



ADTRAN[®]

SHDSL 2-Wire/4-Wire

NTU Product Series

Installation and Maintenance Guide

Document Number: 61230001E1-5E
July 2015



installation guide

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About this Document

This document provides instructions for the installation and maintenance of the SHDSL 2-Wire/4-Wire NTU Product Series. The intended audience for this information is the craft-person responsible for the installation and maintenance of the equipment. These instructions assume familiarity with the intended use of the equipment, basic required installation skills, and knowledge of local and accepted safety practices.

Additionally, this document provides provisioning information specific to the User Interface of the SHDSL 2-Wire/4-Wire NTU Product Series. The intended audience for this information is system management personnel responsible for the configuration of the software applications. User Interface provisioning assumes familiarity with the intended use of the equipment, concepts peculiar to this product, and a computer operations skill set.

Related information can be obtained by referring to the applicable Component and System level documentation.



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Revision History

Revision	Date	Description
B	May 2006	Initial revision created from 61230001L1-5B to add RoHS Directive 2002/95/EC compliance
C	December 2006	Revise to include TSCAN features
D	September 2011	Revise Safety and Regulatory Compliance content
E	July 2015	Remove RoHS Directive 2002/95/EC compliance information.

Conventions

The following typographical conventions are used in this document:

[This font](#) indicates a cross-reference link.

This font indicates references to other documentation and is also used for emphasis.

This font is used for strong emphasis.

This font indicates a System Response (on-screen messages and prompts).

This font indicates System Input (text to be typed exactly as shown).

This Font indicates screen menu items, fields and parameters.

THIS FONT indicates keyboard keys (ENTER, ESC, ALT). Keys that are to be pressed simultaneously are shown with a plus sign (ALT + X indicates that the ALT key and X key should be pressed at the same time).

THIS FONT indicates silk-screen labels or other system label items.

Hazard Classifications

The following hazard classifications are used in this document:



DANGER

DANGER indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.



WARNING

WARNING indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



CAUTION

CAUTION indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury. CAUTION can also be used to alert against unsafe practices associated with events that could lead to personal injury.

NOTICE

Notice call-outs indicate a potentially hazardous situation not related to personal injury, such as messages related to property damage only.

NOTE

Notes inform the user of additional, but essential, information or features.

Icons

The following icons are used throughout the ADTRAN document suite:

-  jobAid
-  installation guide
-  deployment guide
-  application guide
-  reference guide
-  diagnostic guide
-  safety and regulatory
-  engineering guide
-  release notes
-  upgrade guide
-  user guide

Training

ADTRAN offers training courses on our products. These courses include overviews on product features and functions while covering applications of ADTRAN product lines. ADTRAN provides a variety of training options, including customized training and courses taught at our facilities or at customer sites.

For inquiries concerning training, contact ADTRAN:

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NTU Product Series

SHDSL 2-Wire/4-Wire NTU

Scope of this Guide

This guide provides instructions for the installation and maintenance of the SHDSL 2-Wire/4-Wire NTU Product Series, including connections, optioning, and troubleshooting.

In this Guide

This guide contains the topics listed in [Table 1](#).

Table 1. Topic List

Topic	See Page
Introduction	2
Safety and Regulatory Compliance Avis sur la sécurité et la conformité à la réglementation Konformitätserklärung zur Sicherheit und Einhaltung von Normen	7
Installation	9
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Introduction

This guide provides procedures for the following SHDSL 2-Wire/4-Wire NTU modules in the series.

Table 2. SHDSL 2-Wire/4-Wire NTU Modules

Part Number	Product Name
1230001E1	6540 SHDSL 2-Wire/4-Wire NTU, AC Powered
1230002E1	6540 SHDSL 2-Wire/4-Wire NTU, DC Powered
1230007E1	6541 SHDSL 2-Wire/4-Wire NTU, AC Powered
1230008E1	6541 SHDSL 2-Wire/4-Wire NTU, DC Powered
1230009E1	6542 SHDSL 2-Wire/4-Wire NTU, Span or DC Powered

Note: The 6540 and 6541 model sets are separate AC or DC powered versions of the same base product (for example, P/Ns 1230001 and 1230002; 1230007 and 1230008).

Description

The SHDSL 2-Wire/4-Wire NTU provides an interface between the SHDSL network and the user Data Terminal Equipment (DTE). It supports applications such as LAN-to-LAN bridging, Frame Relay circuit, and PABX termination. The SHDSL 2-Wire/4-Wire NTU can be used as either of the following:

- remote unit to the ADTRAN Total Access[®] 3000 multiservice platform (see [Figure 1](#)), or
- pair of units in a point-to-point limited distance campus configuration (see [Figure 2](#)), with one SHDSL 2-Wire/4-Wire NTU configured to “LT” mode.

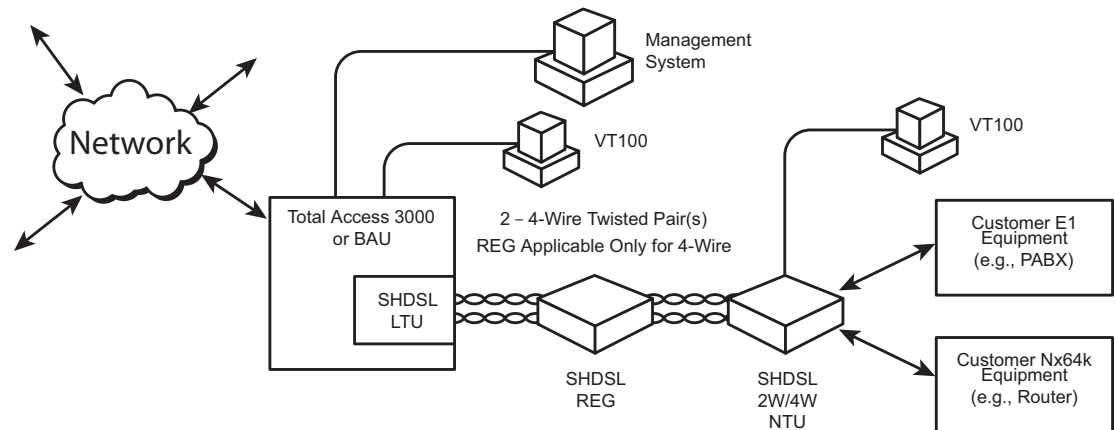


Figure 1. Typical System Application

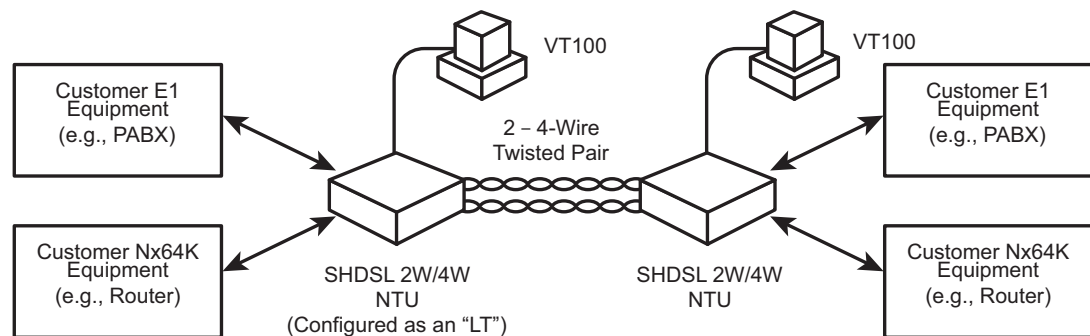


Figure 2. Typical Campus Application

SHDSL 2-Wire/4-Wire Mode, Line Rate

The SHDSL 2-Wire/4-Wire NTU supports multi-rate line operation (refer to [Table 3](#)).

Table 3. 2-Wire/4-Wire Multi-Rate Operation

Data Rate Type	2-Wire Mode	4-Wire Mode
SHDSL Line Aggregate Data Rate	200 kbps to 2.312 Mbps ($N \times 64$ kbps + 8 kbps, where $N = 3$ to 36) In 2-wire mode, 8 kbps of bandwidth is required for overhead framing	400 kbps to 4.624 Mbps ($N \times 64$ kbps + 16 kbps, where $2 \times N = 3$ to 36) In 4-wire mode, 16 kbps is required for overhead framing.
Payload Data Rate	192 kbps to 2.304 Mbps ($N \times 64$ kbps, where $N = 3$ to 36)	384 kbps to 4.608 Mbps in 4-wire mode ($2 \times N \times 64$ kbps, where $N = 3$ to 36)
Service Data Rate	64 kbps to 2.304 Mbps ($N \times 64$ kbps, where $N = 1$ to 36)	64 kbps to 4.608 Mbps ($N \times 64$ kbps, where $N = 1$ to 72) This is the actual user data rate delivered to either the G.703 or Nx64 kbps ports.

Features

Table 4 is a matrix of product features for the five versions of the SHDSL 2-Wire/4-Wire NTU.

