T200 SHDSL NTU
Installation and Maintenance Practice

CONTENTS

FIGURES

TABLES

1. GENERAL

This practice contains installation and maintenance information for the T200 SHDSL NTU, P/N 1225135L1. The unit is illustrated in **Figure 1**. The ADTRAN T200 NTU is a network terminating unit using Single-Pair High Speed Digital Subscriber Line (SHDSL) technology to transport data over a single copper loop. The T200 NTU interfaces between the incoming ITU G.991.2 (SHDSL) leased-line service and the customer's Data Terminal Equipment (DTE), providing solutions for LAN-to-LAN bridging, Frame Relay, and/or PBX termination.

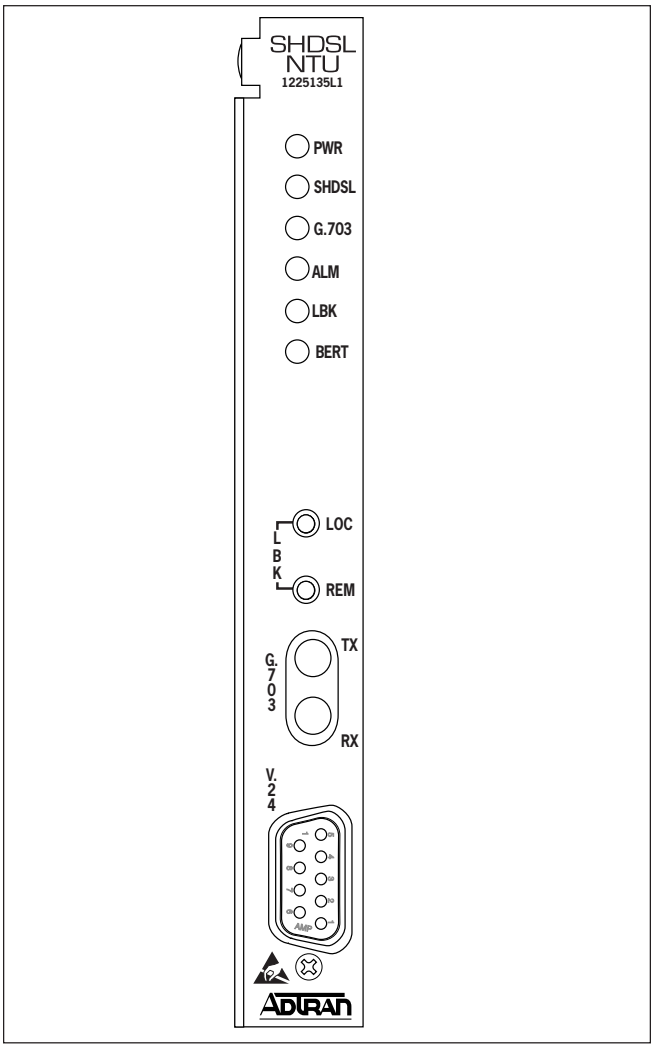


Figure 1. T200 SHDSL NTU

The T200 NTU is a locally powered or span powered standalone unit that contains an integrated Data Service Unit (DSU), eliminating the need for a separate DSU. The T200 NTU interfaces to a customer's G.703 interface and can be provisioned to support G.703 services. The SHDSL interface is designed to operate from 192 kbps to 2.048 Mbps in 64 kbps increments or from 3 to 32 time slots, with each time slot representing 64 kbps. The SHDSL time slots can be multiplexed to the G.703. The maximum number of time slots that can be directed toward the G.703 interface is 32 (2.048 Mbps). A block diagram of the T200 NTU functionality is illustrated in **Figure 2**.

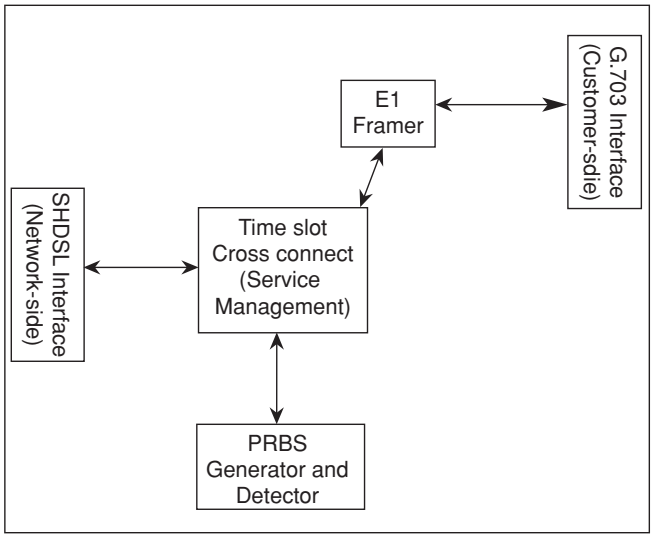


Figure 2. T200 Functional Overview

The T200 NTU can be locally or remotely provisioned with local provisioning being accomplished through the V.28 control port using a dumb terminal or PC with a terminal emulation program. The T200 NTU can be remotely provisioned by an ADTRAN SHDSL LTU. The T200 NTU can initiate and respond to local and remote loopbacks and has an internal 2^{15}-1 pseudorandom test pattern for bit error testing. Front panel-mounted LEDs and pushbuttons provide interface and test status as well as the initiation of a remote or local loopback.

