Express NTU

128 kbps ISDN Service Unit

Part Numbers 1200200L1
Document Number 61200200L1-20A

June 1999

ADTRAN

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hi/fn Electronics
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IMPORTANT SAFETY INSTRUCTIONS

When using your telephone equipment, basic safety precautions should always be followed to reduce the risk of fire, electric shock and injury to persons. The precautions are listed below.

1. Do not use this product near water (for example, near a bath tub, wash bowl, kitchen sink or laundry tub, in a wet basement or near a swimming pool).
2. Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electric shock from lightning.
3. Do not use the telephone to report a gas leak in the vicinity of the leak.
4. Use only the power cord, power supply, and / or batteries indicated in the manual. Do not dispose of batteries in a fire. They may explode. Check local codes for any special disposal instructions.

SAVE THESE INSTRUCTIONS.

ADTRAN YEAR 2000 (Y2K) READINESS DISCLOSURE

ADTRAN has established a Year 2000 program to ensure that our products and operations will correctly function in the new millennium. ADTRAN warrants that all products meet Year 2000 specifications regardless or model or revision. Information about ADTRAN's Year 2000 compliance program is available at the following:

Web Site	www.adtran.com
Product Matrix	www.adtran.com / Y2Kfax.html
Faxback Document Line	(256) 963-8200 *Y2K plans and product certifications are listed in the matrix*
Y2K Project Line	(256) 963-2200
E-mail	year 2000@adtran.com

FCC regulations require that the following information be provided in this manual:

1. This equipment complies with Part 68 of the FCC rules. On the bottom of the equipment housing is a label that shows the FCC registration number and Ringer Equivalence Number (REN) for this equipment. If requested, provide this information to the telephone company.
2. If this equipment causes harm to the telephone network, the telephone company may temporarily discontinue service. If possible, advance notification is given; otherwise, notification is given as soon as possible. The telephone company will advise the customer of the right to file a complaint with the FCC.
3. The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of this equipment; advance notification and the opportunity to maintain uninterrupted service is given.
4. If experiencing difficulty with this equipment, please contact ADTRAN for repair and warranty information. The telephone company may require this equipment to be disconnected from the network until the problem is corrected or it is certain the equipment is not malfunctioning.
5. This unit contains no user serviceable parts.
6. An FCC compliant telephone cord with a modular plug is provided with this equipment. In addition, an FCC compliant cable appropriate for the dial backup option ordered is provided with this equipment. This equipment is designed to be connected to the telephone network or premises wiring using an FCC compatible modular jack, which is Part 68 compliant.
7. The following information may be required when applying to the local telephone company for leased line facilities.

Service Type	Digital Facility Interface Code	Service Order Code	Network Jacks
ISDN	021S5	6.0F	RJ-49C

FEDERAL COMMUNICATIONS COMMISSION RADIO FREQUENCY INTERFERENCE STATEMENT:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio or TV reception. The user is encouraged to try to correct the interference by one or more of the following measures:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio / TV technician for help.

WARNING *Change or modifications to this unit not expressly approved by ADTRAN will void the user's authority to operate the equipment.*

CANADIAN EMISSIONS REQUIREMENTS

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled "Digital Apparatus," ICES-003 of the Department of Communications.

Cet appareil nuerique respecte les limites de bruits radioelectriques applicables aux appareils numeriques de Class B prescrites dans la norme sur le materiel brouilleur: "Appareils Numeriques," NMB-003 edictee par le ministre des Communications.

CANADIAN EQUIPMENT LIMITATIONS

Notice: The Canadian Industry and Science Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single-line individual service may be extended by means of a certified connector assembly (telephone extension cord). Compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

WARNING *Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or an electrician, as appropriate.*

The **Load Number** (LN) assigned to each terminal device denotes the percentage of the total load to be connected to a telephone loop which is used by the device, to prevent overloading. The termination on a loop may consist of any combination of devices subject only to the requirement that the total of the Load Numbers of all devices does not exceed 100.

AFFIDAVIT REQUIREMENTS FOR CONNECTION TO DIGITAL SERVICES

- An affidavit is required to be given to the telephone company whenever digital terminal equipment without encoded analog content and billing protection is used to transmit digital signals containing encoded analog content which are intended for eventual conversion into voiceband analog signals and transmitted on the network.
- The affidavit shall affirm that either no encoded analog content or billing information is being transmitted or that the output of the device meets Part 68 encoded analog content or billing protection specifications.
- End user / customer will be responsible to file an affidavit with the local exchange carrier when connecting unprotected CPE to a 1.544 Mbps or subrate digital service.
- Until such time as subrate digital terminal equipment is registered for voice applications, the affidavit requirement for subrate services is waived.

AFFIDAVIT FOR CONNECTION OF CUSTOMER PREMISES EQUIPMENT TO 1.544 MBPS AND/OR SUBRATE DIGITAL SERVICES

For the work to be performed in the certified territory of

_____
(telco name)
State of _____
County of _____

I, _____ (name),

_____ (business address),

_____ (telephone number)
being duly sworn, state:

I have responsibility for the operation and maintenance of the terminal equipment to be connected to 1.544 Mbps and / or _____subrate digital services. The terminal equipment to be connected complies with Part 68 of the FCC rules except for the encoded analog content and billing protection specifications. With respect to encoded analog content and billing protection:

( ) I attest that all operations associated with the establishment, maintenance, and adjustment of the digital CPE with respect to encoded analog content and billing protection information continuously complies with Part 68 of the FCC Rules and Regulations.

