as a pattern continues to be sent, errors are injected again every 20 seconds. The number of errors injected each time depends on the current status of signal quality and pulse attentuation parameters on each loop. 111 errors are injected if all HDSL2 receiver points (H2TU-C, H2R NET, H2R CST, and H2TU-R indicate pulse attenuation is 30 or lower and signal quality (margin) is 6 or higher. 11 errors at a time are injected if any of the 12 receiver points indicate pulse attenuation is greater than 30 and/or signal quality (margin) is less than 6. This code has no functionality when sent from the customer.
Loopback Timeout Override / D5D6 (1101 0101 1101 0110) [1,*] If the units are armed and this pattern is sent, the loopback timeout will be disabled. The timeout option will be updated on the PROVISIONING menu of the H2TU-C (viewable through the RS-232 port) to NONE. As long as the units remain armed, the timeout will remain disabled. When the units are disarmed, the loopback timeout will return to the value it had before the D5D6 code was sent.
Span Power Disable / 6767 (0110 0111 0110 0111) [1,*] If the units are armed and this pattern is sent, the H2TU-C will deactivate its span power supply, turning off the H2TU-R and H2R (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 H2TU-C will reactivate its span power supply, turning the remote unit(s) on. All units will retrain and return to the disarmed and unlooped state.

Note: All codes listed above must be sent for a minimum of 5 seconds in order for them to be detected and acted upon.
* If NIU is enabled, then the H2TU-R can be in network loopback when the H2TU-C or H2R loop-up codes are sent.

[1] Units must be armed with 11000b or FF48h before this code will work.
[2] In order to behave like a NIU, the H2TU-R will not loop down from the network side with 9393h if the NIU loopback option is enabled.