Table 4. Product Feature Set Matrix

			Model Number				
			1230001E1	1230002E1	1230007E1	1230008E1	1230009E1
Physical Description							
Net Housing: 5.3 cm (2.1 in.) H x 23.6 cm (9.3 in.) W x 16.8 cm (6.6 in.) D			•	•	•	•	•
Front Panel Recessed Pushbuttons (4 total)							
PORT SELECT			•	•	•	•	•
LOCAL LOOP/ERR INJ			•	•	•	•	•
REMOTE LOOP			•	•	•	•	•
BERT			•	•	•	•	•
Front Panel Tri-Color LED Indicators (Always Eight Total)							
Left to Right Order	Label	Function					
LED 1	SHDSL	SHDSL Port Status, Test Select, Alarms	•	•	•	•	
LED 2	G.703	G.703 Port Status, Test Select, Alarms	•	•	•	•	
LED 3	Nx64k	Nx64k Port Status, Test Select, Alarms	•	•	•	•	
	SPN PWR	Span Power Status					•
LED 4	RTS/C	Nx64k Port RTS/C Status	•	•	•	•	
	DC PWR	Local DC Power Status					•
LED 5	RLSD/I	Nx64k Port RLSD/I Status	•	•	•	•	
	PRGM	Firmware Programming Status					•
LED 6	LLOOP	Local loopback test status for selected port	•	•	•	•	•
LED 7	RLOOP	Remote loopback test status for selected port	•	•	•	•	•
LED 8	BERT	BERT for selected port/service	•	•	•	•	•
Rear Panel							
SHDSL Port (RJ-45 135 ohms, TNV-3 rated)			•	•	•	•	•
G.703 E1 Port (RJ-45 120 ohms, SELV rated)			•	•			•
Optional G.703 E1 Port (RJ-45 to BNC 75 ohms through external adapter, ADTRAN P/N 1225002L1)			•	•			•
G.703 E1 Port (BNC, 75 ohms, SELV rated)			•	•	•	•	•
Nx64k Port X.21 (DB-15 female / ISO 4903, SELV; V.11 electrical)			•	•	•	•	
Nx64k Port V.35 (M34 Winchester 34-pin female / ISO 2593, SELV rated; V.35, V.28 electrical)			•	•	•	•	
Nx64k Port V.36 using the V.35 (34-pin male) to V.36 (ISO 4902 37-pin female) 12 inch adapter cable, ADTRAN P/N 1225004L1; V.11, V.10 electrical			•	•	•	•	
Local Management Port (DB-9 female, SELV; V.28 electrical)			•	•	•	•	
AC Power (IEC-320 power receptacle)			•	•	•	•	•

Table 4. Product Feature Set Matrix (Continued)

	Model Number				
	1230001E1	1230002E1	1230007E1	1230008E1	1230009E1
DC Power (5.08 mm (0.2 inc.) 4-pin terminal block shrouded male (MOLEX/BEAU 861904 or equivalent)		•		•	•
Power					
100-240 VAC, 50/60Hz, 100 mA	•		•	•	
35-80 VDC, 250 mA		•			
120 VDC Span Powered, 150 mA					
120 VDC Span Powered, 150 mA; 35-80 VDC, 250 mA Auto-Switched Local Powered					•

Industry Standards Compliance

The SHDSL 2-Wire/4-Wire NTU interfaces adhere to these industry standards, either partially or in full:

- SHDSL: ITU-T G.991.2 (12/03 and 2003 amendments) and G.994.1 (05/03)
- G.703: ITU-T G.703 (10/98), G.704 (10/98), G.706 (4/91), G.732 (11/88), G.775 (10/98), G.784 (1/94), G.797 (3/96), G.821 (8/96), G.823 (03/93), and G.826 (2/99)
- Nx64K: ITU-T X.21 (09/92), V.35 (10/84), and V.36 (11/88); and ISO 2593 (1984), 4903 (1991), and 4902 (1980)

Safety and Regulatory Compliance

Avis sur la sécurité et la conformité à la réglementation

Konformitätserklärung zur Sicherheit und Einhaltung von Normen



WARNING • AVERTISSEMENT • WARNUNG

- Read all warnings and cautions before installing or servicing this equipment. Refer to the Safety and Regulatory Compliance Notice for this product (P/N 61230001E1-17, 61230002E1-17, 61230007E1-17, 61230001E8-17, or 61230009E1-17) for detailed safety and regulatory information.
- Lisez tous les avertissements et mises en garde avant l'installation de cet équipement ou la réalisation de toute opération de maintenance. Consultez l'avis sur la sécurité et la conformité à la réglementation pour ce produit (P/N 61230001E1-17, 61230002E1-17, 61230007E1-17, 61230001E8-17, ou 61230009E1-17) pour obtenir des renseignements détaillés sur la sécurité et la réglementation.
- Lesen Sie sich alle Warn- und Sicherheitshinweise durch, bevor Sie dieses Gerät installieren oder warten. Ausführliche Sicherheits- und regulatorische Informationen sind in der Konformitätserklärung zur Sicherheit und Einhaltung von Normen zu diesem Produkt (P/N 61230001E1-17, 61230002E1-17, 61230007E1-17, 61230001E8-17, oder 61230009E1-17) aufgeführt.

The SHDSL 2-Wire/4-Wire NTU complies with the following international standards:

- EN 300 386-2
- IEC 60950/EN 60950/AS NZS60950
- S016
- S043.2
- ITU K.21 Enhanced
- Telstra 1555

Figure 3 shows the compliance code labels for the SHDSL 2-Wire/4-Wire NTU Product Series.

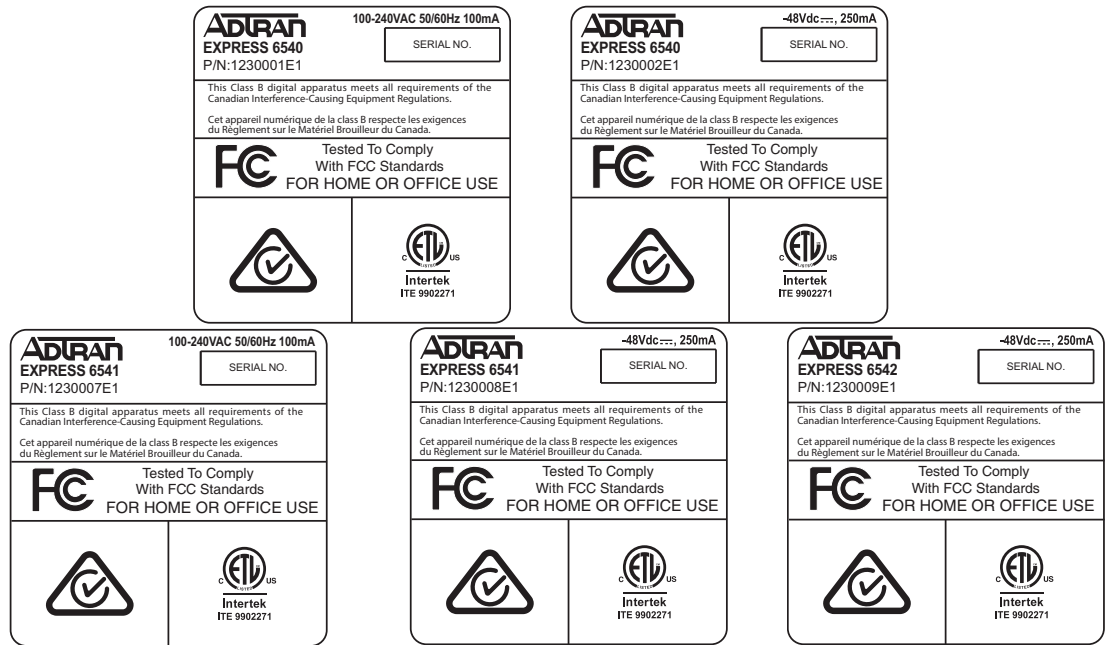


Figure 3. Compliance Labels

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

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

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

Installation

**CAUTION!**

SUBJECT TO ELECTROSTATIC DAMAGE
OR DECREASE IN RELIABILITY
HANDLING PRECAUTIONS REQUIRED

After unpacking any SHDSL 2-Wire/4-Wire NTU, inspect it for damage. If damage has occurred, file a claim with the carrier, then contact ADTRAN Customer Service. Refer to [Appendix A, "Warranty and Customer Service"](#) for further information. If possible, keep the original shipping container for returning the unit for repair or for verification of shipping damage.

Shipping Contents

The contents include the following items:

- SHDSL 2-Wire/4-Wire NTU
- Mating quick-connect terminal screw block (DC models only)
- SHDSL 2-Wire/4-Wire NTU Job Aid (product specific)

Front Panel Push Buttons

There are four push buttons on the SHDSL 2-Wire/4-Wire NTU front panel (refer to [Table 5](#)). The push buttons are recessed to avoid accidental actuation and can be disabled, either individually or as a group, using the management interface.

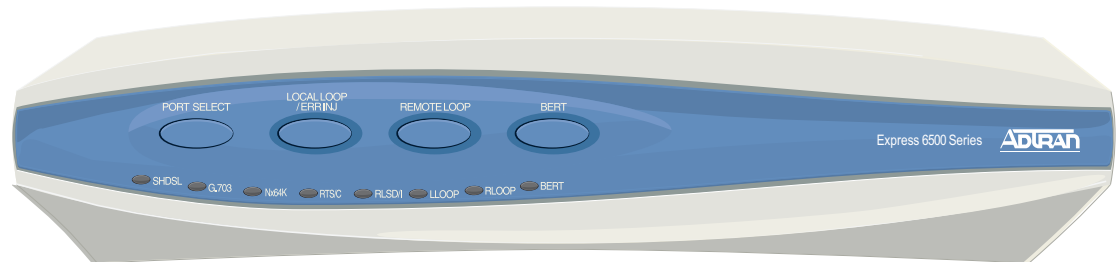
Table 5. Front Panel Push Buttons

Push Button	Description
PORT SELECT	Press the PORT SELECT button to select the active port. Selection choices cycle through the following order: No Port, Nx64k, G.703, SHDSL.
LOCAL LOOP/ ERR INJ	If a port is selected, and a Bit Error Rate Test (BERT) is not in progress, press the LOCAL LOOP/ERR INJ button to initiate or terminate a local loop on the selected port. If a BERT is in progress, press the button to inject a single bit error.
REMOTE LOOP	If the SHDSL port is selected, press the REMOTE LOOP button to either place or remove a remote loop on the port by sending a EOC request message to the LTU (or NTU in campus mode). If the Nx64K port or G.703 port (with only one service defined) is selected, press this button to place or remove a remote loop on the selected port's single data service by sending respective inband loop up or loop down patterns to the far end (in the associated data service timeslots).
BERT	If a port is selected and there are no local loops, press the BERT button to start or stop a BERT on the selected port.