( ) The digital CPE does not transmit digital signals containing encoded analog content or billing information which is intended to be decoded within the telecommunications network.

( ) The encoded analog content and billing protection is factory set and is not under the control of the customer.

I attest that the operator(s) / maintainer(s) of the digital CPE responsible for establishment, maintenance, and adjustment of the encoded analog content and billing information has (have) been trained to perform these functions by successfully having completed one of the following (check appropriate blocks):

---

x

( ) A. A training course provided by the manufacturer / grantee of the equipment used to encode analog signals; or

( ) B. A training course provided by the customer or authorized representative, using training materials and instructions provided by the manufacturer / grantee of the equipment used to encode analog signals; or

( ) C. An independent training course (e.g., trade school or technical institution) recognized by the manufacturer / grantee of the equipment used to encode analog signals; or

( ) D. In lieu of the preceding training requirements, the operator(s) / maintainer(s) is (are) under the control of a supervisor trained in accordance with _____ (circle one) above.

I agree to provide _____(telco's name) with proper documentation to demonstrate compliance with the information as provided in the preceding paragraph, if so requested.

_____Signature

_____Title

_____Date

Transcribed and sworn to before me

This ____day of _____, 199 ____

_____
Notary Public

My commission expires:

_____

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Chapter 1 Understanding ISDN and the Express NTU

THE ADTRAN EXPRESS NTU

The Express NTU (see *Figure 1-1*) is a stand-alone device that connects data terminal equipment (DTE) to the ISDN network or to a leased line. The Express NTU includes built-in network termination and terminal adapter functionality. It operates as a high-speed synchronous ISDN modem using one or both bearer (B) channels (up to 128 kbps utilizing Multilink PPP or BONDING protocol). It also functions as a high-speed asynchronous ISDN modem using one or both B-channels (up to 230.4 kbps, flow control, using Multilink PPP or BONDING protocol).

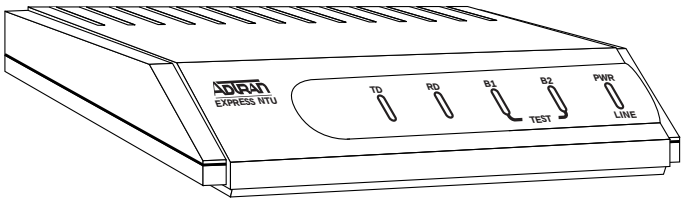


Figure 1-1. ADTRAN Express NTU

NOTE

If problems occur with the Express NTU, contact ADTRAN Technical Support for assistance. The telephone number is on the inside back cover of this manual.

The Express NTU transmits data over EIA-232, EIA-530, and V.35 interfaces. The Express NTU may be viewed as an ISDN *dial modem*.

The unit has one RJ-45 jack, labeled **ISDN,** on the rear panel for network connection (see *Figure 1-2*).

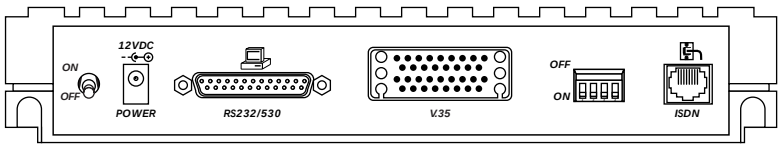


Figure 1-2. ADTRAN Express NTU Rear Panel

The Express NTU also supports a leased digital connection that allows data to be transferred at up to 128 kbps over a 2-wire facility using the same RJ-45 jack. This type of service is a permanent connection between end points and is sometimes referred to as a leased connection or a limited distance modem connection.

Dialing from the Express NTU is accomplished in a variety of ways:

- Using a VT 100 terminal connected to the rear panel EIA-232 port. (See *Configure the Express NTU* on page 3-4.)
- Over the DTE interface using the AT command set. (See *AT Commands and S-Registers* on page A-1.)
- V.25 bis in-band (used in applications such as LAN / WAN bridging). (See *Configuring the Express NTU for V.25 bis In-band Dialing* on page 4-24.)
- With DTR enabled. Routers raise DTR when bandwidth on their dedicated line is exceeded. In high-traffic times, this allows the Express NTU to dial out over the ISDN for an extra 128 kbps of bandwidth-on-demand.

The LED indicators located on the front of the Express NTU monitor data flow and display the status of the DTE interface and the network interface leads as described in *LEDs* on page D-1.

The primary interface for offline configuration is EIA-232, but once the connection is established, the selected interface takes precedence.

RECOMMENDED OPERATING PROTOCOLS

The Express NTU supports a wide range of operating modes. Many combinations of circuit type, protocol, and data rate may be selected. However, only the combinations shown in Table 1-1 on page 1-4 are recommended.

Table 1-1 shows that a given data rate may be achieved by more than one protocol/rate adaption selection. The table is organized so that selections with the least transport delay are closer to the top of the table for any given circuit type. Therefore, choose a protocol and rate closer to the top of the protocol rate list for a given circuit type.