The T200 NTU can be span powered from a Total Access SHDSL LTU, or a nominal –48 VDC power source.

The SHDSL NTU will be used to provide access to customer premises to E1 or leased-line services, as well as primary-rate ISDN. The SHDSL NTU is required to support leased-line G.703/G.704 services to customers. The primary applications will include connection to routers and PBXs.

Front Panel Features

The T200 NTU unit has six front panel LEDs. **Table 1** lists and describes these front panel LEDs.

Table 1. LED Descriptions

LED	Status	Description
PWR	Off	No power
	Green	Adequate power
SHDSL	Green	SHDSL Loop is trained
	Yellow	SHDSL Loop is trained with marginal signal quality
	Red	(SNR margin) SHDSL Loop is not trained
G.703	Off	G.703 port not configured, or in alarm condition
	Green	G.703 port configured and no alarms
ALM	Off	No alarm condition detected
	Yellow	Remote alarm condition detected
	Red	Alarm condition detected locally
LBK	Off	Module is not in loopback
	Green	Local loopback is active
BERT	Off	Module is not in BERT
	Green	BERT running with no errors
	Flashing Yellow	Module is running a BERT with bit errors
	Red	BERT running with no pattern sync

The T200 NTU has two front panel pushbuttons. The buttons are protected from accidental operation. The front panel button functions can be disabled via the management interface. It is possible to disable the port select SHDSL option to avoid the possibility of looping the SHDSL port when disabled. **Table 2** lists and describes these two pushbuttons.

2. CONNECTIONS

All connections of the NTU are made through card edge connectors. The circuit pack operates in a standalone chassis, or the ADTRAN HR12 HDSL shelf.

When the circuit pack is installed in any of the NTU enclosures, all connections are made through the enclosure backplanes. See the following ADTRAN Installation and Maintenance Practices for more information:

- 61242007L1-5, HR12
- 61242061L3-5, E1 T400 HTU-R Housing
- 61245034L2-5, 1:1 Protection Switching Housing

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

Table 2. Front Panel Pushbuttons

Button Label	Description
LOC LBK	If the Local Loopback (LOC LBK) is pressed, a dual sided loopback at the T200 NTU is initiated. If the LOC LBK is pressed again, the loopback is terminated.
REM LBK	If the Remote Loopback (REM LBK) is pressed, a dual sided loopback at the LTU is initiated. If the REM LBK is pressed again, the loopback is terminated.

The local management port is a DB-9 female connector and is labeled V.24. The interchange circuits and pinouts are listed in **Table 3**. The local management baud rate will auto-detect between 2400 baud and 57600 baud.

The other pins are internally connected to ensure correct handshaking interoperability. These internal connections shall be made via resistor traces to facilitate with future build options.

3. OPTIONING

Hardware Optioning

The strap map for the T200 SHDSL NTU is illustrated in **Figure 3**.

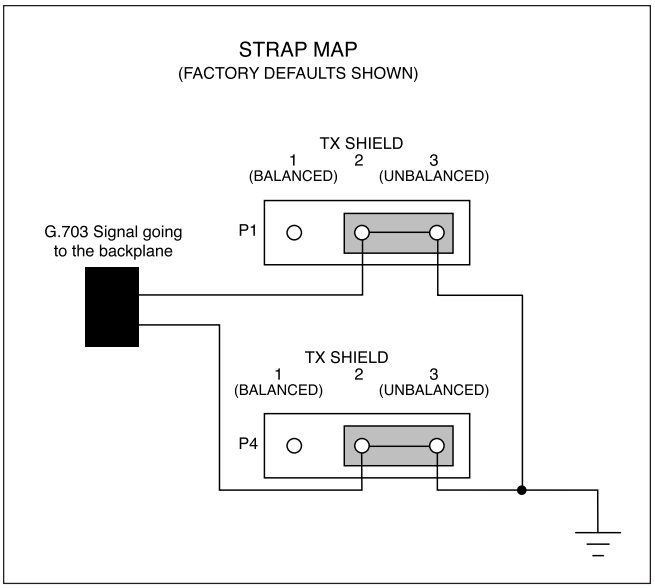


Figure 3. T200 Strap Map

Software Optioning

The menu tree in **Figure 4** illustrates the path to every provisioning, performance monitoring, and test access point in the T200 menu system.

Cross-Connect Map

The purpose of the cross-connect map is to allocate the time slots (TS0s) from the SHDSL loop to user ports (E1) and configure framing. The cross-connect maps can be accessed via the VT100 terminal screens. Select "1," *Provisioning*, from the Main Menu. Choose to provision the local unit (Selection 1) or the

Table 3. V.24 Pin Connections

Interchange Name	Description	Pinout
DCD	Data Carrier Detect – Internally connected to DTR and DSR	1
RXD	Receive Data	2
TXD	Transmit Data	3
DTR	Data Terminal Ready – Internally connected to DCD and DSR	4
GND	Signal Ground	5
DSR	Data Set Ready – Internally connected to DCD and DTR	6
RTS	Ready To Send – Internally connected to CTS	7
CTS	Clear To Send – Internally connected to RTS	8
NC	No Connection	9