Front Panel LEDs

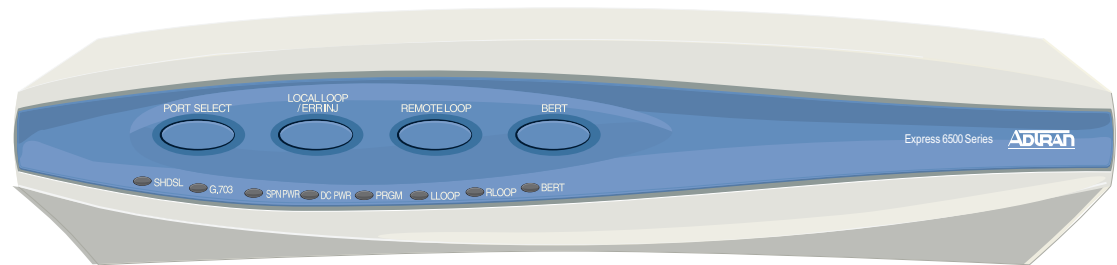
The front panel has LED status indicators that match the specific feature set of the model.

- Table 6 lists the LED configuration for each product in the series.
- Table 7 on page 13 details LED functionality.
- Figure 4 and Figure 5 illustrate the two possible front panel configurations.



6540 Front Panel

Figure 4. Front Panel for 6540 and 6541 Models



6542 Front Panel

Figure 5. Front Panel for 6542 Model

Table 6. LED Indicator Functionality

Label	Status	Description
SHDSL	○ Off	Unit is powered off
	● Green	Port is trained; no active alarms
	● Yellow	Port is trained with a minor active alarm ⁽¹⁾
	● Red	Port is attempting to or is trained with a major alarm ⁽²⁾
G.703	○ Off	Port is not active
	● Green	Active Port with no active alarm
	● Yellow	Active Port with a minor alarm ⁽³⁾
	● Red	Active Port with a major alarm ⁽⁴⁾
NX64K	○ Off	Port is not active
	● Green	Active Port with no active alarm
	● Red	Active Port with an active alarm condition ⁽⁵⁾
RTS/C	○ Off	Nx64K port is not active or when active, V.35/V.36 "Request To Send" or X.21 "Control" line from the DTE is off
	● Green	V.35/V.36 "Request To Send" or X.21 "Control" line from the DTE is on

Table 6. LED Indicator Functionality

Label	Status	Description
RLSD/I	○ Off	Nx64K port is inactive or when active, V.35/V.36 "Receive Line Signal Detector" and X.21 "Indication" control line from the NTU is off.
	● Green	V.35/V.36 "Receive Line Signal Detector" or X.21 "Indication" control line from the NTU (DCE) is on
LLOOP	○ Off	Local Loop is not active
	● Yellow	Active Local Loopback on the selected port
	● Red	Active Local Loop on one or more ports or services (when no port is selected)
RLOOP	○ Off	Remote Loop is not active
	● Yellow	Active Remote Loopback on the selected port (when determined via established EOC)
	● Red	Active Remote Loop on one or more ports or services (when no port is selected)
BERT	○ Off	BERT is not active
	● Green	Active BERT and the test pattern detector is synchronized with no received bit errors
	● Yellow	Active BERT and one or more test pattern bit errors have been received
	● Red	Active BERT but the test pattern detector is not synchronized
SPN PWR	○ Off	Unit is not SHDSL span powered
	● Green	Unit is SHDSL span powered
DC PWR	○ Off	Unit is not DC powered
	● Green	Unit is DC powered
PRGM	○ Off	Firmware is not being programmed
	● Green	Local unit firmware is being locally programmed
	● Yellow	Remote unit firmware is being locally programmed
	● Red	Local unit firmware is being remotely programmed

1. Minor SHDSL port alarms: CRC errors, Loop Attenuation Threshold Alarm, SNR Margin Threshold Alarm, Segment Anomaly, and any ES, SES, UAS, CVC, and LOSWS 15-Minute Threshold Alarm
2. Major SHDSL port alarms: LOS, LOSW, or Segment Defect
3. Minor G.703 port alarms: Rx RAI, Frame Slip, CRC-4 errors, LBER, and any ES, SES, UAS, and CVC 15-Minute Threshold Alarm
4. Major G.703 port alarms: LOS, LOF, LOMF, Rx AIS, or HBER
5. Nx64K port alarms: Clock Slip, Loss of External Clock, FIFO Underflow/Overflow, and Inactivity Alarm

Push Button and LED Indicator Interaction

The following is a further explanation of the required interaction between the front panel pushbuttons and LEDs.

When no port has been selected, (no flashing port LEDs) only the **PORT SELECT** push button is enabled, and the **LLOOP**, **RLOOP**, and **BERT** LEDs indicate the status (refer to [Table 7](#)).

Table 7. LED Indication - No Port Selected

Test	Description
SHDSL, G.703, or Nx64k interface test condition active	LED is on
No interface test condition active	LED is off

When the **PORT SELECT** push button is first pressed, the **NX64K** LED flashes (if the model has an active Nx64K port) to indicate that the Nx64K port has been selected. The **LLOOP**, **RLOOP**, and **BERT** LEDs indicate the state of tests only on the Nx64K port. Additionally, the **LLOOP**, **RLOOP**, and **BERT** pushbuttons initiate/terminate tests only on the Nx64K port.

When the **PORT SELECT** push button is pressed again, the G.703 LED flashes (if the model has an active G.703 port) to indicate that the G.703 port has been selected. The **LLOOP**, **RLOOP**, and **BERT** LEDs indicate the state of tests only on the G.703 port.

If there is only a single service on the G.703 port, then the **LLOOP**, **RLOOP**, and **BERT** pushbuttons initiate/terminate tests only on this G.703 service. If there are multiple G.703 services on the G.703 port, then the **LLOOP**, **RLOOP**, and **BERT** pushbuttons are disabled, and the **LLOOP**, **RLOOP**, and **BERT** LEDs indicate the status of all services using the G.703 port (refer to [Table 8](#)).

Table 8. LED Indication - G.703 Port Services

Test	Description
One or more G.703 service test conditions active	LED is on
No Service test condition active	LED is off

When the **PORT SELECT** push button is pressed again, the **SHDSL** LED flashes (if the SHDSL port push button option is enabled) to indicate that the SHDSL port has been selected. The **LLOOP**, **RLOOP**, and **BERT** LEDs indicate the state of tests on the SHDSL payload.

Connections

All connections on the SHDSL 2-Wire/4-Wire NTU are on the rear panel.

Rear Panel

The SHDSL 2-Wire/4-Wire NTU does not have a power switch. A rear panel for each model is designed with connections and labeling (refer to [Table 9](#)).

[Figure 6](#) through [Figure 10](#) illustrate the SHDSL 2-Wire/4-Wire NTU rear panels.

Table 9. Rear Panel Connectors

Rear Panel			Model P/N				
Description	Connector	Label	1230001E1	1230002E1	1230007E1	1230008E1	1230009E1
SHDSL Port	RJ-45 (135 ohm; 2-wire or 4-wire)	SHDSL	•	•	•	•	•
G.703 Port	RJ-45 (120 ohm)	G.703	•	•			•
	BNC pair (75 ohm)	G.703; TX, RX			•	•	
Nx64K Port	M34 Winchester 34-pin Female (V.35)	V.35/V.36	•	•	•	•	
	Blank	(none)					•
Management	DB-15 Female (X.21)	X.21	•	•	•	•	
	DB-9 Female (V.28)	Control V.28	•	•	•	•	•
Power	IEC-320 (AC)	100-240 VAC, 50/60 HZ 100 mA	•		•		
	Terminal Block (DC)	35-80 VDC, 250 mA		•		•	
	Terminal Block (Span or DC)	35-80 VDC, 250 mA					•

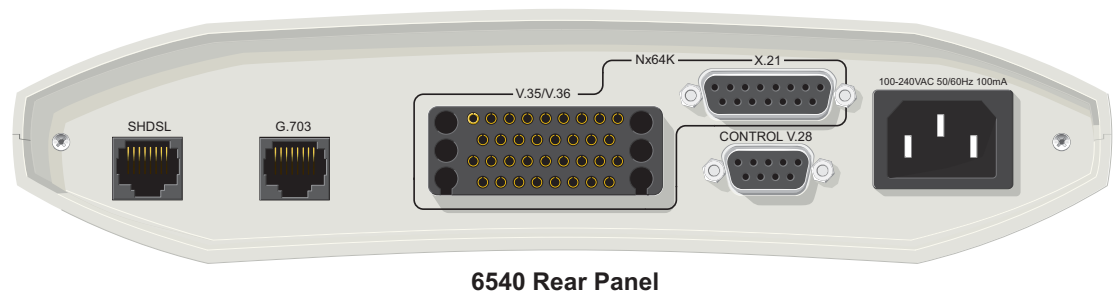
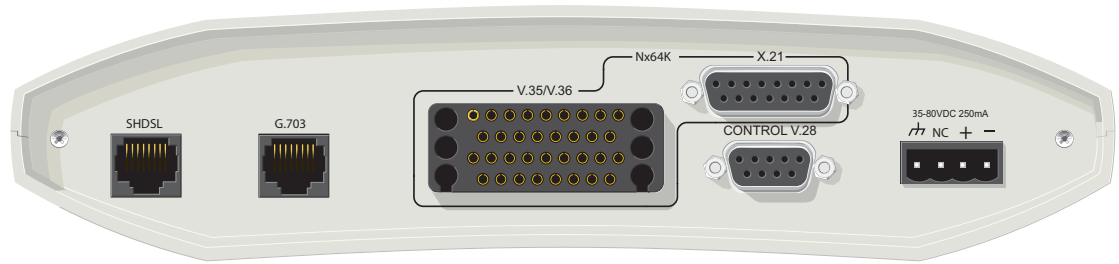
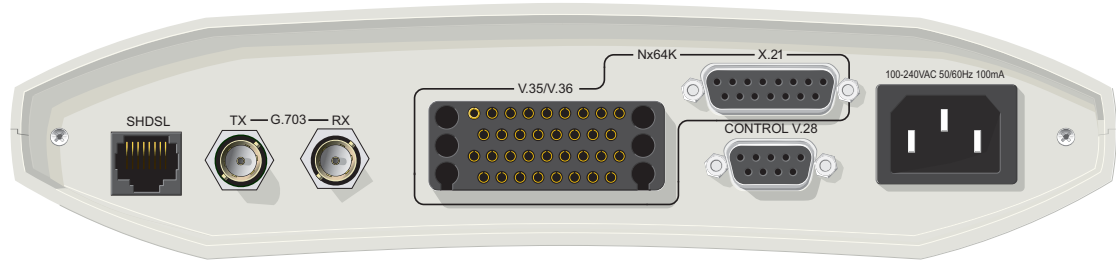