Table 1-1. Recommended Operating Modes

Call Type	Protocol	Sync/ Async	Rates Supported (bps)								
DIAL-64K	BONDING	Sync	56000	64000							
	Clear Chan	Sync	48000	56000	64000						
	PPP	Sync	2400	4800	9600	19200	38400	56000	64000		
	V.110	Sync	2400	4800	9600	19200	38400				
	V.120	Sync	9600	19200	38400	48000					
	PPP async-sync	Async	1200	2400	4800	9600	19200	38400	57600	115200*f*	230400*f*
	BONDING	Async	2400	4800	9600	19200	38400	57600			
	V.110	Async	1200	2400	4800	9600	19200	38400			
	V.120	Async	1200	2400	4800	9600	19200	38400	57600	115200*f*	230400*f*
DIAL-56K	BONDING	Sync	56000								
	Clear Chan	Sync	48000	56000							
	PPP	Sync	2400	4800	9600	19200	38400	56000			
	V.110	Sync	2400	4800	9600	19200					
	V.120	Sync	9600	19200	38400	48000					
	PPP async-sync	Async	1200	2400	4800	9600	19200	38400	57600	115200*f*	230400*f*
	BONDING	Async	2400	4800	9600	19200	38400	57600			
	V.110	Async	1200	2400	4800	9600	19200				
	V.120	Async	1200	2400	4800	9600	19200	38400	57600	115200*f*	230400*f*
DIAL-64K*2	BONDING	Sync	128000								
	MPPP	Sync	128000								
	MPPP	Async	115200								
	BONDING	Async	115200								
DIAL-56K*2	BONDING	Sync	112000								
	MPPP	Sync	112000								
	MPPP	Async	115200								
	BONDING	Async	115200								
LEASED 64K	Clear Chan	Sync	48000	56000	64000						
LEASED 128K	Clear Chan	Sync	128000								

1.All asynchronous rates support flow control

2.All dial-up modes support front panel, DTR, AT command, and V.25 bis dialing methods.

*3.Rates marked with **f** require flow control.*

4.Given a choice between two protocols, pick the protocol closer to the top of the list for the circuit type.

Chapter 2 Ordering ISDN

ISDN is a complex service with many network options. Obtaining service from the local telephone company and long distance providers can be complicated.

The development of ISDN ordering codes (IOCs) simplifies the process of ordering ISDN service. The ISDN Solutions Group, a consortium of ISDN equipment vendors, service providers, and Bellcore, established these codes to represent predetermined line configurations for ISDN Basic Rate service for specific applications.

ADTRAN and Bellcore have registered and tested eight generic IOCs. These IOCs are supported by all major local exchange carriers as well as several independent carriers.

Capability S (previously **Generic Data M**) ordering code is the most feature-rich and supports most voice and data applications. The voice capability is not necessary for operation of the Express NTU; however, it is useful in troubleshooting a misconfigured ISDN line. In some areas, ISDN tariffs may warrant the use of ordering codes with less features. For example, in a particular region, there may be additional monthly expense associated with having voice service on each B channel. If you have a data only application, **Capability R** (previously **Generic Data I**) may be more cost-effective. Each ISDN line provides 112/128 kbps of service.

For more information regarding ordering ISDN, see the ADTRAN document *Ordering ISDN Service User Guide* (part number 60000.015-8), or contact the telephone company for alternative line configurations. The *Ordering ISDN Service User Guide* is available on the ADTRAN home page at **http://www.adtran.com** (under the Information Desk) or by calling ADTRAN.

Chapter 3 Installation and Operation

UNPACK AND INSPECT

After unpacking the unit, immediately inspect it for possible shipping damage. If damage is discovered, file a claim immediately with the shipping carrier, then contact ADTRAN Customer and Product Service department (see the inside back cover of this manual).

INSTALL THE EXPRESS NTU

Verify Switch Settings

Dip switches 1, 2, 3, and 4, located on the rear panel of the Express NTU, allow certain settings to be physically configured. Figure 3-1 shows the location of these dip switches.

The factory default position for all switches is down (on) during initial installation.

SW 1:	Off (Up)	230.4 kbps
	On (Down)	Autobaud (speeds up to 115.2 kbps)

If dip switch 1 is set to the off position (up), the unit is set to operate at a DTE rate of 230.4 kbps. **A special serial COM port using a 16650 UART is required while in this mode.** If switch 1 is set to the on position (down), the unit will automatically adapt to the async DTE rate (up to 115.2 kbps).

SW 2:	Off (Up)	Factory Default (previous settings not saved)
	On (Down)	Normal (previous settings saved)
SW 3:	Off (Up) (Offline)	A call is up and the Express NTU can receive AT commands.
	On (Down) (Online)	A call is up and the Express NTU can pass data.
SW 4:	Off (Up)	Leased Line mode setup (DNA 128K)
	On (Down)	Normal operation

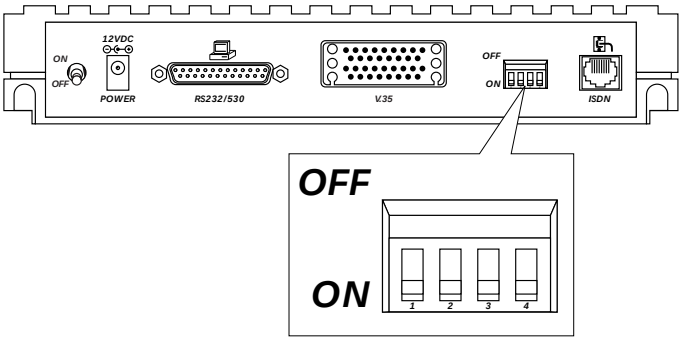


Figure 3-1. Dip Switches on Rear Panel

Connect the Express NTU

Follow these steps in connecting the Express NTU (see Figure 3-2 on page 3-4 for a connection diagram).

