Section 61181412L1-5B
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# Total Access® 3000 HDSL4 Transceiver Unit for the Central Office Installation and Maintenance Practice

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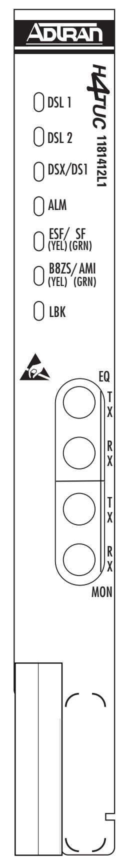



**Figure 1. Total Access 3000 H4TU-C**

## 1. GENERAL

The ADTRAN Total Access 3000 HDSL4 Transceiver Unit for the Central Office (H4TU-C) (ADTRAN P/N 1181412L1) is the Central Office (CO) unit used to deploy an HDSL4 T1 circuit using 4-wire metallic facilities. See **Figure 1**. The unit occupies one slot in a Total Access 3000 shelf.

The DS1 or DSX-1 input signal can be supplied from the network or a Total Access 3000 Multiplexer (DS3, STS-1, or OC-3). The HDSL4 signals are provided to the local loop.

The ADTRAN Total Access 3000 H4TU-C works in conjunction with the ADTRAN H4TU-R and up to two H4Rs to provide a DS1 service on the local loop.

This H4TU-C works with the following list versions of the HDSL4 unit for the remote end (H4TU-R) and the repeater (H4R):

| Part Number | Description |
|---|---|
| 1221424L1 | 1st Gen T200 H4TU-R, Local Power |
| 1221426L1 | 1st Gen T200 H4TU-R, Span Power |
| 1222424L1 | 2nd Gen T200 H4TU-R, Local Power |
| 1222426L1 | 2nd Gen T200 H4TU-R, Span Power |
| 1221441L1 | T200 H4R |
| 1221445L1 | 239 H4R |

The Total Access 3000 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 Total Access 3000 shelf. DSX-1 and HDSL4 signals are connected through the 64-pin shelf connectors located on the rear of the shelf.

The H4TU-C contains an onboard fuse. If the fuse opens, it supplies a –48 VDC voltage to the fuse alarm bus and all front panel indicators will be *off*. This fuse is not designed to be replaced in the field.

The Total Access 3000 H4TU-C uses a DC-to-DC converter to derive its internal logic and span powering voltages from the –48 VDC office supply. The H4TU-C can span power an H4TU-R and up to two H4Rs as listed above. Span powering voltages (negative only with respect to ground, –190 VDC nominal, GFI 5mA) meet all requirements of Bellcore GR-1089-CORE (Class A2) and ANSI T1.418 Issues 1 and 2.

### Revision History

This is the second issue of this practice. This issue corrects the response for loopback code FF48.

## 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. Refer to *Warranty and Customer Service*.

### Compliance Codes

**Table 1** lists Compliance Codes for the H4TU-C. This product is intended for installation in restricted access locations only and in equipment with a Type “B” or “E” enclosure.

**Table 1. Compliance Codes**

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

**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.

This product 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.

### Front Panel Indicators

The Total Access 3000 H4TU-C has seven front panel LEDs, illustrated in **Table 2**, which indicate operational status.

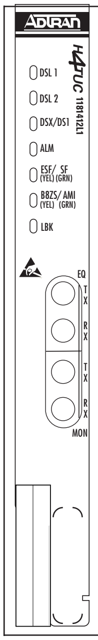
The Total Access 3000 H4TU-C plugs directly into the Total Access 3000 shelf. No installation wiring is required.

There are no configuration switches for the H4TU-C. Configuration is performed via software discussed in the SCU Control Port Operation (HDSL4) section of this practice.

## Powering Options

The H4TU-C is default enabled for span powering mode. The H4TU-C will power either one, two, or three elements and can be set to disable span power when the H4TU-R is being locally powered and there are no H4Rs on the circuit.

### Table 2. Front Panel Indicators




| Label | Condition | Description |
|---|---|---|
| DSL 1/DSL 2 | Green<br>Red | DSL Loop 1/ Loop 2 sync, no errors currently detected, and signal margin ≥ 3 dB<br>No DSL Loop 1/ Loop 2 sync, errors being detected, or signal quality < 3 dB |
| DSX/DS1 | Green<br>Red | DSX-1 signal is present and synchronized<br>DSX-1 loss of sync is present, frame synchronization cannot be achieved, or a mismatch has occured between the user provisioned framing and the actual received framing format |
| ALM | Off<br>Red<br><br>Yellow | No alarm condition detected<br>Alarm condition detected either locally (H4TU-C) or locally and remotely (H4TU-C and H4TU-R)<br>Remote alarm condition detected |
| ESF/SF | Off<br>Yellow<br>Green | Unit has detected DS1 unframed operation<br>Unit has detected DS1 ESF framing mode<br>Unit has detected DS1 SF framing mode |
| B8ZS/AMI | Yellow<br>Green | Unit has detected B8ZS coding<br>Unit has detected AMI coding |
| LBK | Off<br>Yellow | Unit is not in a state loopback<br>Local H4TU-C loopback is active toward network or customer |

## Provisioning

Through management access via the Total Access 3000 SCU, (refer to Section 5), the provisioning settings can be viewed and manipulated. **Table 3** lists the available provisioning options and the factory default settings.

### Table 3. Provisioning Options

| Provisioning Option | Option Settings | Default Settings |
|---|---|---|
| DSX-1 Line Build Out | 0-133 ft., 133-266 ft., 266-399 ft., 399-533 ft., 533-655 ft. | 0-133 ft. |
| DSX-1/DS1 Line Code | B8ZS, AMI | B8ZS |
| DSX-1/DS1 Framing | SF, ESF, Unframed, Auto | ESF |
| Forced Frame Conversion | Enabled, Disabled | Disabled |
| Smartjack Loopback | Enabeld, Disabled | Enabled |
| Loopback Timeout | None, 120 Minutes | 120 Minutes |
| Latching Loopback Mode | T1 (Disabled), FT1 (Enabled) | T1 (Disabled) |
| DS1 Tx Level | 0, –7.5 dB, –15 dB | –7.5 dB |
| Span Power | Enabled, Disabled | Enabled |
| Customer Loss Indicator | AIS, AIS/CI, Loopback | AIS/CI |
| PRM Setting | None, SPRM, NPRM, AUTO | AUTO |
| Loop Attenuation Alarm Threshold | 0 (Disabled), 1-99 dB | 34 dB |
| SNR Margin Alarm Threshold | 0 (Disabled), 1-15 dB | 04 dB |
| Remote Provisioning | Enabled, Disabled | Enabled |
| Service State[1] | In Service, Out of Service-Unassigned, Out of Service-Maintenance | Out of Service-Unassigned |
| Network Source | DSX, MUX A, MUX B, Auto MUX | DSX |
| External Alarms | Enabled, Disabled | Disabled |

[1] The Service State is default to Out of Service-Unassigned. In this setting, the loops will train up but will not connect to the DSX or MUX interface. The In Service setting enables normal connection to the DSX or MUX interface. The Out of Service-Maintenance setting supports active connections to the DSX or MUX interface, however, alarms cannot be generated.

## 3. CONNECTIONS

The Total Access 3000 H4TU-C occupies one card slot in a Total Access 3000 shelf. Power and alarm signals are provided to the card through the backplane of the shelf. DSX-1 and HDSL4 loop signals are connected to the mass termination shelf connectors. See **Table 4** for the pin numbers of the Total Access 3000 backplane amphenol connectors.