Figure 6. Rear Panel for Model 6540, AC Powered



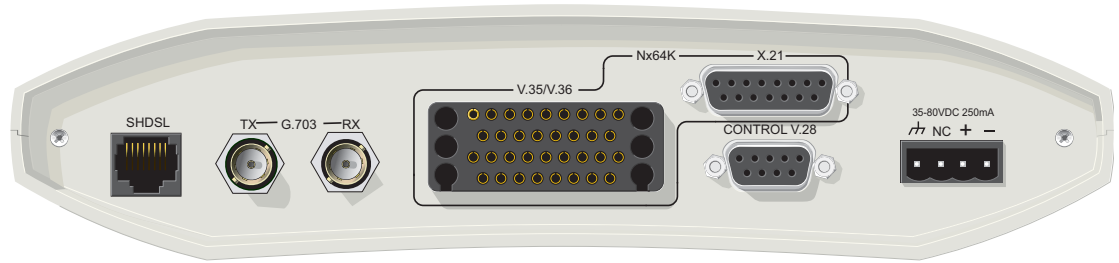
6540 Rear Panel

Figure 7. Rear Panel for Model 6540, DC Powered



6541 Rear Panel

Figure 8. Rear Panel for Model 6541, AC Powered



6541 Rear Panel

Figure 9. Rear Panel for Model 6541, DC Powered



6542 Rear Panel

Figure 10. Rear Panel for Model 6542, Span or DC Powered

Power Supply

The various models support one of the following power schemes:

- Local AC powered only
- Local DC powered only
- Span powered with local DC power auto-switchover

NOTICE

No adjustments, strapping, or configuration changes are necessary to power the units.

The NTU power supply includes “dying gasp” circuitry that meets the power status bit requirements as specified in ITU-T G.991.2 and for ISDN PRA V3 operation mode.

AC Powering

Physical connection for AC operation is through an IEC-320 power receptacle. The AC model operates over an AC input range of 90 VAC to 264 VAC (100 VAC, 110-120 VAC or 220-240 VAC nominal), 48 Hz to 63 Hz (50 Hz or 60 Hz nominal), and with a power rating not to exceed seven watts.

DC Powering

Physical connection for DC operation is made on a 4-pin terminal block, shrouded male receptacle. The DC model operates over a DC input range of ± 35 VDC to ± 80 VDC (-48 VDC nominal), with a power rating not to exceed seven watts. A detachable mating terminal-screw block is supplied separately.

Span Powering

The SHDSL 2-Wire/4-Wire NTU span powered models adhere to sections ITU-T G.991.2 Annex B.5.3 as it applies to STU-Rs.

SHDSL Pinout

The SHDSL port uses a TNV-3 rated, 135W impedance, RJ-45 connection with signals and pinouts (refer to [Table 10](#)).

Table 10. SHDSL Port RJ-45 Pinout

Pin	Circuit Name	Function
1	Tip 2	4-Wire Loop, 2 Pair Tip
2	Ring 2	4-Wire Loop, 2 Pair Ring
3	NC	Not Connected
4	Tip 1	2-Wire Pair Tip, 4-Wire Loop, 1 Pair Tip
5	Ring 1	2-Wire Pair Ring, 4-Wire Loop, 1 Pair Ring
6 - 8	NC	Not Connected

G.703 Pinout

The G.703 port is SELV rated with a rear panel connection of either a 120 Ω balanced RJ-45 jack with signals and pinouts per [Table 11](#), or a TX/RX pair of 75 Ω balanced or unbalanced BNC connectors, depending on specific model.

Table 11. G.703 Port RJ-45 Pinouts

Pin	Circuit Name	Function
1	RX Ring	Receive Pair Ring
2	RX Tip	Receive Pair Transmit
3	RX Shield	Receive Pair Ground Shield
4	TX Ring	Transmit Pair Ring
5	TX Tip	Transmit Pair Tip
6	TX Shield	Transmit Pair Ground Shield
7, 8	NC	Not Connected

Nx64K Port V.35, ISO 2593, 34-pin Female Pinout

Table 12 lists the V.35 pinout information.

Table 12. Nx64k Port V.35 34-Pin Pinout

V.35 (M34 Winchester) Pin	Interchange Circuit				
	No.	Name	Function	Electrical Characteristics	To/From DCE
A	101	PGND	Protective Ground	-	-
B	102	SGND	Signal Ground	-	-
P	103	TD-A	Transmit Data	V.35	To
S	103	TD-B	Transmit Data	V.35	To
R	104	RD-A	Receive Data	V.35	From
T	104	RD-B	Receive Data	V.35	From
C	105	RTS	Request To Send	V.28	To
D	106	CTS	Clear To Send	V.28	From
E	107	DSR	Data Set Ready	V.28	From
H	108/2	DTR	Data Terminal Ready	V.28	To
F	109	RLSD	Received Line Signal Detect	V.28	From
U	113	ETC-A	Transmit Signal Element Timing	V.35	To
W	113	ETC-B	Transmit Signal Element Timing	V.35	To
Y	114	TC-A	Transmit Signal Element Timing	V.35	From
AA	114	TC-B	Transmit Signal Element Timing	V.35	From
V	115	RC-AB	Receive Signal Element Timing	V.35	From
X	115	RC-B	Receive Signal Element Timing	V.35	From
N	140	RL	Remote Loopback or Loopback/Maintenance Test	V.28	To
L	141	LL	Local Loopback	V.28	To
NN	142	TI	Test Indicator	V.28	From
B, J, K, M, Z, BB, CC, DD, EE, FF, HH, JJ, KK, LL, MM	-	NC	Not Connected	-	-

V.36 Pinout

This product supports a 37-pin (DB-37) female connection through a 12-inch V.35-to-V.36 adapter cable that complies to ISO 4902 pinouts (ADTRAN P/N 1225004L1). This cable connects to the NTU rear panel V.35 M34 Winchester female connector and provides ID pins to automatically set the Nx64K type to V.36. Refer to [Table 13](#) for the V.35 to V.36 Adapter Cable pinouts.

Table 13. V.35 to V.36 Adapter Cable Pinouts

V.35 (M34 Winchester) Pin	V.36 (DB-37 Female) Pin	Interchange Circuit				
		No.	Name	Function	Electrical Characteristics	To/ From DCE
A	1	101 or 102	SHIELD	Cable Shield (Protective or Signal Ground)	-	-
B	19, 37, 20	109, 102a, 102b	SGND	Signal Ground	-	-
P	4	103	TD-A	Transmit Data	V.11	To
S	22	103	TD-B	Transmit Data	V.11	To
R	6	104	RD-A	Receive Data	V.11	From
T	24	104	RD-B	Receive Data	V.11	From
C	7	105	RTS-A	Request To Send	V.10	To
M	25	105	RTS-B	Request To Send	>10K Ω to SGND	To
D	9	106	CTS-A	Clear To Send	V.10	From
FF	27	106	CTS-B	Clear To Send	Tri-state	From
E	11	107	DSR-A	Data Set Ready	V.10	From
CC	29	107	DSR-B	Data Set Ready	Tri-state	From
H	120	108/2	DTR- AB	Data Terminal Ready	V.10	To
EE	30	108/2	DTR-B	Data Terminal Ready	>10K Ω to SGND	To
F	13	109	RLSD-A	Received Line Signal Detect	V.10	From
Z	31	109	RLSD-B	Received Line Sig- nal Detect	Tri-state	From
U	17	113	ETC-A	Transmit Signal	V.11	To
W	35	113	ETC-B	Element Timing	V.11	To
Y	5	114	TC-A	Transmit Signal	V.11	From

Table 13. V.35 to V.36 Adapter Cable Pinouts (Continued)

V.35 (M34 Winchester) Pin	V.36 (DB-37 Female) Pin	Interchange Circuit				
		No.	Name	Function	Electrical Characteristics	To/ From DCE
AA	23	114	TC-B	Element Timing	V.11	From
V	8	115	RC-A	Receive Signal Element Timing	V.11	From
X	26	115	RC-B	Receive Signal Element Timing	V.11	From
N	14	140	RL	Remote Loopback or Loopback/Main- tenance Test	V.10	To
L	10	141	LL	Local Loopback	V.10	To
NN	18	142	TI	Test Indicator	V.10	From
DD, B	-	-	ID0	Adapter Identifier Bit 0 (= 0, SGND)	-	-
LL	-	-	ID1	Adapter Identifier Bit 1 (= 1, NC)	-	-
MM	-	-	ID2	Adapter Identifier Bit 2 (= 1, NC)	-	-
J, K, BB, HH, JJ, KK	2, 3, 15, 16, 21, 28, 32, 33, 34, 36	-	NC	Not Connected	-	-

X.21 Pinout

The SHDSL 2-Wire/4-Wire NTU Product Series rear panel provides a 15-pin female connection that complies with ISO 4903 pinouts. The X.21 interface implementation is intended to be for leased lines with no end-to-end signaling or byte timing. Refer to [Table 14](#) for the X.21 pinouts.