1. Connect the Express NTU to an ISDN U-line using the RJ-45 telephone cable provided.

NOTE *To default to factory configuration while powering up the Express NTU, lift dip switch 2 on the rear panel.*

The Express NTU initiates a self-test upon power up. A continuously flashing PWR/LINE LED (for more than a few seconds) signifies a problem between the NTU and the ISDN line. When properly connected to an ISDN U-line, the PWR/LINE LED illuminates and remains on. This signifies that the ISDN U-link is up and the Express NTU is ready for operation. If the PWR/LINE LED does not illuminate and remain on, check your network connections. If the LED remains off, check the power connection. Refer to *Troubleshooting* on page 5-1 for detailed troubleshooting instructions.

2. Connect the NTU to a PC with a communication package or a to a VT 100 terminal with an EIA-232 cable.

NOTE *The NTU can adjust to any asynchronous DTE rate if you type **AT** and press **Enter**. The NTU should respond with **OK**.*

3. Prior to operating the Express NTU, configure the unit in one of the following manners (the configuration process is discussed in general in later sections of this chapter and detailed in *Configuration* on page 4-1): (1) Use the built-in Express NTU menu system. This requires an asynchronous VT 100 terminal or personal computer with asynchronous VT 100 emulation capabilities; or (2) Use AT configuration commands similar to those used by high-speed modems. Both of these configuration methods require an asynchronous DTE (terminal, PC, etc.) to be connected to the EIA-232 / 530 port (labeled **RS232/530**) located on the rear panel of the unit.
4. Once the NTU is configured, if a different DTE connector is desired, disconnect the EIA-232 and connect the desired DTE cable.

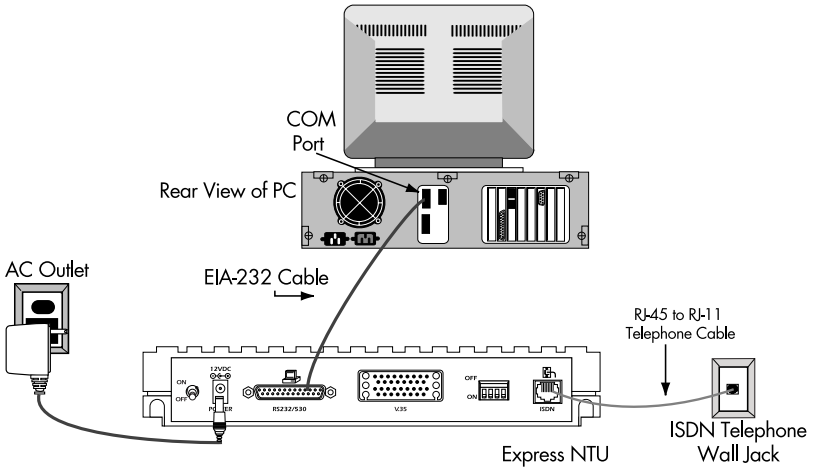


Figure 3-2. Connection Diagram

CONFIGURE THE EXPRESS NTU

When connected to an asynchronous VT 100 terminal or VT 100 terminal emulator, use the built-in Express NTU menu system for configuration. To enter into the menus, type **AT!V** and press **Enter**. The Configuration screen (menu) displays first. Figure 3-3 on page 3-7

shows each menu as it appears on the VT 100 terminal. To go to a particular menu, simply press the *hot keys* for that menu. The main branches of the menu and their hot keys are:

STATUS	**Ctrl + V**
TEST	**Ctrl** + **T**
CONFIG	**Ctrl** + **C**
DIAL	**Ctrl** + **D**

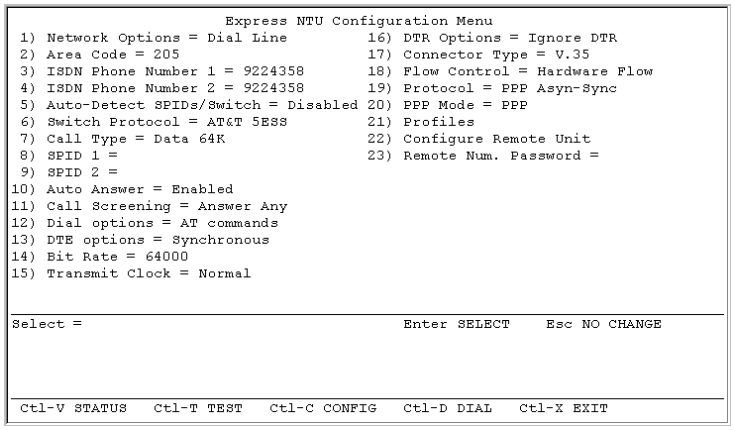
Ensure that the communications package is configured to pass these control sequences through to the Express NTU.