**Table 4. Total Access Backplane Connector Pinout**

| Slot | HDSL4 Loop Pair 1 and Pair 2 (Customer Side) | DSX-1 Pair 7 and Pair 8 (Network Side) |
|---|---|---|
| 1 | 1/33 | 1/33 |
| 2 | 2/34 | 2/34 |
| 3 | 3/35 | 3/35 |
| 4 | 4/36 | 4/36 |
| 5 | 5/37 | 5/37 |
| 6 | 6/38 | 6/38 |
| 7 | 7/39 | 7/39 |
| 8 | 8/40 | 8/40 |
| 9 | 9/41 | 9/41 |
| 10 | 10/42 | 10/42 |
| 11 | 11/43 | 11/43 |
| 12 | 12/44 | 12/44 |
| 13 | 13/45 | 13/45 |
| 14 | 14/46 | 14/46 |
| 15 | 15/47 | 15/47 |
| 16 | 16/48 | 16/48 |
| 17 | 17/49 | 17/49 |
| 18 | 18/50 | 18/50 |
| 19 | 19/51 | 19/51 |
| 20 | 20/52 | 20/52 |
| 21 | 21/53 | 21/53 |
| 22 | 22/54 | 22/54 |
| 23 | 23/55 | 23/55 |
| 24 | 24/56 | 24/56 |
| 25 | 25/57 | 25/57 |
| 26 | 26/58 | 26/58 |
| 27 | 27/59 | 27/59 |
| 28 | 28/60 | 28/60 |

The Total Access 3000 H4TU-C is capable of span powering the H4TU-R and two H4Rs by applying simplex current to the local loop. From 30 to 155 mA of loop current is coupled onto the HDSL4 span to power the H4TU-R and two H4Rs when deployed. The span powering voltage is approximately –190 volts with GFI protection to less than 5 mA.
The –190 VDC span powering voltage is provided on Loop 2. See **Figure 2.**

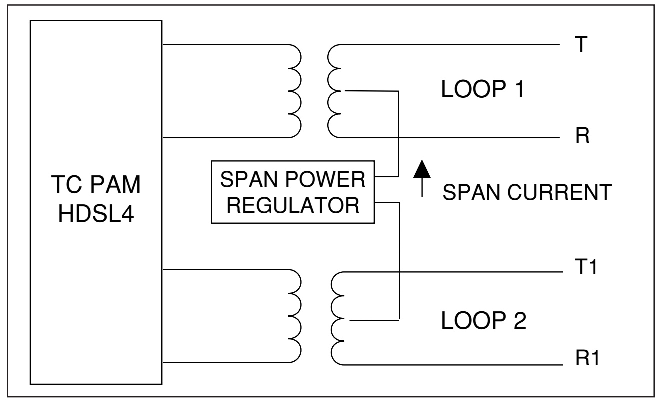



**Figure 2. H4TU-C Span Powering Diagram**

### H4TU-C Alarm Outputs

Each H4TU-C has a built-in fuse for the –48 VDC power feed. If this fuse blows, the System Controller Unit (SCU) will be notified and generate an alarm. A blown fuse indicates the card has malfunctioned and should be replaced.

If there is a need to remove an H4TU-C from the Total Access 3000 shelf, the H4TU-C should be provisioned for Out-of-Service, Unassigned state. This will disable all HDSL4 level alarms from being sent to the shelf. Any HDSL4 alarm that occurred prior to changing the service state must be acknowledged at the SCU before removing the H4TU-C.

In order to avoid a shelf alarm, the H4TU-C element can be provisioned for External Alarms Disabled. This will disable all DSX and DS1 alarms.

Upon removal of an H4TU-C, all provisioning information is stored in the H4TU-C's nonvolatile memory and is stored at the SCU. When the original H4TU-C (or a new H4TU-C) is re-seated, all provisioning information is restored from memory of the original H4TU-C or through a download from the SCU (if the SCU is set for autoprovisioning).

## 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 Total Access 3000 SCU. 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 H4TU-C contains metallic splitting bantam jacks for both nonintrusive (monitoring) and intrusive (terminating) DSX-1 test access.

See *Appendix B* for detailed information regarding the testing capabilities of the bantam jacks.

**Figure 3** illustrates the complete bantam jack arrangement and details for specific jacks.

### H4TU-C Loopbacks

The H4TU-C responds to two different loopback activation processes. First, loopbacks may be activated using the craft interface of the Total Access 3000 SCU. The Loopbacks and Test Screen, which provides for the H4TU-C and H4TU-R loopbacks, is described in *Section 5* of this practice.

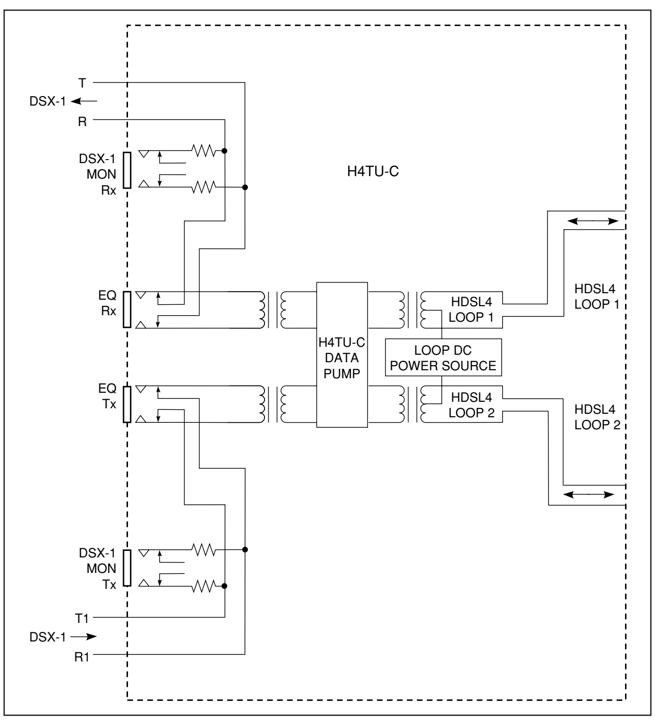



**Figure 3. H4TU-C Bantam Jack Arrangement**

Second, the H4TU-C responds to the industry standard for HDSL4 loopbacks. A detailed description of these loopback sequences is given in *Appendix A*.

Even though all framing modes do not provide frame transparency, if a framed or unframed loopback control sequence is sent, then the unit will initiate the proper loopback command (Refer to *Appendix A*, Table A-1), regardless of the framing mode.

The loopback condition imposed in all cases is a logic level loopback at the point within the H4TU-C where the DSX-1 signal passes into the HDSL4 modulators. **Figure 4** depicts all of the loopback locations possible with ADTRAN HDSL4 equipment.