Table 14. X.21 Pinouts

X.21 (DB-15 Female) Pin	Interchange Circuit			
	Name	Function	Electrical Characteristics	To/From DCE
8	G	Signal Ground	-	-
15	Ga	DTE Common Return	-	To
2	T-A	Transmit	V.11	To
9	T-B	Transmit	V.11	To
4	R-A	Receive	V.11	From
11	R-B	Receive	V.11	From
3	C-A	Control	V.11	To
10	C-B	Control	V.11	To
5	I-A	Indication	V.11	From
12	I-B	Indication	V.11	From
6	S-A	Signal Element Timing	V.11	From
13	S-B	Signal Element Timing	V.11	From
7	X-A	DTE Signal Element Timing	V.11	To
14	X-B	DTE Signal Element Timing	V.11	To

Optioning

Timeslot Cross-Connect Map

The SHDSL 2-Wire/4-Wire NTU Product Series supports the configuration of multiple services.

A service is comprised of an arbitrary collection of timeslots from the SHDSL interface that are configured through the management interface. These services are routed to either the G.703 interface or the Nx64k interface. The SHDSL 2-Wire/4-Wire NTU supports simultaneous use of the G.703 interface (for multiple services) and either, but not both, the X.21, V.35, or V.36 Nx64K port interfaces. When there is only a single service from the G.703 interface, then the number of timeslots in that service must be less than or equal to 32. The SHDSL timeslots that are not assigned to a service are considered idle, and contain a fixed bit pattern of All Ones. Idled G.704 framed timeslots contents are determined by a programmable pattern register.

The SHDSL 2-Wire/4-Wire NTU Product Series supports the following interfaces and operation:

- A Nx64K single service interface with a data transmission rate of 64 kbps to 2.304 Mbps in 2-wire mode ($N \times 64$ kbps, where $N = 1$ to 36) or 64 kbps to 4.608 Mbps in 4-wire mode ($N \times 64$ kbps, where $N = 1$ to 72).
- A G.703 interface with G.704 framing, with a single or multiple G.703 services with a data transmission rate from 64 kbps to 1.984 Mbps ($N \times 64$ kbps, where $N = 1$ to 31). G.704 framing may be either passed through delivered to end devices, or generated and terminated locally at the NTU G.703 port. In the former case, G.704 framing must be assigned to SHDSL timeslot 0. In the latter case, no G.704 framing passes across the SHDSL line.
- The G.703 interface with G.704 framing runs over SHDSL in aligned mode and supports simultaneous services using the Nx64k port for the second service.
- A G.703 interface without framing, with a single 2.048 Mbps service (32×64 kbps), and therefore the only service configured.

Timeslot Allocation

The SHDSL timeslots are individually mapped to the required G.703/G.704 and Nx64k service timeslots on a one-to-one basis. As illustrated in Figure 11 and Figure 12 on page 24, both contiguous and non-contiguous service allocations are allowed, as long as the chronological transmission ordering of timeslots is maintained.

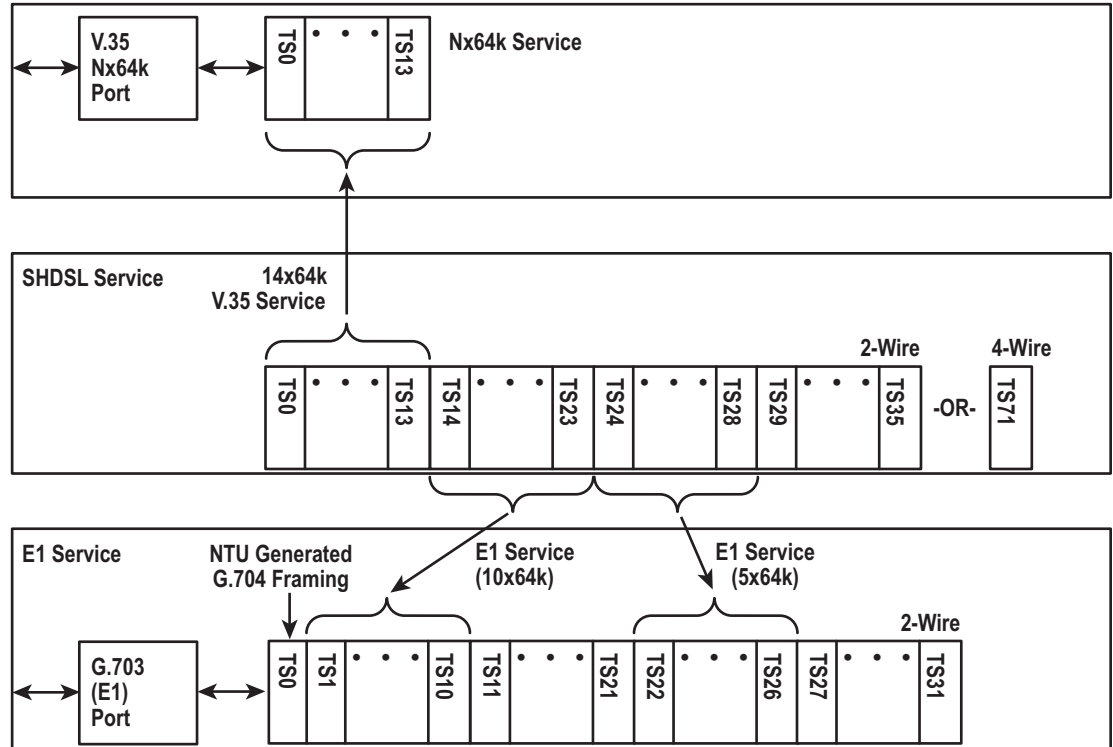


Figure 11. Contiguous Time Slot Allocation

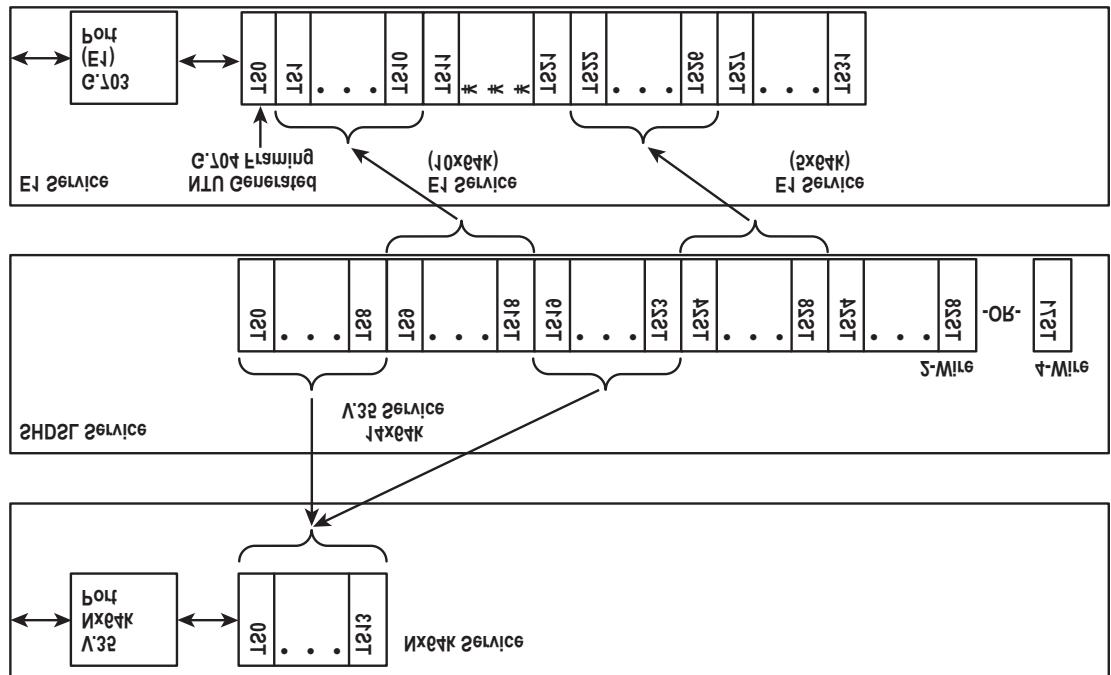


Figure 12. Non-Contiguous Time Slot Allocation

Timing Sources

Transmit and receive clocking is controlled by a configurable option, **Clk Source**, which has the following settings:

- Internal Clock (derived from internal oscillator with better than 32 ppm tolerance)
- Nx64k ETC (Nx64k port external transmit clock from DTE, Circuit 113)
- G.703 RX Clock (G.703 port derived receive clock)
- SHDSL RX Clock (SHDSL port derived receive clock)

When in NT mode, interface clock references are always derived from the received SHDSL network signal. When a loss of signal occurs, the transmit timing will be internally loop-timed with a frequency accuracy of ± 32 ppm. Refer to [Figure 13](#).