The status buffer can be displayed at any time after entering the menu structure. As stated earlier, pressing **Ctrl** + **V** displays the Express NTU Status menu. The last 20 status messages generated during the operation of the unit are displayed with relevant status items (see Figure 3-3). Status messages provide information about call progress, ISDN link status and error conditions. The most recent status message appears as Status 1, with the remaining status messages appearing in ascending order. *Status Buffer Messages* on page C-1 contains a list of the status buffer messages, including their descriptions. Press **Ctrl** + **C** to return to the Configuration menu. To exit the menus, press **Ctrl** + **X**. The **Ctrl** + **X** command also places the unit back on-line if a call is connected.

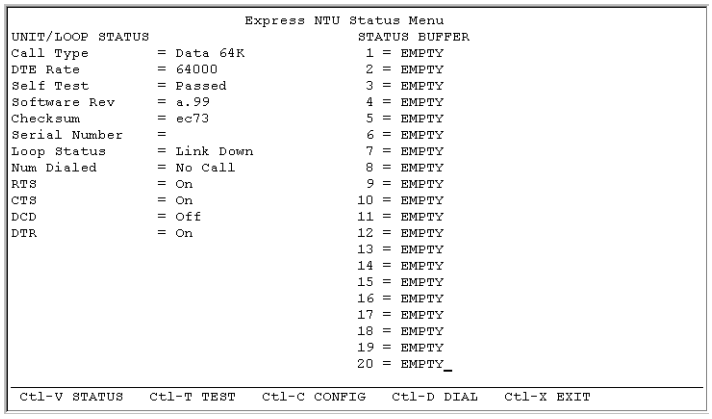
Follow these steps to configure the unit (*Configuration* on page 4-1 gives detailed information on configuring the Express NTU using a VT 100 terminal or PC with asynchronous VT 100 emulation capabilities):

1. Press **Ctrl + C** to display the Configuration screen.
2. Enter the area code.
3. Enter ISDN phone number 1.
4. Enter ISDN phone number 2.
5. Enable Auto-Detect SPIDs / Switch (see *Auto-Detection of SPIDs/ Switch Configuration* on page 4-1).
6. View the status by using the key sequence **Ctrl+V** as described previously.

It is important to note that some features in the Express NTU do not immediately take effect upon selection. This prevents unintentional reconfiguration of the unit during an active call. Items such as **Protocol** and **Call Type** take effect *only* at the beginning of a new call.

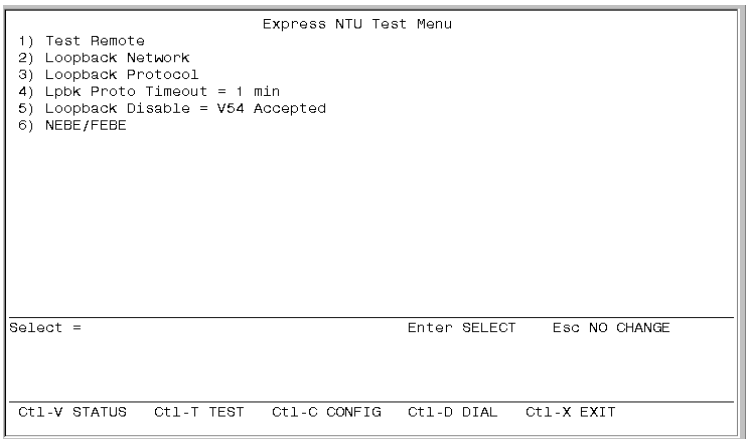


Configuration Menu

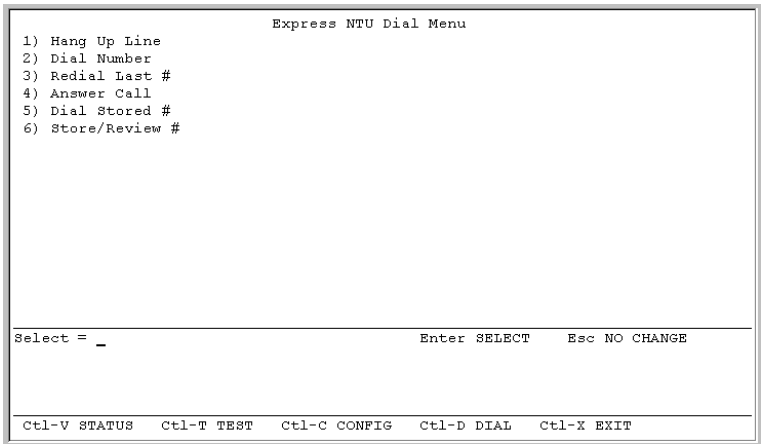


Status Menu

(Figure 3-3 continued on next page)



Test Menu



Dial Menu

Figure 3-3. Terminal Interface Menu Screens

Auto-Detection of SPIDs and Switch Type

Auto-detection of SPIDs and Switch Type (see *Auto-Detection of SPIDs/ Switch Configuration* on page 4-1) greatly reduces the likelihood of time-consuming problems occurring during installation of the Express NTU. It evaluates common SPID formats based on the area code and phone numbers and reports success after placing a test call.

After installation is complete, the Express NTU resets the ISDN line for a clean start. Therefore, the PWR/LINE LED may not be on solid (indicating link up) for a few more seconds.