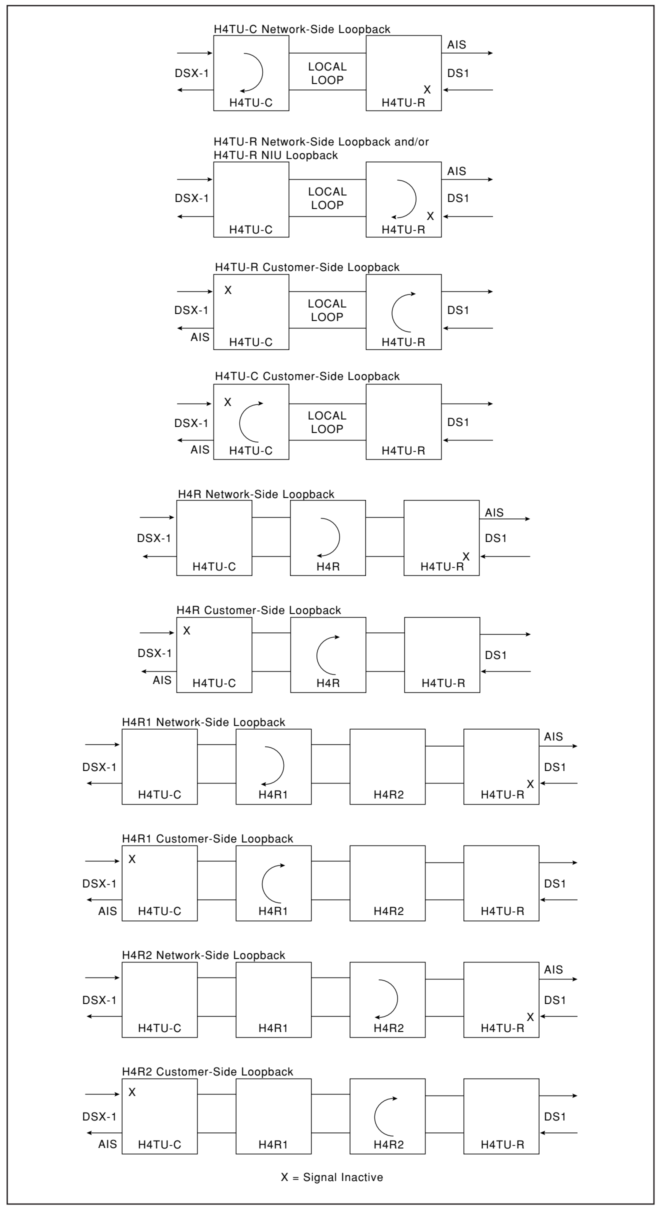



**Figure 4. HDSL4 Loopbacks**

In addition to network-side loopbacks, the 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. SCU CONTROL PORT OPERATION (HDSL4)

H4TU-C management access is achieved via the Total Access 3000 Enhanced System Controller Unit (SCU). The SCU provides VT100, Telnet, TL1, and SNMP management access through local or remote connections.

The Total Access 3000 SCU 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**.

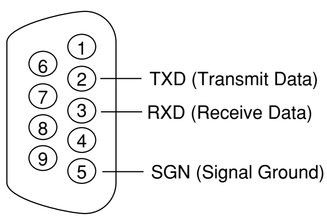



**Figure 5. RS-232 (DB-9) Pin Assignments**

The terminal interface can operate at data rates of 9.6, 19.2, 38.4, 57.6, and 115.2 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.

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 and/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.

The screens illustrated in Figure 7 through Figure 23 are for a circuit deployed with ADTRAN's HDSL4 technology. The circuit includes an H4TU-C, up to two H4Rs and an H4TU-R. Other configurations are possible, and the displays will vary slightly from those shown in this section.

Accessing the HDSL4 circuit information via the Total Access SCU Control Port requires an account name and a password if VT100/Telnet menu access is used. See **Figure 6**, Logon Screen.

After successful logon, the Total Access System Screen will display, as illustrated in **Figure 7**.

```
Shelf:  1                    Total Access System                01/25/02 10:23
Unacknowledged Alarms: None




                             Total Access System

                             Account Name:
                             Password:
```

**Figure 6. Logon Screen**

```
Shelf:                       Total Access System                01/25/02 16:29
Unacknowledged Alarms: None



                             Total Access

                              1.  System Controller
                              2.  Common A - [.....]
                              3.  common B - [.....]
                              4.  Access Modules
                              5.  System Alarms
                              6.  Auxiliary Shelf Access
                              7.  Logoff


                             Selection:
```

**Figure 7. Total Access System Screen**

From the Total Access System Screen, select **Access Modules**. The Access Module Menus Screen, illustrated in **Figure 8**, will display the access modules occupying the Total Access 3000 shelf. Select the corresponding channel slot number for the desired H4TU-C. To the right of each access module listed, the current alarm state is indicated.

```
Shelf: 1                      Total Access System              01/25/02 09:54
Unacknowledged Alarms: None

                              Access Module Menus

             1 - H4TUC L1.... [Info]      15 - ............ [None]
             2 - ............ [None]      16 - ............ [None]
             3 - ............ [None]      17 - ............ [None]
             4 - ............ [None]      18 - ............ [None]
             5 - ............ [None]      19 - ............ [None]
             6 - ............ [None]      20 - ............ [None]
             7 - ............ [None]      21 - ............ [None]
             8 - ............ [None]      22 - ............ [None]
             9 - ............ [None]      23 - ............ [None]
            10 - ............ [None]      24 - ............ [None]
            11 - ............ [None]      25 - ............ [None]
            12 - ............ [None]      26 - ............ [None]
            13 - ............ [None]      27 - ............ [None]
            14 - ............ [None]      28 - ............ [None]

                    Enter Channel Slot Number :

                    Inverse = Busy Modules
```

**Figure 8. Access Module Menus Screen**

After selecting the H4TU-C in the access module menu, the ADTRAN HDSL4 Main Menu is displayed as illustrated in **Figure 9**.

From the ADTRAN HDSL4 Main Menu, the following screens can be accessed.

1. HDSL4 Unit Information
2. Provisioning
3. Status
4. Loopbacks and Test
5. Performance Monitoring
6. Scratch Pad, Ckt ID
7. Alarm History
8. Event History
9. System Status/PM Report

The Unit Information Screen, illustrated in **Figure 10,** provides detailed product information on each component in the HDSL4 circuit.

```
Shelf:  1  Slot:  1          Total Access System              04/17/02 01:49
Unacknowledged Alarms: None
                     Circuit ID:

                              HDSL4 Main Menu

                             1.  HDSL4 Unit Information
                             2.  Provisioning
                             3.  Status
                             4.  Loopbacks and Test
                             5.  Performance Monitoring
                             6.  Scratch Pad, Ckt ID
                             7.  Alarm History
                             8.  Event History
                             9.  System Status/PM Report





                             Selection:
```

**Figure 9. HDSL4 Main Menu Screen**

```
Shelf:  1  Slot:  1          Total Access System              01/25/02 09:21
Unacknowledged Alarms: None
                      Press ESC to return to previous menu

                                  ADTRAN
                           901 Explorer Boulevard
                       Huntsville, Alabama 35806-2807
--------------------- For Information or Technical Support ---------------------
      Support Hours ( Normal 7am - 7pm CST, Emergency 7 days x 24 hours )
Phone: 800.726.8663 / 888.873.HDSL  Fax: 256.963.6217  Internet: www.adtran.com
--------------------------------------------------------------------------------

              ADTN H4TU-C                        ADTN H4TU-R
              P/N: 1181412L1                     P/N: 1222426L1
              S/N: 123456789                     S/N: 123456789
             CLEI: SIC4LTPDAA                   CLEI: T1L5JZTCAAA
             Manf: 01/01/2000                   Manf: 01/01/2000
              Ver: 24  1 A00000                  Ver: 27  2 A00000

              ADTN H4R1                          ADTN H4R2
              P/N: 1221445L1                     P/N: 1221445L1
              S/N: BB50A8343                     S/N: BB50A8353
             CLEI: T1R5YP3DAA                   CLEI: T1R5YP3DAA
             Manf: 02/12/2002                   Manf: 02/12/2002
              Ver: 21  1 A00001                  Ver: 21  1 A00001
```

**Figure 10. Unit Information Screen**

The Provisioning Screen, illustrated in **Figure 11**, displays current provisioning settings for the HDSL4 circuit. Options that can be changed from this screen are labeled with a number (i.e., “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 3 are available with the 1222426L1 H4TU-R. Some settings may differ when using different H4TU-Rs.