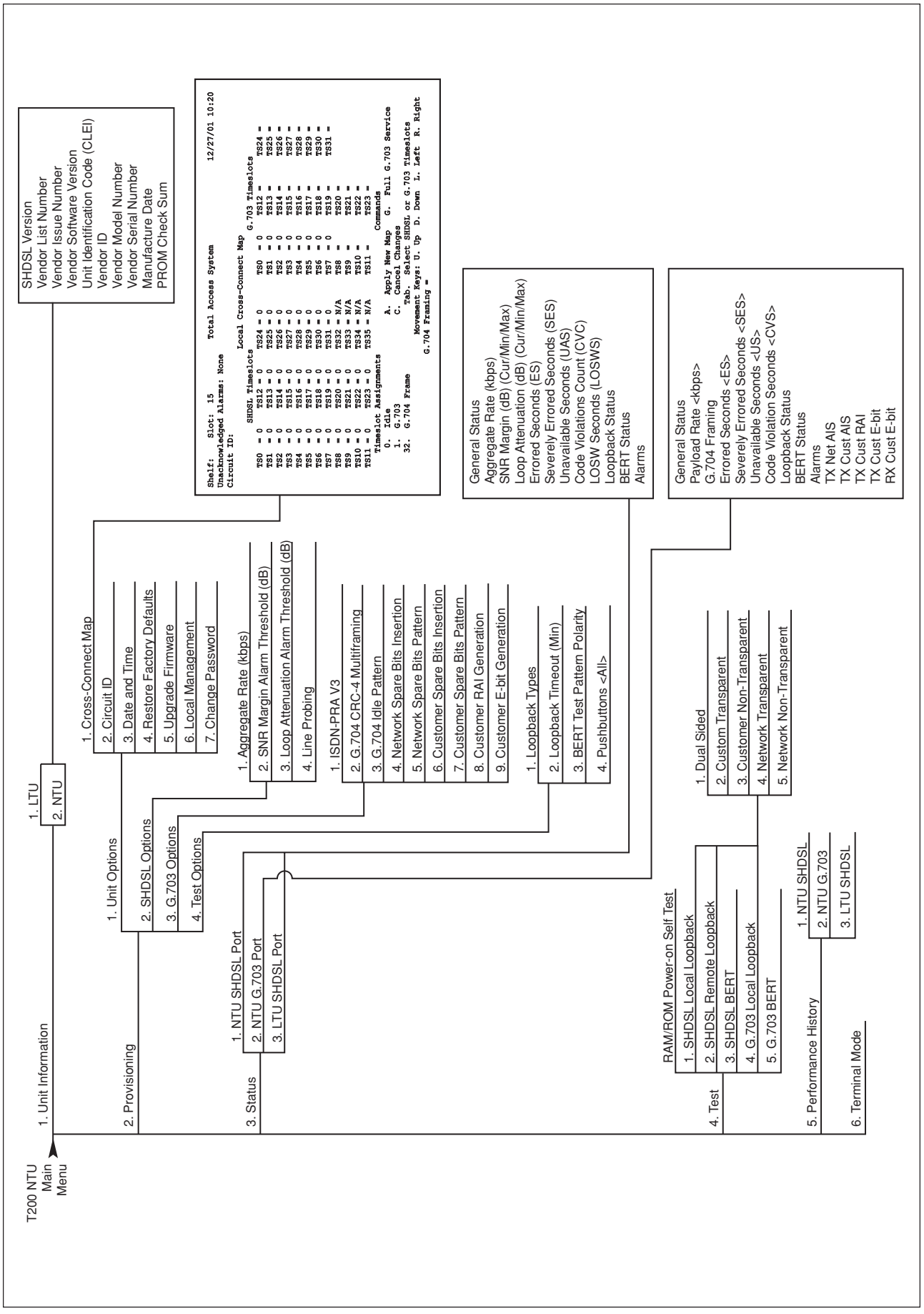


Figure 4. T200 Menu Tree

remote unit (Selection 2). Next, select "1," *Unit Options*, and then "1," *Cross Connect Map*. The cross-connect map is shown in **Figure 5**.

The cross-connect map is split down the middle in two sections. The left section of the map lists the SHDSL time slots and right section of the map lists the G.703 time slots. The user builds a new pending map before making it active with the apply key. The options listed at the bottom of the screen allow the user to setup and manipulate the time slots. The statement under the list of commands indicates the framing status. Time slot configuration options are defined as follows:

0. Idle
If a time slot is set for idle, an idle code is inserted. The pattern will always be FF hex (all 1s) toward the SHDSL network.

The idle pattern out the G.703 interface is programmable under the G.703 option. The default is FF hex (all 1s).

1. G.703 Service
The selected time slot will carry G.703 service (Refer to the *Full G.703 Services* subsection for more information).

32. G.704 Framing
This option enables three different framing configurations. Framing is always set in the first time slot (TS0). The framing will be locally generated if 32 is entered in the G.703 TS0 slot only. If 32 is entered in the G.703 TS0 and the SHDSL TS0, then the framing will be passed transparently between the G.703 and SHDSL ports. If values other than 32 are assigned to both the SHDSL TS0 slot and G.703 TS0 slot then the operation is G.703 unframed (if other G.703 service values are assigned to the G.703 time slots).

A. Apply New Map
This command saves and activates any changes made by the user.

C. Cancel Changes
This command will undo any changes made by the user since the last saved configuration. The new pending map will revert to the currently active time slot assignments.