In the few cases where the procedure does not succeed, the nonstandard SPIDs may be entered. Refer to the section *Service Profile ID (SPID)* on page 4-3 for more information.

Chapter 4 Configuration

Refer to Figure 3-3 on page 3-7 for an illustration of the VT 100 terminal screens to clarify the information in this chapter.

AUTO-DETECTION OF SPIDS/SWITCH CONFIGURATION

The switch type and SPID numbers can be detected automatically through the Express NTU interface by using the following steps:

1. Type **AT!V** to activate the VT 100 screen.
2. Type **Ctrl+C** to activate the Configuration menu.
3. Enter the area code and ISDN phone numbers given by the ISDN service provider.
4. Enter "Enabled" under the Auto-Detect SPIDS / switch selection.

CONFIGURING THE ADTRAN EXPRESS NTU FOR DIAL OPERATION

*It is important to note that some features in the Express NTU do not immediately take effect upon selection. This prevents unintentional reconfiguration of the Express NTU during an active call. Items such as **Protocol** and **Call Type** take effect only at the beginning of a new call.*

Network Options

To place ISDN modem calls, the unit must be configured for **Dial Line**. Perform the following steps to configure for Dial Line operation:

1. Go to the Configuration screen as described above and in the section *Configure the Express NTU* on page 3-4.
2. Press the number corresponding to **Network Options** and press **Enter** to view the **Network Options** choices: **Dial Line** and **Leased Line**.
3. Press the number corresponding to **Dial Line** and press **Enter** to select **Dial Line**.

Area Code

Enter the area code when using the AutoSPID/switch option.

ISDN Phone Number (Local Directory Number)

This option allows the entry of 0, 1, or 2 LDNs. The LDN is used when placing or receiving calls. The LDN is the local phone number assigned to the line.

LDN 1 = 5 5 5 1 2 1 2
LDN 2 = 5 5 5 1 2 1 2

Auto-Detect SPIDs/Switch

This can be set to **Active** or **Disabled**. If set to **Active,** the SPID and switch type for your ISDN switch are automatically detected. If set to **Disabled**, no automatic detection takes place.

Switch Protocol

Find out what kind of ISDN switch your local CO is using by asking your telephone administrator or your telephone company representative. The Express NTU can be configured for a Northern Telecom DMS-100, LUCENT 5ESS® CO switch, a switch conforming to the National ISDN-1 standard (usually an LUCENT 5ESS, NTI DMS-100™, or Siemens EWSD), or an NEC Switch.

Press the number corresponding to **Switch Protocol** and press **Enter** to display the **Switch Protocol** options: **LUCENT 5ESS**, **DMS-100**,

and **National ISDN1**. Press the number corresponding to the desired option and press **Enter** again.

Call Type

The Call type can be configured four different ways, depending on the type of service used. Press the number corresponding to **Call Type** and press **Enter** to display the Call Type options: **Speech, Audio, Data 56k,** and **Data 64k**. Press the number corresponding to the desired option, and then press **Enter**.

Service Profile ID (SPID)

The SPID is a sequence of digits used to identify ISDN terminal equipment to the ISDN switch. The SPID is assigned by the local phone company when the ISDN line is installed and it usually looks similar to the phone number. Obtain SPIDs from your telephone administrator or local telephone representative.

The number of SPIDs required (0, 1, or 2) depends on how your ISDN line is configured. For instance, a point-to-point line has no SPID. Multipoint lines may have one or two SPIDs. The Express NTU uses the presence of SPID 1 to determine if the line is multipoint. If the line has only one SPID, then it must be entered in SPID 1. Outside of North America, the SPID format may not be used.

Example:

SPID 1 = 2 5 6 5 5 5 1 2 3 4 0 1 0 1
SPID 2 = 2 5 6 5 5 5 4 3 2 1 0 1 0 1

PREFIX SUFFIX

National ISDN-1 switches require the addition of a two-digit terminal identifier (TID) at the end of the SPID.

Disconnect the network interface from the unit before initially entering or altering the SPIDs and LDNs.

Press the number corresponding to SPID 1 and press **Enter** to display the field for entering or changing SPID1. Type the SPID and press **Enter**.

Press the number corresponding to SPID 2 and press **Enter** to display the field for entering or changing SPID2. Type the SPID and press **Enter**.

*See Auto-Detection of SPIDs/Switch Configuration on page 4-1 for instructions on enabling the **Auto-Detect SPIDs/Switch feature.***

Auto Answer

Press the number corresponding to **Auto Answer** and press **Enter** to view the **Auto Answer** options: **Disabled, Enabled,** and **Dump All Calls**. Press the number corresponding to the desired options; then press **Enter**.

Disabled

When **Disabled** is selected, the Express NTU will not answer the call. An AT answer command (ATA) must be issued to the Express NTU before it accepts the incoming call. The ringing call can be dumped using the **Hang up line** command.

Enabled

When **Enabled** is selected, the Express NTU will accept an incoming data call on the primary phone number (SPID1, LDN1). If that call is a BONDING call, then another incoming call is accepted on the secondary phone number (SPID2, LDN2).

Dump all calls

When **Dump all calls** is selected, the Express NTU will not accept any incoming calls, keeping the line clear for outgoing calls.