The Span Status Screen, illustrated in **Figure 12**, provides quick access to status information for each HDSL4 receiver in the circuit.

```
Shelf:  1  Slot:  1          Total Access System                04/17/02 01:50
Unacknowledged Alarms: None
                     Circuit ID:

                                 Provisioning

                       1.  DSX-1 Line Buildout     =  0-133 Feet
                       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            =  -7.5 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.  Service State           =  OOS-Unassigned
                      16.  Network Source          =  DSX
                      17.  External Alarms         =  Disabled
                             Selection:
```

**Figure 11. Provisioning Screen**

```
Shelf:  1  Slot:  1          Total Access System                   01/25/02 09:22
Unacknowledged Alarms: None
                     CIRCUIT ID:ABC123
                               Span Status Screen

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


                                    1.  View Detailed Status



                              Selection:
```

**Figure 12. Span Status Screen**

The Detailed Status Screen from the Span Status Menu, illustrated in **Figure 13**, displays the HDSL4 status for each receiver point.

**Figure 14** illustrates the Loopback and Test Commands Screen, which is used 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. The equipment jack can be configured for the Customer or Network direction for use in testing (MUX mode only). For more information regarding bantam jack testing capabilities, refer to *Appendix B*.

```
CShelf:  1  Slot:  1          Total Access System                 01/25/02 09:22
Unacknowledged Alarms: None
                     CIRCUIT ID:ABC123
                              Detailed Status Screen

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



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

**Figure 13. Detailed Status Screen**

```
Shelf:  1  Slot:  1          Total Access System                 01/25/02 09:22
Unacknowledged Alarms: None
                     CIRCUIT ID:ABC123

                             Loopback and Test Commands

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

         1.  Run Self Tests                        6.  H4R1  Loopup  Net
         2.  H4TU-C  Loopup  Net                   7.  H4R1  Loopup  Cust
         3.  H4TU-C  Loopup  Cust                  8.  H4R2  Loopup  Net
         4.  H4TU-R  Loopup  Net                   9.  H4R2  Loopup  Cust
         5.  H4TU-R  Loopup  Cust                  10. Equipment Jack = Customer


                              Selection:
```

**Figure 14. Loopback and Test Commands Screen**

The Performance Data Selection Screens, illustrated in **Figure 15** and **Figure 16**, allows the user 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 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.

```
Shelf:  1  Slot:  1          Total Access System               04/17/02 01:50
Unacknowledged Alarms: None
                     Circuit ID:
           Menu                15 Minute H4TUC DSX-1 Performance Data

     1.  Definitions             ES-L  SES-L LOSS-L PDVS-L B8ZS-L CV-L
     2.  Reset Data              000   000   000    000    000    00000
     3.  15 Min Data       01:45 000   000   000    000    000    00000
     4.  60 Min Data       01:30 000   000   000    000    000    00000
     5.  24 Hr Data        01:15 ---   ---   ---    ---    ---    -----
     6.  Line Data         01:00 ---   ---   ---    ---    ---    -----
     7.  Path Data         00:45 ---   ---   ---    ---    ---    -----
     8.  H4TUC DSX-1       00:30 ---   ---   ---    ---    ---    -----
     9.  H4TUC LOOP        00:15 ---   ---   ---    ---    ---    -----
    10.  H4TUR LOOP        00:00 ---   ---   ---    ---    ---    -----
    11.  H4TUR DS1
    12.  H4R #1 NETW
    13.  H4R #1 CUST          ___       ___       ___                ___
    14.  H4R #2 NETW         | C |     |#1 |     |#2 |              | R |
    15.  H4R #2 CUST     -8->|   |-----|   |-----|   |--------------|   |--->
                             |   |9  12|   |13 14|   |15          10|   |
                         <---|   |-----|   |-----|   |--------------|   |<-11
                             |___|     |___|     |___|              |___|
                             Selection:
```

**Figure 15. 15-Minute H4TU-C DSX-1 Performance Data Screen**

```
Shelf:  1  Slot:  1          Total Access System               04/17/02 01:51
Unacknowledged Alarms: None
                     Circuit ID:
           Menu                 24 Hour H4TUC DSX-1 Performance Data

     1.  Definitions            ES-L  SES-L LOSS-L PDVS-L B8ZS-L CV-L
     2.  Reset Data             00000 00000 00000  00000  00000  0000000
     3.  15 Min Data      04/16 ----- ----- -----  -----  -----  -------
     4.  60 Min Data      04/15 ----- ----- -----  -----  -----  -------
     5.  24 Hr Data       04/14 ----- ----- -----  -----  -----  -------
     6.  Line Data        04/13 ----- ----- -----  -----  -----  -------
     7.  Path Data        04/12 ----- ----- -----  -----  -----  -------
     8.  H4TUC DSX-1      04/11 ----- ----- -----  -----  -----  -------
     9.  H4TUC LOOP       04/10 ----- ----- -----  -----  -----  -------
    10.  H4TUR LOOP
    11.  H4TUR DS1
    12.  H4R #1 NETW
    13.  H4R #1 CUST          ___       ___       ___                ___
    14.  H4R #2 NETW         | C |     |#1 |     |#2 |              | R |
    15.  H4R #2 CUST     -8->|   |-----|   |-----|   |--------------|   |--->
                             |   |9  12|   |13 14|   |15          10|   |
                         <---|   |-----|   |-----|   |--------------|   |<-11
                             |___|     |___|     |___|              |___|
                             Selection:
```

**Figure 16. 24-Hour H4TU-C DSX-1 Performance Data Screen**

Abbreviations used in the Performance Data Screens are defined in Performance Data Definitions Screens, see **Figure 17** and **Figure 18**.

```
Shelf:  1  Slot:  1          Total Access System                04/17/02 05:08
Unacknowledged Alarms: None
                     Circuit ID:
                          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 17. Performance Data Definitions – HDSL4 Loop Related Screen**

```
Shelf:  1  Slot:  1          Total Access System                04/17/02 05:08
Unacknowledged Alarms: None
                     Circuit ID:
                          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 18. Performance Data Definitions – DS1 and DSX-1 Path Related Screen**

**Figure 19** illustrates the Scratch Pad and Circuit ID Screen. The circuit ID can be any alphanumeric string up to 25 characters in length. A Scratch Pad is available for storage of HDSL4 circuit specific notes. The Scratch Pad can hold 28 alphanumeric characters in any combination.

```
Shelf: 1  Slot: 1            Total Access System                01/25/02 09:22
Unacknowledged Alarms: None
                     CIRCUIT ID: ABC123



   Current Scratch Pad:
      New Scratch Pad =



       New Circuit ID =







                    Begin typing to change Circuit ID field


                              Press ESC to Exit.
```

**Figure 19. Scratch Pad and Circuit ID Screen**

The alarm history screens are divided into three separate screens: T1 Alarm History (**Figure 20**), Facility Alarm History (**Figure 21**), and HDSL4 Span History (**Figure 22**).

T1 Alarm History screen displays:

- DSX-1/DS1 Red Alarm
- DSX-1/DS1 Yellow Alarm
- DSX-1/DS1 Blue Alarm

Facility Alarm History screen displays:

- DC Open
- Over-current (short)
- Ground fault
- Power cycle

HDSL4 Span History screen displays:

- Loss of Sync for each HDSL4 receiver
- Margin Threshold Alarm for each HDSL4 receiver.
- Attenuation Threshold Alarm for each HDSL4 receiver.