G. Full G.703 Service
If this quick key command is selected, the cross-connect map will automatically configure the time slots for Full G.703 service, and the framing will be set for transparent. Refer to the *Typical Applications* subsection for more information.

Tab. Select SHDSL or G.703 Time Slots
The tab key moves the cursor between the SHDSL and G.703 sections of the cross-connect map.

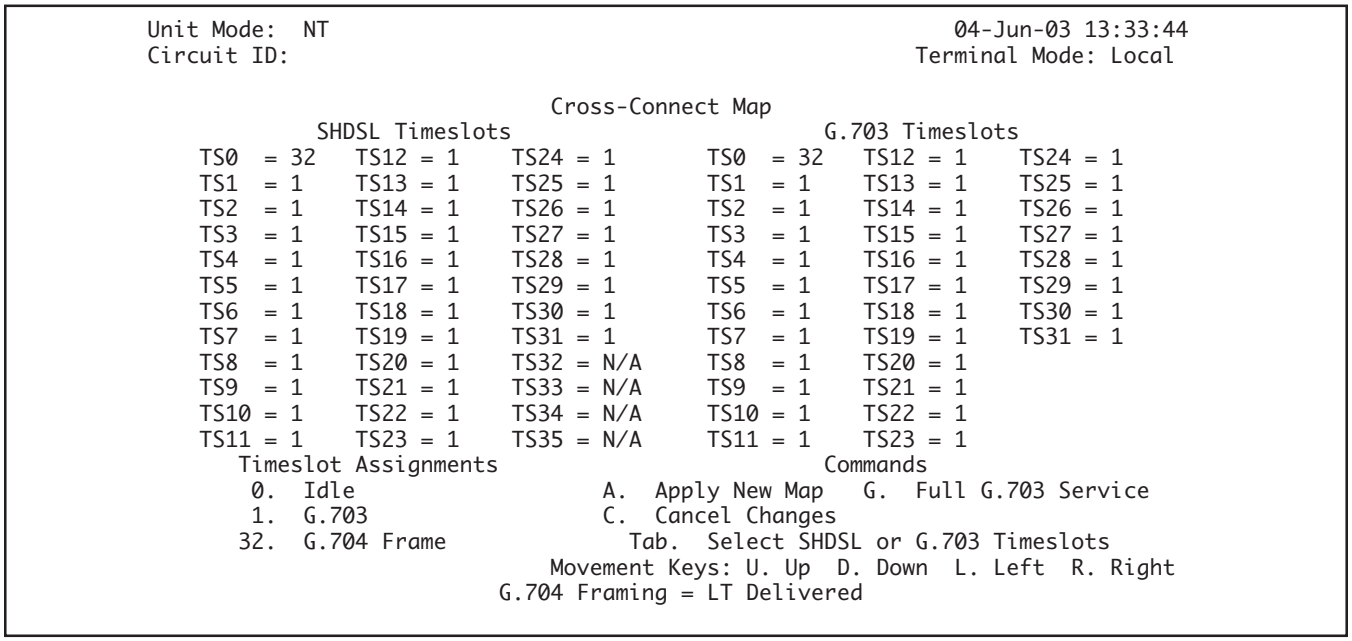


Figure 5. Cross-Connect Map

Arrow Keys Move Cursor
The arrow keys allow movement between the individual time slots.

Typical Applications

Framed Full E1 Service is set up using the quick key "G," and then selecting "A" to save the changes. The screen in **Figure 6** illustrates a cross-connect map configured for Framed Full E1 Service.

Unframed Full E1 Service is set up using the quick key "G," entering "1" in both the SHDSL TS0 slot and the G.703 TS0 slot, and then selecting "A" to save the changes. The screen in **Figure 7** illustrates a cross-connect map configured for Unframed Full E1 Service.

```
Unit Mode:  NT                                              04-Jun-03 13:33:44
Circuit ID:                                               Terminal Mode: Local

                            Cross-Connect Map
          SHDSL Timeslots                          G.703 Timeslots
    TS0  = 32   TS12 = 1    TS24 = 1       TS0  = 32   TS12 = 1    TS24 = 1
    TS1  = 1    TS13 = 1    TS25 = 1       TS1  = 1    TS13 = 1    TS25 = 1
    TS2  = 1    TS14 = 1    TS26 = 1       TS2  = 1    TS14 = 1    TS26 = 1
    TS3  = 1    TS15 = 1    TS27 = 1       TS3  = 1    TS15 = 1    TS27 = 1
    TS4  = 1    TS16 = 1    TS28 = 1       TS4  = 1    TS16 = 1    TS28 = 1
    TS5  = 1    TS17 = 1    TS29 = 1       TS5  = 1    TS17 = 1    TS29 = 1
    TS6  = 1    TS18 = 1    TS30 = 1       TS6  = 1    TS18 = 1    TS30 = 1
    TS7  = 1    TS19 = 1    TS31 = 1       TS7  = 1    TS19 = 1    TS31 = 1
    TS8  = 1    TS20 = 1    TS32 = N/A     TS8  = 1    TS20 = 1
    TS9  = 1    TS21 = 1    TS33 = N/A     TS9  = 1    TS21 = 1
    TS10 = 1    TS22 = 1    TS34 = N/A     TS10 = 1    TS22 = 1
    TS11 = 1    TS23 = 1    TS35 = N/A     TS11 = 1    TS23 = 1
       Timeslot Assignments                          Commands
        0.  Idle                    A.  Apply New Map   G.  Full G.703 Service
        1.  G.703                   C.  Cancel Changes
       32.  G.704 Frame               Tab.  Select SHDSL or G.703 Timeslots
                                Movement Keys: U. Up  D. Down  L. Left  R. Right
                           G.704 Framing = LT Delivered
```