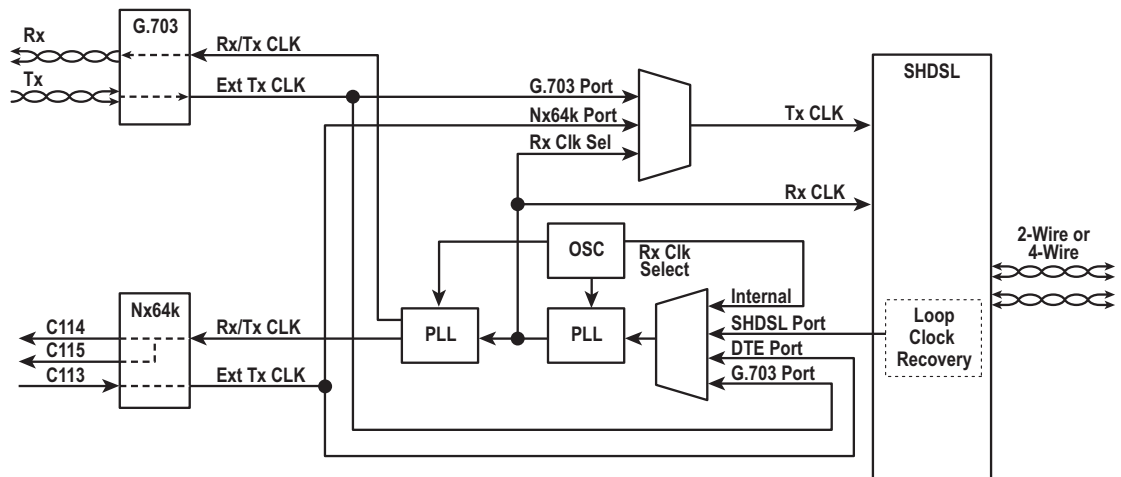
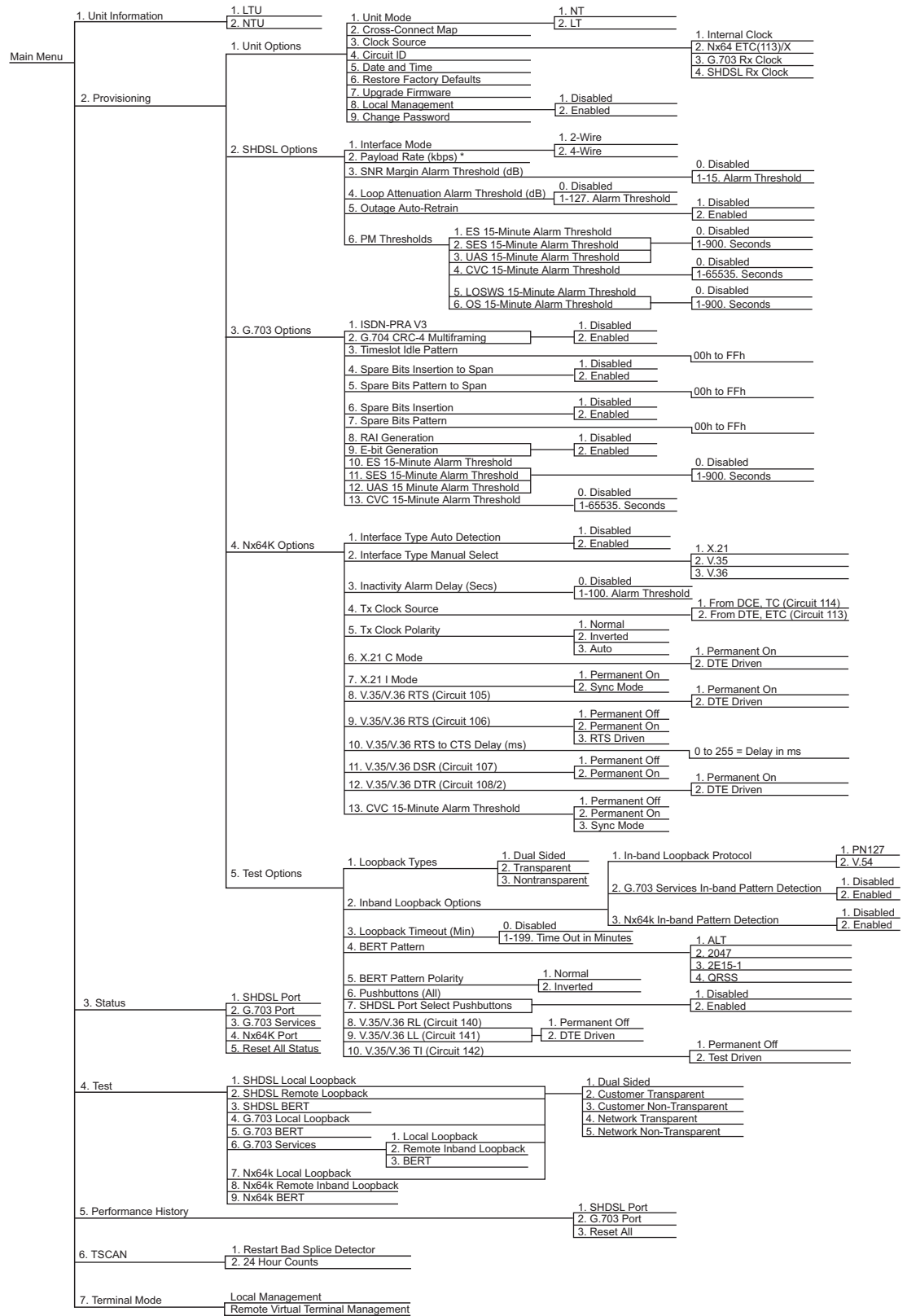


Figure 13. Timing Sources

Menu Tree

The User Interface for the SHDSL 2-Wire/4-Wire NTU Product Series consists of a number of menu screens designed to aid in maintenance and troubleshooting. The SHDSL 2-Wire/4-Wire NTU menu tree (see [Figure 14](#)) is a visual map that can be used to locate configuration information and provisioning options.



* 2-wire mode: 192 kbps to 2.304 Mbps (N x 64 kbps, where N=3 to 36)
4-wire mode: 384 kbps to 4.608 Mbps (N x 64 kbps, where N=even numbers, 6 to 72)

Figure 14. 6500 Series Menu Tree

Troubleshooting

For troubleshooting, the SHDSL 2-Wire/4-Wire NTU provides loopback tests, an internal Bit Error Rate Tester, and bad splice detection.

Local and Remote Loopbacks for Ports and Services

For troubleshooting purposes, the SHDSL 2-Wire/4-Wire NTU provides five types of loopback tests for each interface port and each data service.

- Dual sided
- Network transparent
- Network non-transparent
- Customer transparent
- Customer non-transparent.

Loopback tests are initiated from EOC message commands, which are initiated as follows:

- The network management system (NMS)
- Local VT100 management screens
- Front panel pushbuttons
- The V.35/V.36 RL (Circuit 140) and LL (Circuit 141) control leads
- Received V3 command
- Generating and detecting in-band signaling

The SHDSL 2-Wire/4-Wire NTU provides an option register for each looping point. The default loopback type is dual-sided. [Table 15](#) specifies the various looping points, originating sources, loopback types, and applicability of the Loopback Type option. VT100 screens and polled EOC status response messages indicate the active or inactive status of each looping point. If active, the type and originating source of the loopback test displays.

The direction of transparent and non-transparent loopbacks depends on the direction of test initiation. For example, if an in-band signal is detected on a particular G.703 service having the loopback type option set to transparent, then the received G.703 service data is looped back to the SHDSL port and also passed through to the G.703 port.

If the SHDSL 2-Wire/4-Wire NTU unit mode is set to NT, it is labeled as a network transparent loopback. If unit mode is set to LT, and operating in a campus-type application, it is indicated as a customer transparent loopback.

For example, if the Nx64K port loopback type option is set to non-transparent, and the V.35/V.36 LL (Circuit 141) lead is asserted ON, then the received Nx64k data is looped back to the DTE equipment and an all ones pattern is sent to the SHDSL port. If that SHDSL 2-Wire/4-Wire NTU is configured as an NTU (or STU-R) this is indicated as a customer non-transparent loopback. If configured as an LTU (or STU-C) and operating in a campus-type application, this is indicated as a network non-transparent loopback.

The initiation or removal of any loopback test will not cause a clock glitch on any interface. Loopbacks may be set by one source and removed by another source. If the SHDSL line is dropped, or if the NTU is power-cycled, all active loopback tests are released. Refer to [Table 15](#) for loopback test summary information.

Table 15. Loopback Test Summary

Initiating Source	SHDSL Port	G.703 Port	G.703 Service	Nx64k Port/Service
NMS				
Proprietary EOC Local Loopback Request Message ACTIVATE (Initiates one of five loopback types, regardless of the associated Loopback Type Option setting.)				
Proprietary EOC Local Loopback Request Message DEACTIVATE				
Proprietary EOC Remote Inband Request Message ACTIVATE (Initiates a Remote Loopback per the remote unit's associated port/service Loopback Type option setting, if supported, and in the direction of signal origination.)	N/A	N/A	Sends Inband Signal 	Sends Inband Signal
Proprietary EOC Remote Inband Request Message DEACTIVATE	N/A	N/A		
VT100 Test Screen				
VT100 Local Loopback ON (Initiates one of five loopback types, regardless of the associated Loopback Type Option setting.)				
VT100 Local Loopback OFF				
VT100 Remote In-band Loopback ON⁽¹⁾ (Initiates a Remote Loopback per the remote unit's associated port/service Loopback Type option setting, if supported, and in the direction of signal origination.)	N/A	N/A	Sends In-band Signal 	Sends In-band Signal
VT100 Remote Inband Loopback OFF	N/A	N/A		

Table 15. Loopback Test Summary (Continued)

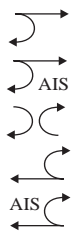

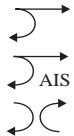
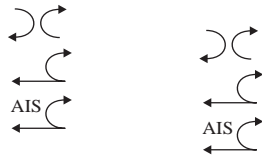












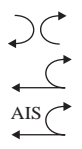

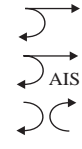
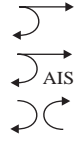