```
Shelf:  1  Slot:  22         Total Access System               06/02/03 00:31
Unacknowledged Alarms:               MINOR       INFO
                     Circuit ID:
                              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            C. Clear T1 Alarms
    2. Facility Alarm
    3. Span H4TUC to H4TUR
                                   Selection:
```

**Figure 20. T1 Alarm History Screen**

```
Shelf:  1  Slot:  1          Total Access System              05/15/02 18:07
Unacknowledged Alarms:         MAJOR MINOR       INFO
                     Circuit ID:1181412L4
                              Facility Alarm History
LOCATION   ALARM       FIRST                LAST                 CURRENT   COUNT
--------------------------------------------------------------------------------
FACILITY DC OPEN       01/01/00  14:00:01   05/02/03  13:15:01   OK         002
FACILITY OVER-CURRENT                                            OK         000
FACILITY GROUND FAULT                                            OK         000

H4TU-C   POWER CYCLE   01/01/00  14:00:01   05/06/03  09:00:01   OK         004
H4TU-R   POWER CYCLE   05/02/03  08:33:33   05/02/03  08:33:33   OK         001

--------------------------------------------------------------------------------
    1. T1 Alarm            4. Span H4R1 to H4TUR
    2. Facility Alarm      C. Clear Facility Alarms
    3. Span H4TUC to H4R1
                             Selection:
```

**Figure 21. Facility Alarm History Screen**

```
Shelf:  1  Slot:  1          Total Access System                05/01/25/02 09:22
Unacknowledged Alarms: None
                     CIRCUIT ID:ABC123
                             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. System Alarm         5. Span H4R2 to H4TU-R
    3. Span H4TUC to H4R1   C. Clear Span Alarms
                             Selection:
```

**Figure 22. HDSL4 Span History Screen**

The Event History Screen, accessed from Option 8 on the main menus, is illustrated in **Figure 23**. This screen provides a log history of HDSL4 circuit events.

```
Shelf: 1  Slot: 1            Total Access System               01/25/02 09:22
Unacknowledged Alarms: None
                     CIRCUIT ID: ABC123
      Num   Description of Event                       Date     Time
      -----------------------------------------------------------------