Figure 6. Framed Full E1 Service

```
Unit Mode:  NT                                              04-Jun-03 13:35:31
Circuit ID:                                               Terminal Mode: Local

                            Cross-Connect Map
          SHDSL Timeslots                          G.703 Timeslots
    TS0  = 1    TS12 = 1    TS24 = 1       TS0  = 1    TS12 = 1    TS24 = 1
    TS1  = 1    TS13 = 1    TS25 = 1       TS1  = 1    TS13 = 1    TS25 = 1
    TS2  = 1    TS14 = 1    TS26 = 1       TS2  = 1    TS14 = 1    TS26 = 1
    TS3  = 1    TS15 = 1    TS27 = 1       TS3  = 1    TS15 = 1    TS27 = 1
    TS4  = 1    TS16 = 1    TS28 = 1       TS4  = 1    TS16 = 1    TS28 = 1
    TS5  = 1    TS17 = 1    TS29 = 1       TS5  = 1    TS17 = 1    TS29 = 1
    TS6  = 1    TS18 = 1    TS30 = 1       TS6  = 1    TS18 = 1    TS30 = 1
    TS7  = 1    TS19 = 1    TS31 = 1       TS7  = 1    TS19 = 1    TS31 = 1
    TS8  = 1    TS20 = 1    TS32 = N/A     TS8  = 1    TS20 = 1
    TS9  = 1    TS21 = 1    TS33 = N/A     TS9  = 1    TS21 = 1
    TS10 = 1    TS22 = 1    TS34 = N/A     TS10 = 1    TS22 = 1
    TS11 = 1    TS23 = 1    TS35 = N/A     TS11 = 1    TS23 = 1
       Timeslot Assignments                          Commands
        0.  Idle                    A.  Apply New Map   G.  Full G.703 Service
        1.  G.703                   C.  Cancel Changes
       32.  G.704 Frame               Tab.  Select SHDSL or G.703 Timeslots
                                Movement Keys: U. Up  D. Down  L. Left  R. Right
                           G.704 Framing = Unframed
```

Figure 7. Unframed Full E1 Service

Bit Error Rate Test

The SHDSL NTU contains a built-in Bit Error Rate Test (BERT). The BERT involves injecting and detecting a Pseudorandom Binary Sequence (PRBS) toward the network on the selected payload (i.e. G.703, or entire SHDSL payload). The PRBS used in the SHDSL NTU is PRS15 as defined in ITU-T 0.150 and 0.151. It is also known as a 2e-15 pattern.

The BERT is only accessible via the VT100 terminal screens. Select "*4. Test*" from the Main Menu Screen. From the Test Screen, the SHDSL BERT, G.703 BERT, and options will appear, and each has one of the following status messages:

N/A – This BERT is currently unavailable. Only one BERT can be active at a time. For example, if SHDSL BERT is active, all others will be N/A.

ACTIVE – This BERT is currently in progress. The source column identifies the person who initiated the BERT.

INACTIVE – This BERT is not currently in progress. After selecting a BERT type from the Test Screen, the BERT Screen will appear, illustrating both BERT statistics and commands.

If no BERT is currently active, the following list of commands will be available:

Start – Starts the BERT on the selected port/service.

If the BERT is currently active, the following list of commands will be available:

Stop – Stops the BERT in progress.

Inject a Single Bit Error – Injects one bit error into the pattern.

Restart – Clears out all statistics and restarts the BERT.

In addition to the commands, the following statistical information is provided:

Bit Error Rate – Total number of bit errors divided by the total number of bits in the current test interval.

Bit Error Count – Total number of bit errors in the current test interval.

Pattern Sync Loss Count – Total number of times that the BERT has lost pattern sync.

Errored Seconds – Total number of seconds in which at least one bit error has occurred.

Total Elapsed Time – Total time that has elapsed since the test began (Days: Hours: Minutes: Seconds).

A BERT status field supplies the following information:

On – The BERT has started and has pattern sync.

Searching for pattern – The BERT has lost pattern sync.

Off – This BERT is currently off.

Loopbacks

There are five types of local loopbacks and five types of remote loopbacks available for each of the two line interfaces (G.703, and SHDSL). When initiating a loopback, the first step is choosing a line interface. When G.703 is chosen, the loopback will occur at the G.703 drivers and receivers. When SHDSL is chosen, the loopback will occur at the SHDSL drivers and receivers.

NOTE

All remote loopbacks are initiated at the local T200 NTU unit.

Local Dual Sided Loopback – Provides a bidirectional loopback at the NTU (**Figure 8**).