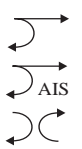











Initiating Source	SHDSL Port	G.703 Port	G.703 Service	Nx64k Port/Service			
VT100 Remote Loopback ON¹ (Initiates a Remote Loopback using proprietary EOC request messages, regardless of remote unit's associated Loopback Type Option setting.) ⁽²⁾	Single proprietary EOC request message		N/A	N/A	N/A		
VT100 Remote Loopback OFF		N/A	N/A	N/A	N/A		
Front Panel Pushbuttons							
Local Loop Push Button ON (Initiates a Local Loopback per the associated port/service Loopback Type Option setting.)		N/A	Single Service Only				
Local Loop Push Button-Push Button OFF		N/A					
Remote Loop Push Button ON (Initiates a SHDSL Port Dual Sided Remote Loopback; or a G.703 Single Service or Nx64K Service Remote Loopback per the remote unit's associated service Loopback Type option setting, if supported, and in the direction of signal origination.)	Sends Standard EOC Request Message		N/A	Single Service Only, Sends Inband Signal	Sends Inband Signal		
Remote Loop Push Button OFF		N/A					
LL (Circuit 141) ON (Initiates a Local Nx64K Loopback per the Nx64K Port Loopback Type option setting.)	N/A	N/A	N/A				
LL (Circuit 141) OFF	N/A	N/A	N/A				

Table 15. Loopback Test Summary (Continued)

Initiating Source	SHDSL Port	G.703 Port	G.703 Service	Nx64k Port/Service
RL (Circuit 140) ON (Initiates a Remote Loopback by sending an inband signal. The remote unit implements a Nx64K service loopback per its Nx64K Loopback Type option setting, if supported, and in the direction of signal origination.) ¹	N/A	N/A	N/A	Sends Inband Signal 
RL (Circuit 140) OFF	N/A	N/A	N/A	
Inband Signal Reception				
Receive Inband Preparatory Signal (Initiates a Local Loopback per the associated service Loopback Type option setting, and in the direction of signal origination.)	N/A	N/A		
Receive Inband Termination Signal	N/A	N/A	N/A	
ISDN PRA V3 Reception				
Receive V3 Loopback Bit ON (Initiates a Local Loopback per the G.703 Port Loopback Type option setting, and in the direction of V3 signal origination.)	N/A		N/A	N/A
Receive V3 Loopback Bit Off	N/A		N/A	N/A

1.The reception of in-band patterns and EOC loopback request messages may be ignored or blocked on certain Total Access 3000s.
 2.If connected to a remote unit that does not support the EOC proprietary message specification, then only the EOC standard Customer and Network Loopback request bits are used. When either the Customer or Network Loopback bit is set, the remote unit determines which loopback type that it implements (for example, transparent or non-transparent).

Table 16. KEY to Symbols used in Table 15.

Directions		Loopbacks	
		 No Loop	 Dual Sided
If an NTU:			
←	Network (to LTU)	 Network Transparent	 Customer Transparent
→	Customer (to NTU)	 Network Non-Transparent	 Customer Non-Transparent
If an LTU:			
←	Customer (to NTU)	 Customer Transparent	 Network Transparent
→	Network (to LTU)	 Customer Non-Transparent	 Network Non-Transparent

Bit Error Rate Tester (BERT)

The NTU provides an internal bit error rate tester (BERT) for the injection and observation of a pseudo-random bit sequence (PRBS) to and from the SHDSL interface on a per service basis.

The BERT runs only one test at a time. When the NTU is injecting PRBS, all ones are transmitted to the applicable G.703 or Nx64K port for that service. The NTU BERT provides the following ITU-T O.150 and O.151 compliant PRBS patterns:

- ALT
- 2047
- 2E15-1
- QRSS

The observation of data on a service under test commences automatically when a BERT test is started. The following statistics become available on the VT100 screens and by EOC response message when polled by NMS:

- Bit Error Rate (of format from 0.00x10E-0 to 9.99x10E-9)
- Bit Error Count (the number of bit errors during the test period)
- Pattern Sync Loss Count (the number of times a PRBS pattern sync has been lost during the test period)
- Errored Seconds (a second that contains one or more PRBS bit errors)
- Outage Seconds (a count of ten or more consecutive Error Seconds - No outage indicates one second occurs with no errors)
- Total Elapsed Time (of format DD:HH:MM:SS)
- BERT Status
 - ◆ On
 - ◆ Off

Searching for Pattern

The SHDSL 2-Wire/4-Wire NTU is able to reset the BERT counters when requested to do so by an NMS or VT100 test screen. Injection of a single bit error from the NMS, VT100 test screen, or front panel BERT push button is also possible.

BERT Application

In a typical testing scenario, a remote loopback or remote BERT is active in conjunction with the locally active BERT (refer to Figure 15 and Figure 16).

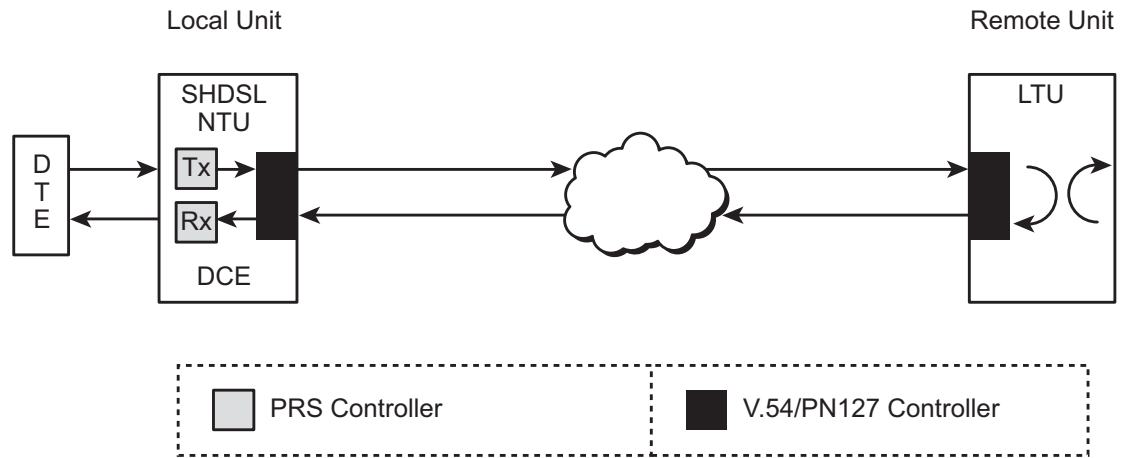


Figure 15. BERT and Remote Loopback

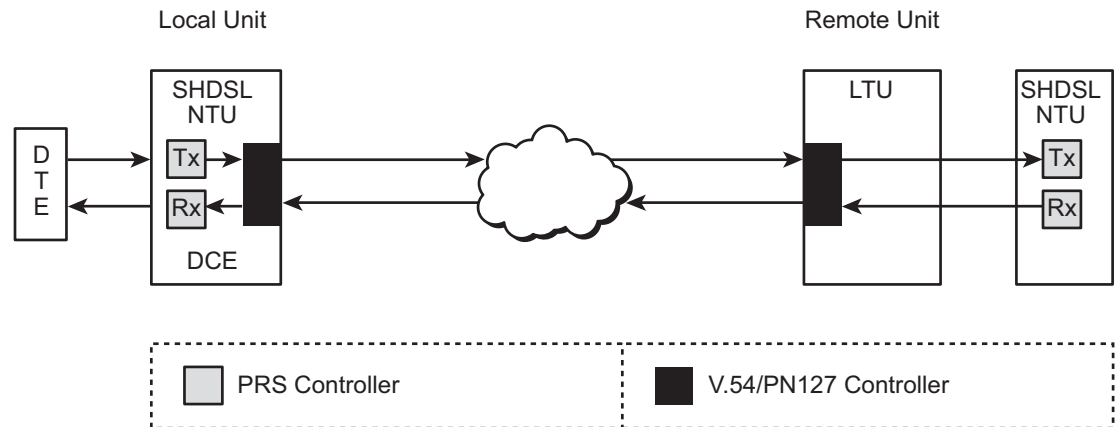


Figure 16. BERT with Remote BERT

Bad Splice Detection (TScan)

The SHDSL 2-Wire/4-Wire NTUs provide bad splice protection using the ADTRAN proprietary Runtime TScan™ 2.0 splice protection feature. TScan splice detection is a non-intrusive algorithm that enables SHDSL 2-Wire/4-Wire NTUs to detect anomalies (bad splices) in the copper pair. This feature can aid in troubleshooting the distribution plant.

Data transmission transceivers (especially echo-cancelled technologies) are subject to performance degradations and errors in the presence of bad splice connections. A splice may be benign for a period of time, allowing a circuit to behave appropriately for portions of the day. Over time the splice can oxidize and incur small, rapid changes in impedance. This inconsistency in behavior makes the problem difficult to locate. Additionally, an impedance change that is large enough to cause the transceiver trouble may still be small enough to be undetected by test equipment used on the copper pairs.

The splice detection algorithm is designed to detect bad splices in data mode. The detector runs periodically after a SHDSL 2-Wire/4-Wire NTU achieves synchronization. The SHDSL transceiver monitors the loop for impedance changes that are of a magnitude to degrade the received signal of the transceiver. When the transceiver detects a significant impedance change, the approximate distance from that transceiver to the anomaly is recorded on a menu screen, the Bad Splice Detection (TSCAN) 24 Hour Counts menu screen, by incrementing the appropriate counter. When enough counts are accumulated at a particular distance, this distance is reported on the Bad Splice Detection (TSCAN) menu screen.

NOTE

The Splice Detection Feature is included with this product as an aid to troubleshooting. Due to inconsistency in environmental conditions and their effect on telecommunications plant, ADTRAN cannot guarantee the accuracy of the measurements. Comparison to existing engineering drawings should provide exact locations of suspect splices indicated by ADTRAN algorithms.

Managing TScan

The VT100 local management port allows access to the splice detection menus through the TSCAN selection from the Main Menu (refer to [Figure 14](#) on page 26). The SHDSL 2-Wire/4-Wire NTU Main Menus provide access to the module. The Main Menu options have several functions and submenus that identify and provide access to specific operations and parameters.