   1.  H4TU-C Powered Up                               01/25/02 09:22:00









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

                             Selection:
```

**Figure 23. Event History Screen**

## 6. HDSL4 DEPLOYMENT GUIDELINES

The different segments of an HDSL4 circuit are defined in **Figure 24.**

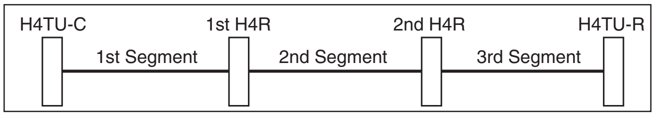



**Figure 24. HDSL4 Circuit Segments**

According to the number of H4Rs in the HDSL4 circuit, the following service ranges apply:

- HDSL4 circuit containing no H4Rs will reach up to 15,250 ft on the local loop (24 AWG) [10,800 ft for 26 AWG]
- HDSL4 circuit containing one H4R will reach up to 15,250 ft on the first segment and 15,050 ft on the second segment (24 AWG) [10,550 ft for 26 AWG]
- HDSL4 circuit containing two H4Rs will reach to 12 kft on the first segment, 13.5 kft on the second segment, and 15 kft on the third segment (24 AWG) *

**This is one example of a circuit with two H4Rs. Other loop length configurations are possible in compliance with loop resistance restraints (90°F).*

**NOTE**

DSL Assistant must be used to engineer HDSL4 circuits with two repeaters.

The ADTRAN HDSL4 system provides DS1-based services over loops designed to comply with the guidelines given below. These guidelines apply to the first segment in the circuit (between the H4TU-C and the first H4R) or an HDSL4 circuit with no H4Rs.

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. Insertion Loss: See **Table 5** for loop insertion loss requirements.
5. Loop Attenuation:

| | Upstream | Downstream |
|---|---|---|
| $1^{st}$ segment | 31 dB | 33 dB |
| $2^{nd}$ segment | 30 dB | 30 dB |
| $3^{rd}$ segment | 30 dB | 30 dB |

**Table 5. HDSL4 Loop Insertion Loss Values**

| Frequency (kHz) | 1st Segment Loss (dB) | 2nd Segment Loss (dB) |
|---|---|---|
| 50 | 31.5 | 29.9 |
| 80 | 35.3 | 33.5 |
| 130 | 39.1 | 37.1 |
| 196 | 42.0 | N/A |

**NOTE**

Refer to the Detailed Status Screen (Main Menu selection "3," Span Status selection "1") for the current loop SNR Margin, Insertion Loss, and Pulse Attenuation status.

Each of the three segments associated with span powering two H4Rs and an H4TU-R must satisfy the recommended insertion loss, loop attenuation requirements in addition to the DC resistance budgets. 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.

The segment resistance ($\Omega_{segment}$) is determined using the equation provided below.

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

where : $L_{\#}$ is the length of # AWG cable (kft., excluding bridge taps), $\Omega_{\#}$ is the DC Resistance of # AWG cable

**Table 6** list single pair cable DC resistance values to be used in the equation above.

Once the resistance of each segment is confirmed, see **Figure 25** to decide if the H4TU-C is capable of span powering two H4Rs and one H4TU-R. Follow these steps to utilize the graph shown in Figure 25:

1. Find the line on the graph which 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.

**Table 6. Single Pair Cable DC Resistance Value**

| Resistance (ohms/kft) | | | | |
|---|---|---|---|---|
| AWG | 70ºF | 90ºF* | 120ºF | 140ºF** |
| 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 |

* Interpolated between 70ºF and 120ºF data
** Extrapolated from 70ºF and 120ºF data

2. Find the first segment resistance on the vertical axis.
3. Find the second segment resistance on the horizontal axis.
4. Find the instance where the two points from Steps 2 and 3 meet on the graph.
5. The point found in Step 4 must be below the upper limit line defined by the third segment measurement (Step 1). 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.

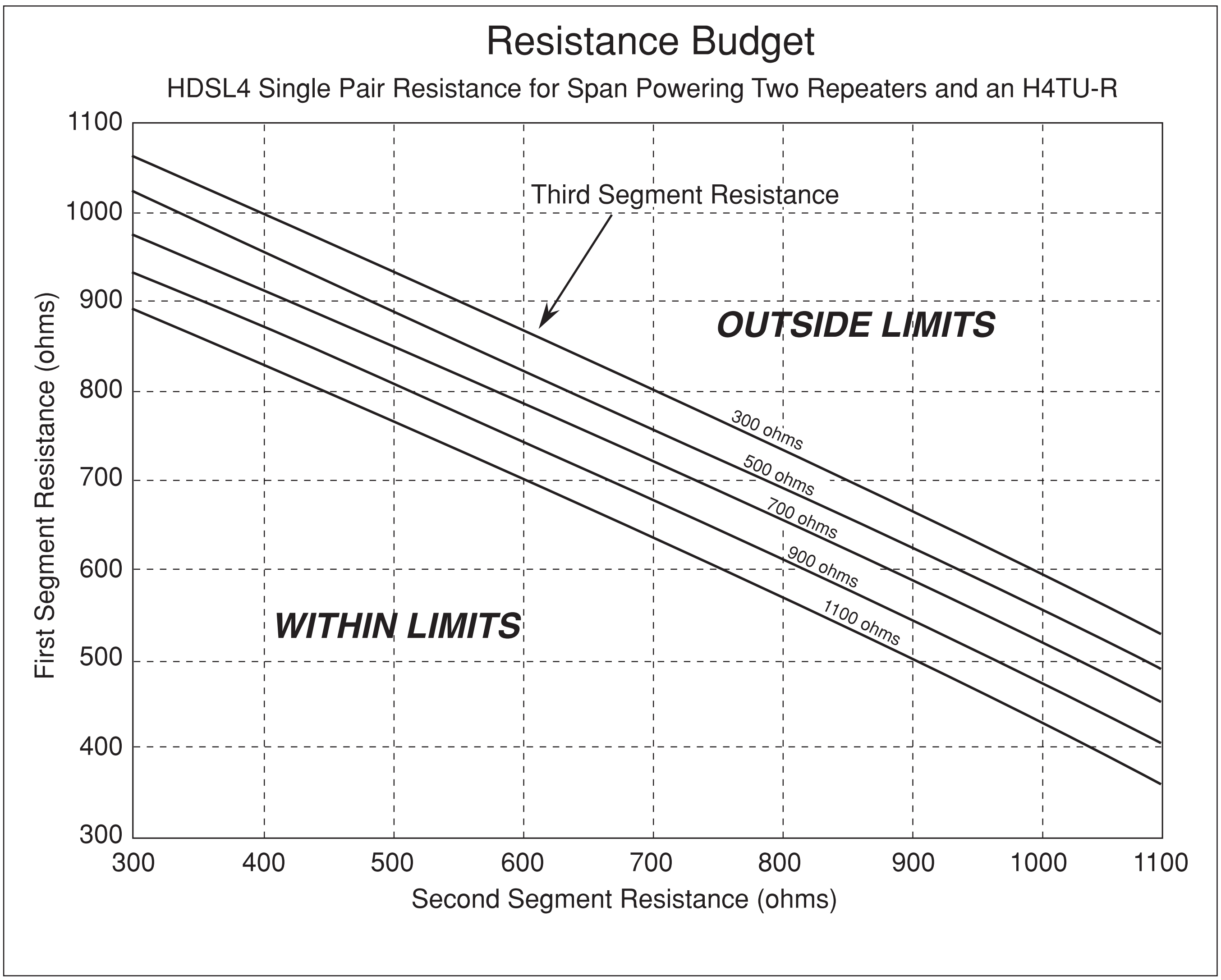



**Figure 25. Resistance Budget Span Powering Two Repeaters**

An example problem is illustrated in **Figure 26**. For this example, begin with three known measurements: 600 ohm first segment resistance, 700 ohm second segment resistance, and 900 ohm third segment resistance. See Figure 26 and the following steps to solve the example problem:

1. Find the 900 ohm third segment resistance line on the graph. This line is depicted in bold in Figure 26. This line is the upper span power limit.
2. Find the 600 ohm first segment resistance point on the vertical axis.
3. Find the 700 ohm second segment resistance point on the horizontal axis.
4. Find the instance on the graph where the points from Steps 2 and 3 meet.
5. Is this point below the bold line defined in Step 1? Yes. Therefore, a circuit with these parameters is capable of span powering two H4Rs and one H4TU-R.

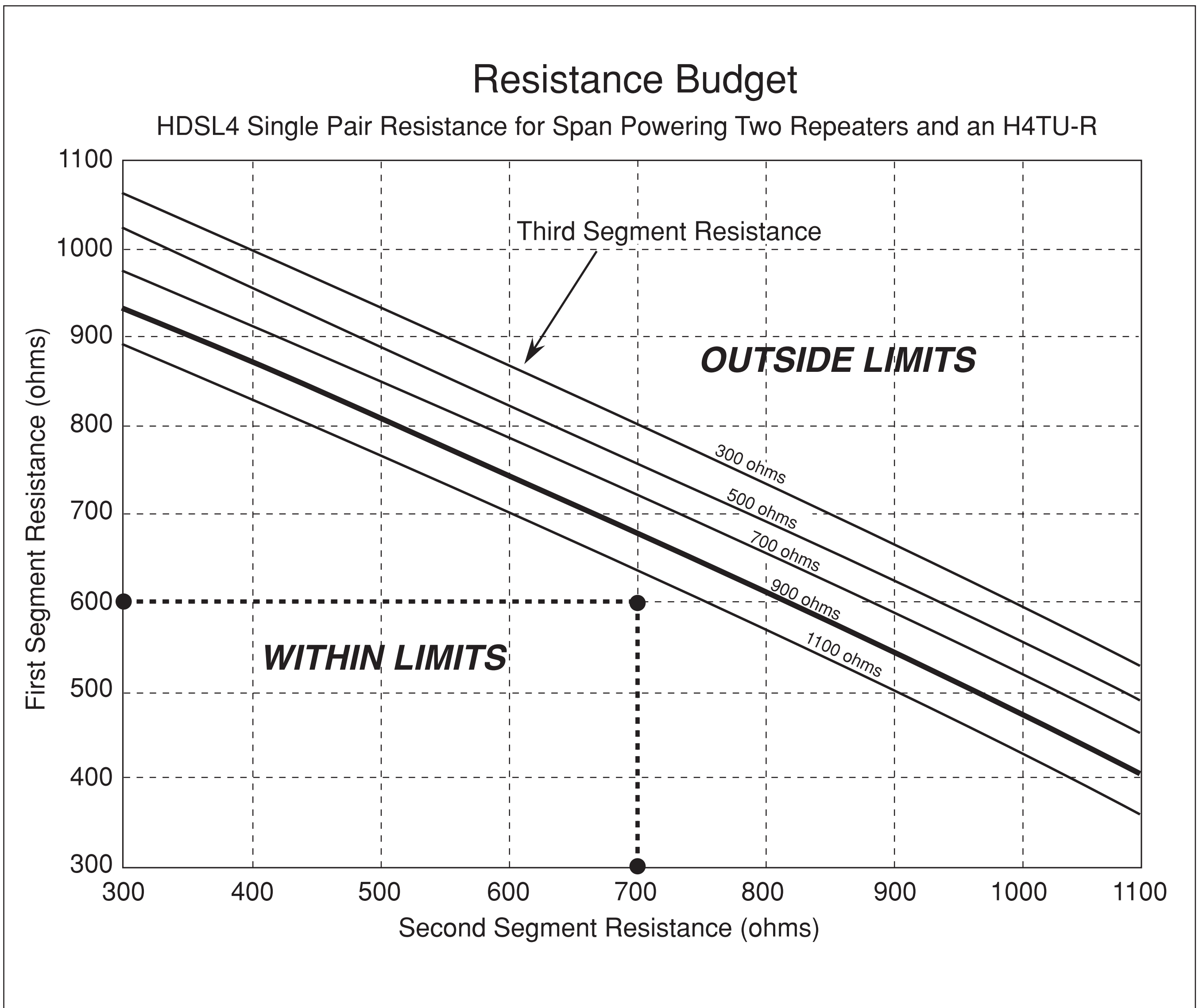



**Figure 26. Resistance Budget Span Powering Two Repeaters (Example)**

### Simplified Loop Qualification Procedure

The field technician should be provided with the expected insertion loss at four frequencies, based on the engineering loop design. This design will be based on records of the loop plant. Assuming accurate loop records, the insertion loss values should be within 1 dB of the design. If they are not, the simplified loop qualification procedure below provides the technician some assurance of the HDSL4 performance.

### Single Span and First Segment of Repeatered Loop

For each of the four measured insertion loss values, compute the difference between the maximum loss and the measured loss (max minus measured). (The worksheet provided below may be used to record these values.) If all four of the differences are positive, then the loop meets the performance criteria. If any one of the four difference values is negative (measured loss is more than maximum loss), then the sum of the four differences must be at least +3 dB. If neither of these criteria is satisfied, then the loop is suspect and may not provide robust HDSL4 deployment.