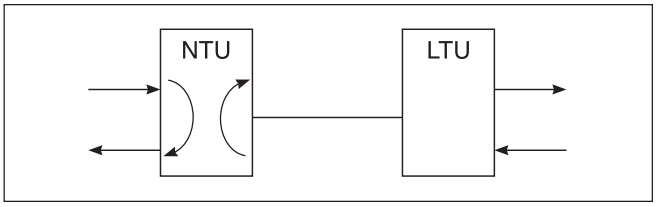


Figure 8. Local Dual Sided Loopback

Remote Dual Sided Loopback – Initiated at the NTU and provides bidirectional loopback at the LTU (**Figure 9**).

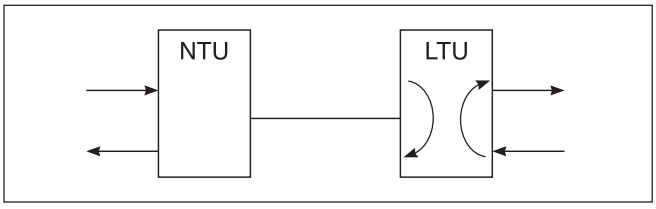


Figure 9. Remote Dual Sided Loopback

Local Customer Transparent Loopback – Provides a loopback at the NTU in the customer direction (**Figure 10**). Data is passed transparently to the network side.

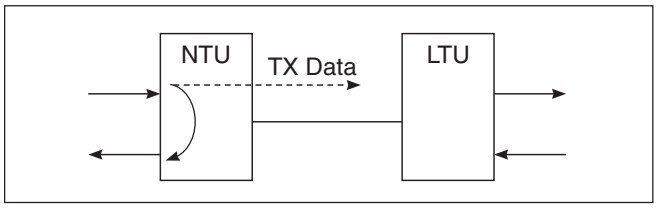


Figure 10. Local Customer Transparent Loopback

Remote Customer Transparent Loopback – Initiated at the NTU and provides a loopback at the LTU in the customer direction (**Figure 11**). Data is passed transparently to the network side.

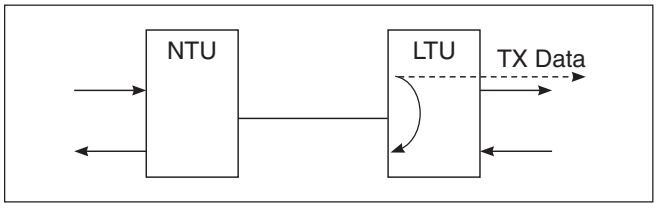


Figure 11. Remote Customer Transparent Loopback

Local Customer Nontransparent Loopback – Provides a loopback at the NTU in the customer direction (**Figure 12**). AIS signal is injected into the network side.

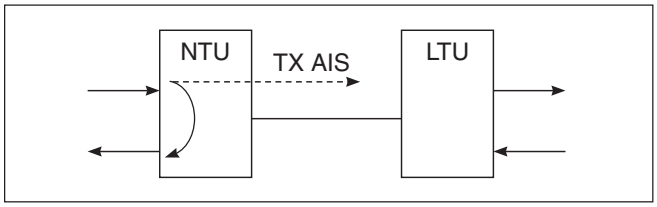


Figure 12. Local Customer Nontransparent Loopback

Remote Customer Nontransparent Loopback – Initiated at the NTU and provides a loopback at the LTU in the customer direction (**Figure 13**). AIS signal is injected into the network side.

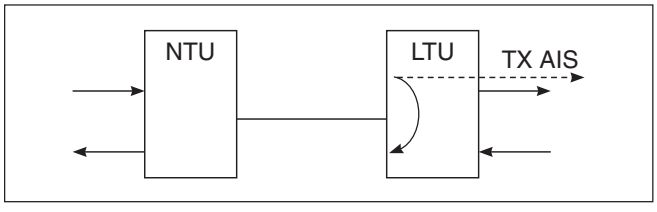


Figure 13. Remote Customer Nontransparent Loopback

Local Network Transparent Loopback – Provides a loopback at the NTU in the network direction (**Figure 14**). Data is passed transparently to the customer side.

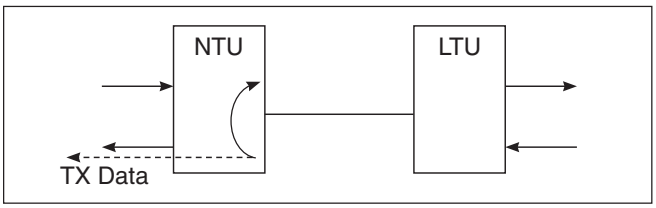


Figure 14. Local Network Transparent Loopback

Remote Network Transparent Loopback – Initiated at the NTU and provides a loopback at the LTU in the network direction (**Figure 15**). Data is passed transparently to the customer side.

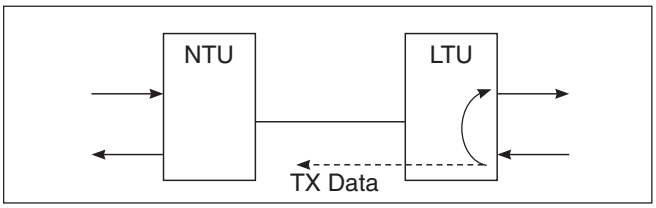


Figure 15. Remote Network Transparent Loopback

Local Network Nontransparent Loopback – Provides a loopback at the NTU in the network direction (**Figure 16**). AIS signal is injected into the customer side.