Bad Splice Detection (TSCAN) Menu

The Bad Splice Detection (TSCAN) menu displays a summary of the bad splice results (see [Figure 17](#)).

- If a SHDSL loop is in good condition, a “No Trouble Found” status appears in the results column.
- If a count register exceeds a certain threshold, a bad splice is predicted to exist at this distance and displays in the results column.
- If more than one count register exceeds the threshold, then the count that is larger displays as a bad splice.

- If two or more count register exceed the threshold and are of equal count, then the distance count closest to the unit displays as a bad splice because the detector is more accurate the closer the anomaly is to the unit.

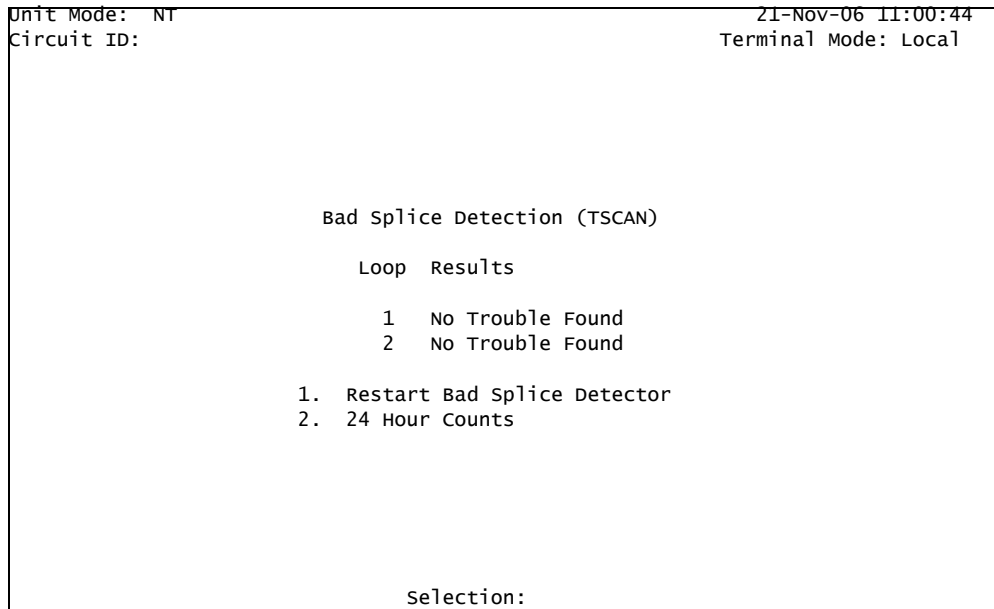


Figure 17. Bad Splice Detection (TSCAN) Menu

The Bad Splice Detection (TSCAN) menu options are shown in [Table 17](#).

Table 17. Bad Splice Detection (TSCAN) Menu Options

Option	Description	Function
1	Restart Bad Splice Detector	Enables a reset of the entire count history. See “Restart Bad Splice Detector Screen” on page 35.
2	24 Hour Counts	Displays the register history. See “Bad Splice Detection (TSCAN) 24 Hour Counts Screen” on page 36.

Restart Bad Splice Detector Screen

The Restart Bad Splice Detector screen ([Figure 18](#)) enables a reset of the 24 hour count history.

NOTE

SHDSL 2-Wire/4-Wire NTUs also clear the count history automatically on power-up.

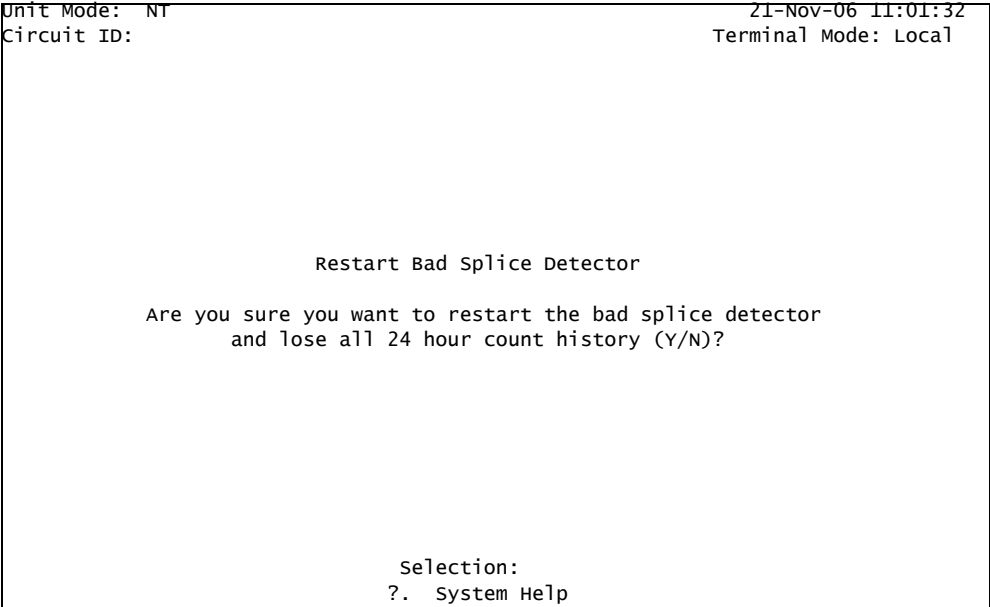


Figure 18. Restart Bad Splice Detector Screen

The Restart Bad Splice Detector screen options are shown in [Table 18](#).

Table 18. Restart Bad Splice Detector Screen Options

Field	Description
(Y)	Restart the bad splice detector. This erases the 24 hour count history.
(N)	Do not restart the bad splice detector. The 24 hour count history is retained.

Bad Splice Detection (TSCAN) 24 Hour Counts Screen

The Bad Splice (TSCAN) 24 Hour Counts screen displays the history register.

If the unit is handshaking or training, the splice loop rates and count registers do not update. If the unit is trained, it updates the splice current day data registers. But, if there was just a change in trained rate, it updates the loop rates and re-initializes to zero the current day data registers. The distance resolution, and therefore the number of count registers displayed, is loop rate dependent. Up to seven days of count history is maintained.

Unit Mode: NT				21-Nov-06 11:44:30			
Circuit ID:				Terminal Mode: Local			
Bad Splice Detection (TSCAN) 24 Hour Counts							
Ref Point: NTU				Day: CURRENT			
Loop 1 (Rate N=16; 4w, Trained)				Loop 2 (Rate N=16; 4w, Trained)			
Meters	Cnt	Meters	Cnt	Meters	Cnt	Meters	Cnt
0000	000	1072	000	0000	000	1072	000
0067	000	1139	000	0067	000	1139	000
0134	000	1206	000	0134	000	1206	000
0201	000	1273	000	0201	000	1273	000
0268	000	1340	000	0268	000	1340	000
0335	000	1407	000	0335	000	1407	000
0402	000	1474	000	0402	000	1474	000
0469	000	1541	000	0469	000	1541	000
0536	000	1608	000	0536	000	1608	000
0603	000	1675	000	0603	000	1675	000
0670	000	1742	000	0670	000	1742	000
0737	000	1809	000	0737	000	1809	000
0804	000	1876	000	0804	000	1876	000
0871	000	1943	000	0871	000	1943	000
0938	000			0938	000		
1005	000			1005	000		
				?. System Help		D. Day	

Figure 19. Bad Splice Detection (TSCAN) 24 Hour Counts Screen

Specifications

Table 19 lists the specifications for the SHDSL 2-Wire/4-Wire NTU Product Series.

Table 19. SHDSL 2-Wire/4-Wire NTU Product Series Specifications

Specification	Description
Electrical	
Operating Voltage:	100 – 240 VAC @ 50/60 Hz for AC modules -48 VDC for DC Modules
Typical Current and Power Consumption:	95 mA RMS, 5.5 W @ 115 VAC 60Hz, 60 mA RMS, 5.3 W @ 220 - 240 VAC 50 Hz for AC modules 120 mA, 5.7 W @ -48VDC for DC modules
Maximum Current Draw:	110 mA RMS @ 100 – 240 VAC for AC modules 200 mA @ 35 – 80 VDC for DC modules
Maximum Power Consumption:	5.6 watts @ 100 VAC for AC modules 6.5 watts @ 35 VDC for DC modules
Environmental	
Operating Temperature Range:	-5°C to +55°C
Storage Temperature Range:	-40°C to +85°C
Relative Humidity:	90 percent maximum @ 50°C, noncondensing
Physical	
Dimensions:	Height: 2.215 inches (5.63 cm) Width: 9.25 inches (23.5 cm) Depth: 6.625 inches (16.8 cm)
Weight:	Less than 1 pound (0.45 kg)
Part Numbers	
6540 SHDSL 2-Wire/4-Wire NTU, AC:	1230001E1
6540 SHDSL 2-Wire/4-Wire NTU, DC:	1230002E1
6541 SHDSL 2-Wire/4-Wire NTU, AC:	1230007E1
6541 SHDSL 2-Wire/4-Wire NTU, DC:	1230008E1
6542 SHDSL 2-Wire/4-Wire NTU, Span or DC:	1230009E1





Appendix A

Warranty and Customer Service

Warranty

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.

Refer to the following subsections for sales, support, Customer and Product Service (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 CAPS prior to returning equipment to ADTRAN.

ADTRAN, Inc.

CAPS Department

901 Explorer Boulevard

Huntsville, Alabama 35806-2807



Carrier Networks Division
901 Explorer Blvd.
Huntsville, AL 35806
U.S.A.

<http://www.adtran.com>

ADTRAN CUSTOMER CARE
From within the U.S. 1.800.726.8663
From outside the U.S. +1 256.963.8716

PRICING AND AVAILABILITY
1.800.827.0807



installation guide