### Second Segment of Repeatered Loop

For each of the three measured insertion loss values, compute the difference between the maximum loss and the measured loss (max minus measured). (The worksheet provided below may be used to record these values.) If all three of the differences are positive, then the loop meets the performance criteria. If any one of the three difference values is negative (measured loss is more than maximum loss), then the sum of the three differences must be at least +1 dB. If neither of these criteria is satisfied, then the loop is suspect and may not provide robust HDSL4 deployment.

**Table 7. Qualification Worksheet for Single Span and First Segment of Repeatered Loop**

| Frequency (kHz) | Maximum Loss (dB) | Measured Loss (dB) | Delta Loss (dB) (Maximum minus Measured) |
|---|---|---|---|
| 50 | 31.5 | | |
| 80 | 35.3 | | |
| 130 | 39.1 | | |
| 196 | 43.0 | | |
| | | *Sum Delta Loss = | |

*If any single frequency insertion loss exceeds the maximum loss (delta loss < 0), then the sum of the four delta loss values must be > 3.0 dB.

**Table 8. Qualification Worksheet for Second Segment of Repeatered Loop**

| Frequency (kHz) | Maximum Loss (dB) | Measured Loss (dB) | Delta Loss (dB) (Maximum minus Measured) |
|---|---|---|---|
| 50 | 29.9 | | |
| 80 | 33.5 | | |
| 130 | 37.1 | | |
| | | *Sum Delta Loss = | |

*If any single frequency insertion loss exceeds the maximum loss (delta loss < 0), then the sum of the three delta loss values must be > 1.0 dB.

## 7. MAINTENANCE

The ADTRAN Total Access H4TU-C requires no routine maintenance. In case of equipment malfunction, use the front panel bantam jack connectors to help locate the source of the problem.

ADTRAN does not recommend that repairs be performed in the field. Repair services may be obtained by returning the defective unit to ADTRAN. Refer to *Warranty and Customer Service* section of this Practice.

## 8. PRODUCT SPECIFICATIONS

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

## 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 9. Total Access 3000 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 | 46 dB Maximum @ 196 kHz (First Segment),<br>42 dB Maximum @ 196 kHz (Second Segment, Third Segment) |
| Bridged Taps | Single Taps < 2000 ft., Total Taps < 2500 ft. |
| Performance | Compliant with T1.418-2002 (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 Impedence | 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, −7.5 dB (default), −15 dB |
| DSX-1 Line Build Out | 0-133 ft. ABAM (default)<br>133-266 ft. ABAM<br>266-399 ft. ABAM<br>399-533 ft. ABAM<br>533-655 ft. ABAM |
| DSX-1 Line Code | B8ZS (default), AMI |
| **Power**<br>Tested with the ADTRAN H4TU-R (1222426L1) and H4R (1221445L1) | |
| H4TU-C Total Power | –48 VDC @ 197 mA with H4TU-R<br>–48 VDC @ 348 mA with H4TU-R and one H4R |
| H4TU-C Power Dissipation | 5.5 watts with H4TU-R<br>6.4 watts with H4TU-R and one H4R |
| Span Power | 190 VDC (Internally Generated) Class A2 Compliant, GFI Current Limited at < 5 mA, Loop Current Limited between 150 to 160 mA |
| Fusing | 1.00 A (not field-replaceable) |
| **Clock** | |
| Clock Sources | Internal, DSX-1 Derived (with HDSL4 frame bit stuffing), MUX Fed (with HDSL4 frame bit stuffing) |
| Internal Clock Accuracy | ±25 ppm (Exceeds Stratum 4), Meets T1.101 Timing Requirements |
| **Tests** | |
| Diagnostics | Self-Test, Local Loopback (H4TU-C), Remote Loopback (H4TU-R) |
| **Physical** | |
| Total Access 3000 H4TU-C, Shelf-Mounted | |
| Dimensions | 6 in. high, x 5/8 in. wide, x 10 in. deep |
| Weight | < 1 lb. |
| **Environment** | |
| Operating Temperature (Standard) | –40ºC to +70ºC |
| Storage Temperature | –40ºC to +85ºC |
| **Compliance** | |
| UL 60950<br>GR-1089-CORE<br>GR-63-CORE<br>ANSI T1.418-2002, Issue 2<br>ANSI T1.102 (DS1 Interface) | |
| **Part Number** | |
| Total Access 3000 H4TU-C | 1181412L1 |

# Appendix A
# HDSL4 LOOPBACKS

## HDSL4 MAINTENANCE MODES

This appendix describes operation of the HDSL4 system with regard to detection of in-band 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 inline T1 Repeater 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 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 (ESF-DL) (1111 1111 0100 1000) | Loopback data from customer toward customer at HTU-R. |
| | (N) | 1in6 (100000) | Loopback data from network toward network at HTU-R. |
| | (N) | FF48 (ESF-DL) (1111 1111 0100 1000) | Loopback data from network toward network at HTU-R. |
| | (N/C) | 1in3 (100) | Loop down everything. |
| | (N/C) | FF24 (ESF-DL) (1111 1111 0010 0100) | Loop down everything. |

[1] The Source column indicates which side of the interface the control codes are sent from. For example, an (N) indicates a network sourced code while a (C) indicates a customer sourced code.

[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 and Control Codes

| Function | Code | 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 (hex) or 1111 1111 0100 1000 (binary) 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. This code has no functionality when sent from the customer. |
| 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 (hex) or 1111 1111 0010 0100 (binary) 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 (hex) or 1101 0011 1101 0011 (binary) | 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 (hex) or 1001 0011 1001 0011 (binary) | 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 (hex) or 1101 0101 1101 0101 (binary) | 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. 231 errors = H4TUC, 10 errors = H4R #1, 200 errors = H4R #2, 20 errors = H4TU-R |