Call Screening

The option **(1) Answer Any** (default) allows the Express NTU to answer all incoming calls. The option **(2) Answer if SN0...9** allows the Express NTU to answer only calls originating from phone numbers stored in the **DIAL** menu as stored numbers SN0 through SN9.

When **Call Screening** is set to answer any numbers stored in SN0 through SN9, an incoming call is not answered if the Call ID received from the switch does not match a stored number. Depending on the switch type, the Call ID may be presented in either a seven- or ten-digit format. The Express NTU displays the Call ID for all dumped calls in the Status buffer. See the section *Configure the Express NTU* on page 3-4 for more information.

Because different switches handle calls and Call ID differently, use the following procedure to determine if your switch uses a seven- or ten-digit Call ID format or phone number.

1. Press the number corresponding to **Call Screening** and press **Enter** to view the **Call Screening** options.
2. Select **Ansr if SN0 . . 9**.
3. Store your seven-digit number in SN0.
4. Place a call to the Express NTU with the stored number to see if it answers.
5. If the Express NTU does not answer the call, look at the Call ID message in the Status buffer. More than likely, the Call ID number is a ten-digit number.
6. Re-store the number in SN0 as it is displayed in the Call ID message, and test **Call Screening** again.

Dial Options

Press the number corresponding to **Dial Options** and press **Enter** to view the **Dial Options**: **AT Commands** and **V.25 bis**. Press the number corresponding to the desired option; then press **Enter**. The selected option will not take effect until exiting the VT 100 interface (**Ctrl+X**).

AT Commands

Configuring the Express NTU for **AT commands** enables in-band dialing over the DTE interface using asynchronous AT commands. **AT commands** can be used to set up the Express NTU as well as establish and end a call.

V.25 bis

Configuring the Express NTU for **V.25 bis** enables in-band dialing over the DTE interface using asynchronous or synchronous V.25 bis commands. **V.25 bis** can be used to establish and end a call.

See the section *Configuring the Express NTU for V.25 bis In-band Dialing* on page 4-24 for more information.

CONFIGURING THE EXPRESS NTU FOR LEASED DIGITAL SERVICE

This section explains how to configure the Express NTU when using a 2B1Q Leased Digital service or a service that provides a permanent connection between end points.

Go to the Configuration menu as described in the section *Configure the Express NTU* on page 3-4, and press the number corresponding to **Network Options** and **Enter** to display the Network Options. Press the number corresponding to **Leased Line** and press **Enter** to select **Leased Line**.

Selecting **Leased Line** configures the unit for leased line service or service that provides a permanent connection between end points such as limited distance modem (LDM) service.

Clock Mode: Slave/Master

Press the number corresponding to **Clock Mode** and press **Enter** to display the **Clock Mode** options: **Slave** and **Master**.

By configuring the Express NTU for **Master** timing, the Express NTU can provide clocking for both ends of the phone line. This **Master** option is used at one end of a limited distance modem application, where two Express NTU units are directly connected without the use of channel banks. The far-end unit should be configured for **Slave,** and it derives its clocking from the Express NTU configured for **Master** timing. If two Express NTU units are connected through channel banks, both units should be configured for **Slave** mode.

The maximum mixed gauge cable length between two Express NTU units operating in leased line mode is 16,000 feet.

Channel Rate

Press the number corresponding to **Channel Rate** and press **Enter** to display the **Channel Rate** options: **64k** and **128k**. When **64 kbps** is selected, only one bearer channel (B1) is used. When **128 kbps** is selected, both bearer channels (B1 and B2) are used.

The section *Recommended Operating Protocols* on page 1-3 gives the data rates available.

Leased Configuration

This option selects a D channel leased line configuration. These configurations specify types of network management that can be used to configure the unit from a leased line multiplexer located at the Central Office. A typical application would have many Express NTUs connected to a multiplexer via their ISDN U interfaces.

None

Sets unit for no D channel configuration, which is typical leased line mode.

No network management (such as loopbacks and unit status) are available with this option.

Ericsson Local

When this option is set, the Ericsson multiplexer connected to the Express NTU can perform loopbacks or read the settings for the bit rate and the connector type.

The Express NTU can only be configured from the EIA-232 serial port.

Ericsson Remote

When this option is set, and Ericsson multiplexer remotely connected to the Express NTU can read the status of the Express NTU, perform loopbacks, or configure the product. A device connected to the Express NTU can read the status for the bit rate and the connector type.

In this configuration, DTE leads and flow control cannot be set, and only V.110 and Clear Channel protocols are supported. The NTU can only be configured from the network.

OPTIONS FOR BOTH LEASED AND SWITCHED ISDN SERVICE

This section describes the options that apply to both leased digital service and dial operation. To access these options, first go to the Configuraton menu as described in the section *Configure the Express NTU* on page 3-4.

DTE Options

Press the number corresponding to **DTE Options** and press **Enter** to display the **DTE** options: **Asynchronous and Synchronous**. Select the desired option.

Bit Rate

Press the number corresponding to **Bit Rate** and press **Enter** to display the **Bit Rate** options.

The **Bit Rate** can be set asynchronously for 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, and 230400 bps and synchronously for 2400, 4800, 9600, 19200, 38400, 48000, 56000, 64000, 112000, and 128000 bps.

Transmit Clock for Synchronous Data

Press the number corresponding to **Transmit Clock** and press **Enter** to display the **Transmit Clock** options: **Normal** and **External**. Select the desired option.