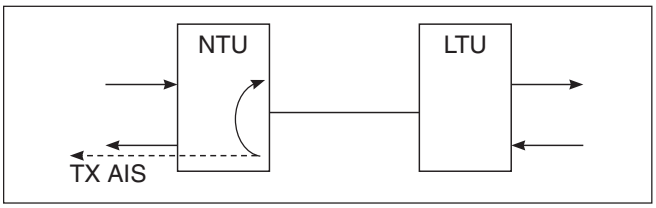


Figure 16. Local Network Nontransparent Loopback

Local Network Nontransparent Loopback – Initiated at the NTU and provides a loopback at the LTU in the network direction (**Figure 17**). AIS signal is injected into the customer side.

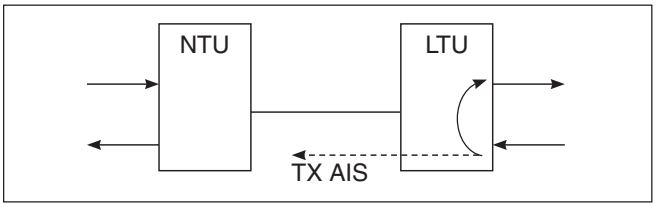
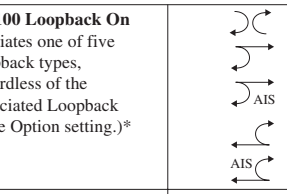
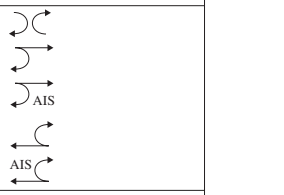
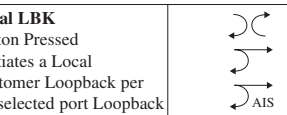
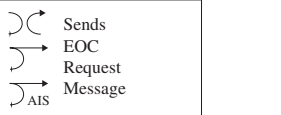


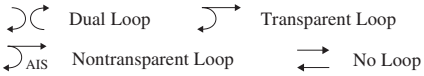
Figure 17. Remote Network Nontransparent Loopback

Loopbacks may be initiated via the VT100 test screens or front panel pushbuttons. Not all loopback types are available for all ports and port services by all initiating sources. See **Table 4** for an overview. A key to the symbols displayed in Table 5 is available below the Table.

Table 4. Loopback Overview

Initiating Source	Ports Customer, away from SHDSL Port (left) G.703 Port	Network, toward SHDSL Port (right) SHDSL Port
VT100 Test Screens		
VT100 Loopback On (Initiates one of five loopback types, regardless of the associated Loopback Type Option setting.)*		
VT100 Loopback Off		
Local LBK Button Pressed (Initiates a Local Customer Loopback per the selected port Loopback Type Option setting)		
LL Button Off		
Remote LBK Button Pressed (Initiates a Remote Network Loopback per the remote unit's selected port Loopback Type Option setting)*	N/A	 Sends EOC Request Message
RL Button Off		 Sends EOC Request Message

Key:



* The reception of in-band loopback patterns and EOC loopback request messages may be ignored or blocked on certain SHDSL LTUs installed in Total Access 3000 Systems.

Multiple Services

The G.703 interface supports a single 2048 kbps service. (See ITU-T G991.2 Annex E.1-TPS-TC for European 2048 kbps digital Unstructured Leased Line (D2048U).)

The SHDSL NTU supports CRC-4 detection/generation toward the SHDSL network (**Figure 18**). The CRC-4 detection/generation can operate in the following modes (configurable via the management interface):

1. CRC-4 detection/generation disabled
2. CRC-4 detection/generation enabled

When less than 32 time slots are configured on the G.703 port, the NTU bases the CRC-4 detection/generation on filling the unused time slots with a fixed pattern configurable via the management interface. This CRC-4 detection/generation is also required for multirate (single or simultaneous services) where less than 31 G.704 time slots are carried over the SHDSL line.

NOTE

All framed services operate in aligned mode.

Operation

The SHDSL NTU supports multiple rate line operation as specified in ITU-T G.991.2. All services described in this document operate in multiple rate mode, with a corresponding change in maximum payload. Unstructured E1 is supported for SHDSL rates equal to 32 and with all G.703 time slot assignments equal to the same G.703 service value of one.

The G.703 interface supports operation in the following modes that are selectable via the management interface:

1. Framed
2. Framed pass through
3. Unframed

The NTU provides framing on the E1 port as described in G.704 (sections 2.3 and 5) and G.706 (section 4) and G.736. In this mode, the data arriving at the SHDSL interface need not contain any G.704 framing and the NTU generates the framing. One or more services can be routed into time slots 1-31.

CRC-4 multiframe may be enabled or disabled. The default is disabled. The NTU routes one or more services from the SHDSL payload into time slots 1-31, as well as routing time slot 0. In this mode G.704 framing is present in the data arriving on the SHDSL interface and is passed transparently to the G.703 interface.

The NTU monitors the G.704 framing to detect errors (and thus drive the NTU LEDs) and to determine the value of the TS0 spare bits. The NTU transfers all SHDSL payload time slots transparently through the G.703 port without framing or monitoring. In this mode the port operates as a 2 Mbps G.703 interface without any G.704 framing. This implies that the whole SHDSL payload comprises a single service.