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. In other words, 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.

## Table A-2. Loopback and Control Codes (Continued)

| Function | Code | Response |
|---|---|---|
| Loopback Time Out Override[1] | D5D6 (hex) or 1101 0101 1101 0110 (binary) | 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.<br>H4TU-C................231 bps<br>H4R1.....................110 bps<br>H4R2.....................2200 bps<br>H4TU-R................ 20 bps |
| Span Power Disable[1] | 6767 (hex) or 0110 0111 0110 0111 (binary) | 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 re-train and return to the disarmed and unlooped state. |
| First H4R Loop Up[1,2] | C741<br>(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<br>(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<br>(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 20 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. In other words, 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.

# Appendix B
# Front Panel DSX and MUX Mode Test Access

Figure B-1 through Figure B-3 are DSX-1 fed modes of operation, and Figure B-4 through Figure B-7 are MUX fed modes of operation. From the Provisioning Screen (Figure 11), select "16" to choose the Network Source as MUX fed or DSX fed. When performing intrusive MUX mode testing, the equipment jack (EQ) on the front panel can be configured to access the signal going to the Network or the Customer. Select "10" from the Test Screen (Figure 14) to configure the Equipment jack for Network or Customer. Every time the H4TU-C is power-cycled, it will default to the Customer direction.

**NOTE**

The H4TU-C must be provisioned for the Out of Service-Maintenance service state when intrusive bantam jack testing is being performed.

## DSX MODE TEST ACCESS

### DSX MON, Tx to Customer

The Rx of the BERT receives data from the Tx MON jack (**Figure B-1**). This data has a monitor jack impedance of 432 ohms and comes from the backplane Network T1 DSX (the data that would go toward the customer). The BERT Tx is not used. **This test is nonintrusive**.

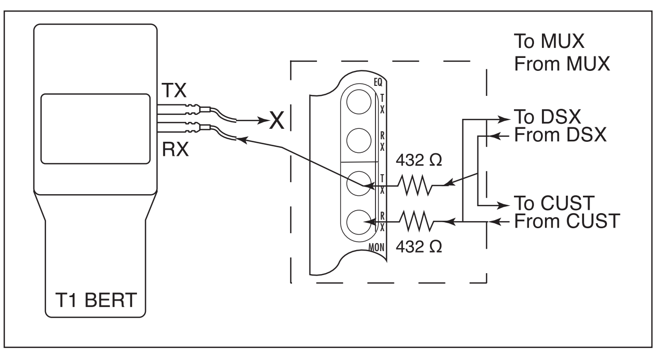



**Figure B-1. DSX MON, Tx to Customer**

### DSX MON, Rx from Customer

The Rx of the BERT receives data from the Rx MON jack (**Figure B-2**). This data has a monitor jack impedance of 432 ohms and comes from the Customer-originated data. The BERT Tx is not used. **This test is nonintrusive**.

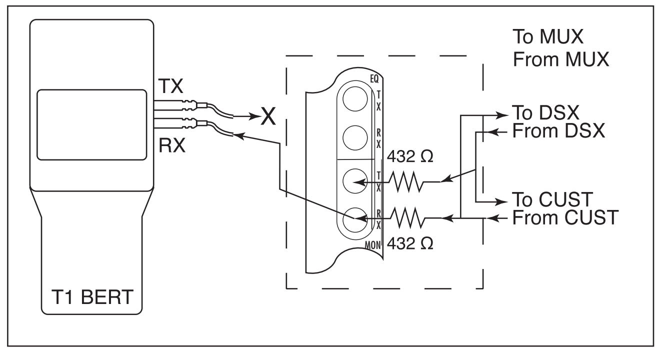



**Figure B-2. DSX MON, Rx from Customer**

### DSX EQ, Tx to Customer and Rx from Customer

The Tx of the BERT goes to the Tx EQ jack, and the Rx of the BERT goes to the Rx EQ jack (**Figure B-3**). The Tx EQ data from the BERT is sent to the Customer. The Rx EQ data to the BERT is data from the Customer. The MON jack Tx and Rx are 432 ohm replicas of the EQ Tx and Rx direct connections. **This test is intrusive**, as it connects the EQ jacks directly to and from the Customer data.

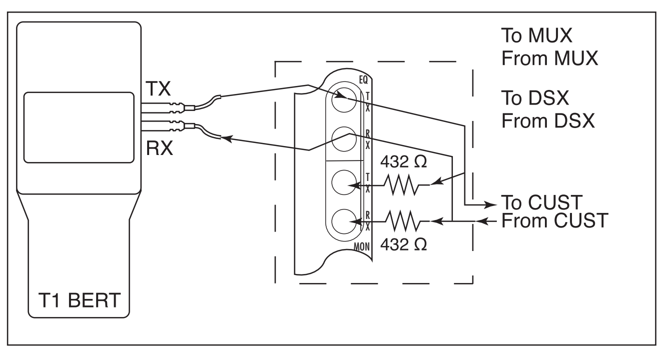



**Figure B-3. DSX EQ, Tx to Customer and Rx from Customer**

## MUX MODE TEST ACCESS

### MUX MON, Tx to Customer

The Rx of the BERT receives data from the Tx MON EQ jack (**Figure B-4**). This data is a copy of the data that the H4TU-C will transmit to the Customer. The Tx of the BERT is not used. **This test is nonintrusive.**

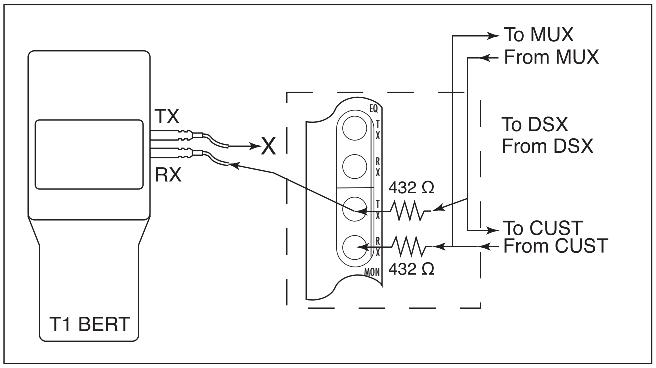



**Figure B-4. MUX MON, Tx to Customer**

### MUX MON, Rx from Customer

The Rx of the BERT receives data from the Rx MON jack (**Figure B-5**). This data is 432 ohm copy of the data that the H4TU-C will receive from the Customer and route to the Total Access 3000 shelf's MUX (Network). The Tx of the BERT is not used. **This test is nonintrusive**.

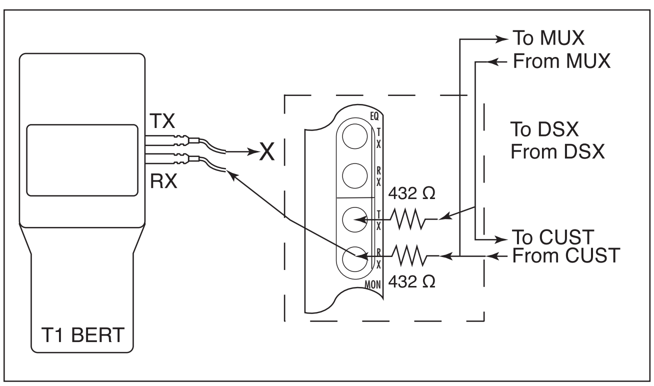



**Figure B-5. MUX MON, Rx from Customer**

### MUX EQ, Tx to Network and Rx from Network

The Tx of the BERT is connected to the EQ Tx jack, and the Rx of the BERT is connected to the Rx EQ jack (**Figure B-6**). The Tx of the BERT is then substituted for the data that the H4TU-C sends to the Total Access 3000 shelf's MUX (Network). The Rx of the BERT receives data directly from the MUX (Network). The MON Tx and Rx jacks are 432 ohm impedance copies of the EQ jack Tx and Rx. **This test is intrusive**.

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**NOTE**

Via the Test Screen, ensure that the equipment jack (EQ) is in "To Network" mode. In "To Network" mode, AIS (unframed all ones) is sent in the Customer direction.

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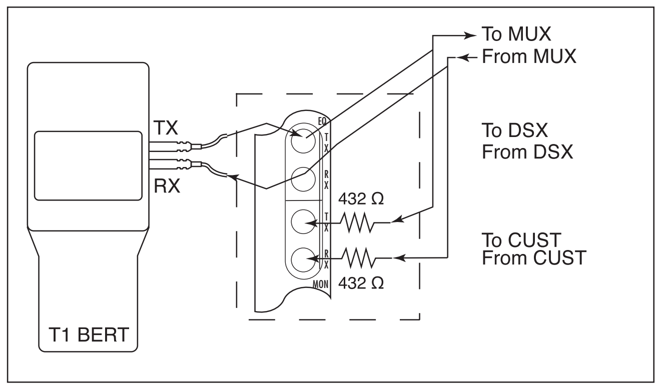


**Figure B-6. MUX EQ, Tx to Network and Rx from Network**

## MUX EQ, Tx to Customer and Rx from Customer

The Tx of the BERT is connected to the EQ Tx jack, and the Rx of the BERT is connected to the Rx EQ jack (**Figure B-7**). The Tx of the BERT is then substituted for the data that the H4TU-C sends to the Customer. The Rx of the BERT receives data directly from the Customer. The MON Tx and Rx jacks are 432 ohm impedance copies of the EQ jack Tx and Rx. **This test is intrusive**.

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**NOTE**

Via the Test Screen, ensure that the equipment jack (EQ) is in "To Customer" mode. In "To Customer" mode, AIS (unframed all ones) is sent in the Network direction.

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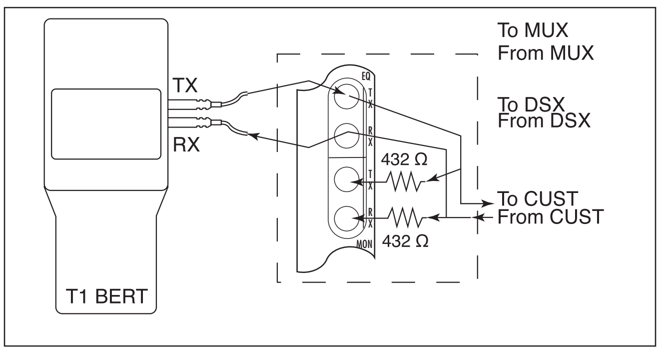


**Figure B-7. MUX EQ, Tx to Customer and Rx from Customer**

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