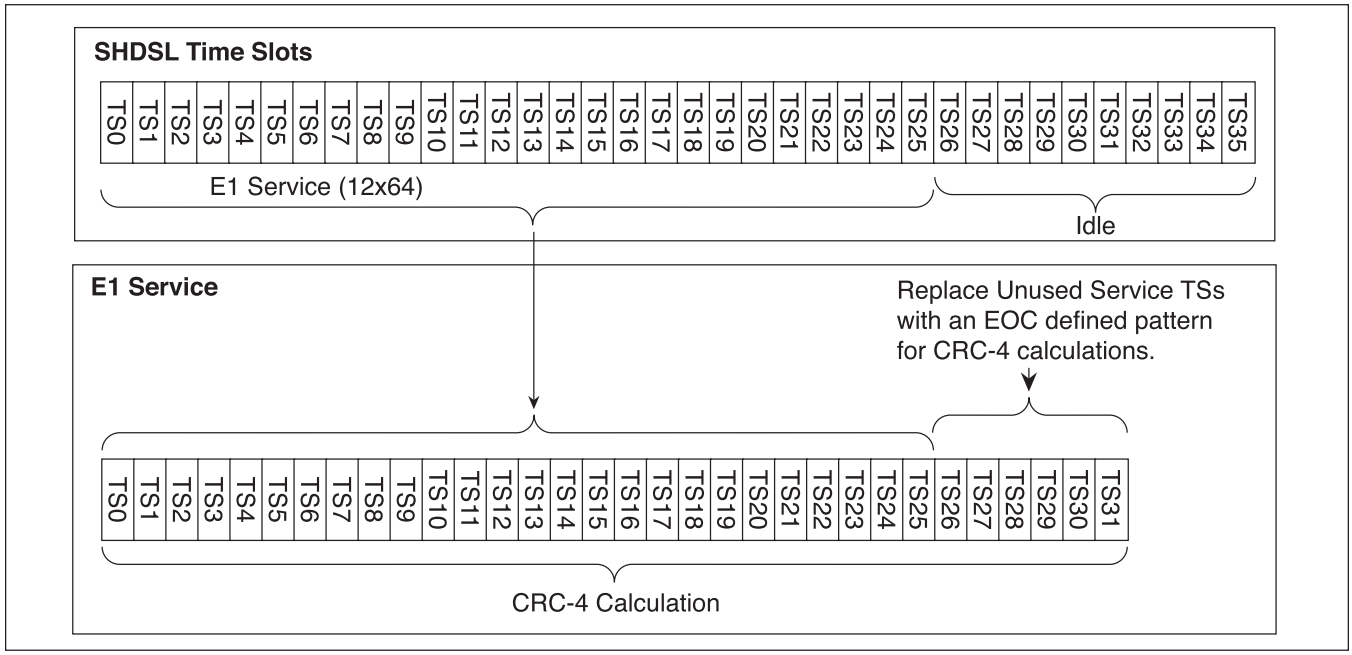


Figure 18. CRC-4 Detection/Generation

The following alarm conditions can be monitored on the G.703/G.704 interface (if applicable to the current configuration):

1. AIS (Alarm Indication Signal)
2. BER (Excessive Bit Error Rate)
3. LOMFA (Loss of Multi-Frame Alignment)
4. LOF (Loss of Frame)
5. LOS (Loss of Signal)
6. RAI (Remote Alarm Indication)
7. Slip

When the NTU is configured for an unframed service the only alarm available is LOS. Consequential actions can only be undertaken if G.704 framing is either delivered by the remote unit or is being generated on the NTU. If framing is being generated by the LT then the LT is responsible for these actions.

While any of the alarm states LOS, AIS, LOF, LOMFA and BER are detected, the following consequential actions will occur:

1. The remote alarm indication (bit 3 of the TS0 B- word) will be set as described in the G.704, G.726 and G.706;
2. The G.703/G.704 alarm LED will be on,
3. AIS will be transmitted toward the network in all corresponding data time slots.

NOTE

RAI assertion by the NTU can be disabled (the default state) under the G.703 Options Screen by the Customer RAI generation option.

When remote alarm indication is detected, the alarm condition will be displayed on the front panel.

4. SPECIFICATIONS

Table 5 lists the specifications for the T200 NTU.

Table 5. T200 SHDSL NTU Specifications

Network Interface
- Line Rate:. ..... SHDSL per ITU G.991.2
- Line Code: ..... TC PAM
- DSL Timing: ..... Network

DTE Interface (DIGITAL)
- Bit Rate: ..... 64 kbps to 2.048 Mbps (Nx64 kbps)

DTE Interface (E1)
- Bit Rate: ..... 2.048 Mbps
- Framing: ..... G.703 (CCS) CRC-4 (enable/disable) Unframed

Craft Port
- Bit Rate: ..... 2.4 kbps to 57.6 kbps
- Connector: ..... DB-9, Female, V.24

Agency Approvals: K.20, K.21, CISPER 22, IEC 950, CE MARK

Environment
- Operating: ..... –40ºC to +70ºC (–40°F to +158°F)
- Storage: ..... –40ºC to +85ºC (–40°F to +185°F)
- Relative Humidity: ..... Up to 95%, noncondensing

Physical
- Dimensions: ..... 5.36 in. L, 5.59 in. H
- Weight: ..... < 1 lbs.
- Power: ..... –48 VDC or Span Power

5. 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.

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