Selecting the **Normal** option causes the Express NTU to be the synchronous DTE interface transmit timing source. Transmit data is timed from the transmit clock provided by the Express NTU on the DTE connector. **Normal** clock is the normal mode of operation for the Express NTU.

With the **External** option selected, the Express NTU slaves to an external transmit timing source. The external clock is provided to the Express NTU by the external transmit clock signal at the DTE. This signal is echoed by the Express NTU to the transmit clock signal on the DTE port.

This option is provided for situations where equipment connected to the Express NTU DTE connector cannot slave to the Express NTU-provided clock. The Express NTU uses the U-interface as the frequency standard when it must provide a synchronous receive or transmit clock. When using the Express NTU in a Tail Circuit application, it may be necessary to add delay to accommodate clock jitter. Entering a number from **0-255** under **TxRxDelay** will yield the size of the delay buffer, which is approximately 8x the number selected in bytes.

DTR Options

Press the number corresponding to **DTR Options** and press **Enter** to display the **DTR** options.

Selecting **Ignore DTR** causes the Express NTU to disregard the state of the data terminal ready (DTR) pin. **Cmd when Off** forces the unit into the AT command processor mode when DTR is not asserted. To return on-line, DTR must be asserted, followed by the AT0 command. **Idle when Off** forces the unit to end the current call when DTR is no longer asserted. **Off>On dial #0** allows one call attempt to be automatically established when the DTR signal goes from inactive to active. While DTR is active, dialing is also possible through the built-in menu system. When DTR goes inactive, any outgoing or incoming call present is disconnected. **Off>On dial #0** uses the phone number in stored number register 0 to establish the call. To store a number for automatic dialing see the section *VT 100 Terminal Dialing Options* on page 4-23. Selecting **Dial #0 if On** allows calls to be automatically established when the DTR signal is in the active state. The unit attempts to establish a call using SN0 until the call is established or DTR goes inactive. Selecting **Answer if On** only allows the unit to answer an incoming call if the DTR signal is asserted.

Connector Type

Press the number corresponding to **Connector Type** and press **Enter** to display the **DTE** options: **EIA-530 , V.35,** and **EIA-232**. Select the desired option.

Flow Control for Asynchronous Data

Press the number corresponding to **Flow Control** and press **Enter** to display the **Flow Control** options.

Selecting **Hardware Flow Control** allows RX data to be presented to the DTE interface only when RTS is asserted. **Software Flow** control uses XON / XOFF to control data transferred between the DTE and the Express NTU. Selecting **No Flow Ctrl** disables flow control.

SETTING PROTOCOL OPTIONS

The Express NTU communicates with many different types of telecommunication equipment including other Express NTU units, ISDN terminal adapters, BONDING mode 1-compatible inverse multiplexers,and PPP-compatible bridges / routers.

Communicating between such diverse types of equipment requires the use of various rate adaptation protocols to support various bit rates and DTE settings. The Express NTU supports the following rate adaptation protocols:

1. Clear Channel (no rate adaption protocol)
2. Point-to point protocol (PPP) asynchronous to synchronous conversion
3. BONDING mode 1 (Bandwidth on Demand Interoperability Group)
4. CCITT V.120
5. CCITT V.110
6. FALLBACK
7. Multilink PPP
8. PPP with compression

The desired protocol may be selected with AT commands at the DTE port or from the Express NTU built-in menu system. (With the built-in menu system, view these protocol choices by press the number corresponding to **Protocol** and pressing **Enter**.) A description of protocols follows.

See the section *Recommended Operating Protocols* on page 1-3 for more information on recommended modes of operation.

Clear Channel

Clear channel provides the entire bearer channel to the DTE without regard to data format or protocol. This provides a rate adaptation at or near the ISDN circuit rate. The primary usage for **Clear Channel** in the dial line mode is for 56 kbps and 64 kbps synchronous. It is useful

when the DTE performs its own internal synchronous protocol/rate adaptation or the Express NTU is calling a 4-wire Switched 56 DSU. In the leased line mode, **Clear Channel** can provide synchronous bit rates of 56 kbps, 64 kbps, 112 kbps, and 128 kbps.

Point-to-Point Protocol (PPP) Async-to-Sync

PPP provides a standard method for transporting multi-protocol datagrams over point-to-point links. The ADTRAN PPP async-sync protocol allows the Express NTU and a PC or Macintosh® running PPP software, to communicate with a PPP-compatible bridge or router. The PPP async-sync protocol complies with Internet Engineering Task Force (IETF) RFC 1662.

The asynchronous control character map (ACCM) option is scanned during the negotiation. When the ACCM option is seen in a configure ACK link control packet, it is adopted by the Express NTU. In addition, when the ACCM option is not seen in the configure-request packet from the network, the Express NTU will spoof or add it to the packet.

BONDING Mode 1

The **BONDING mode 1** protocol allows the Express NTU to communicate at bit rates in excess of 64 kbps to a maximum of 128 kbps. BONDING provides high-speed communication between Express NTU units, ISDN TE/TAs, and inverse multiplexing equipment supporting the BONDING protocol. The protocol allows use of both synchronous and asynchronous bit rates. When the Express NTU uses the **BONDING mode 1** protocol, it must make two separate ISDN phone calls to seize control of both ISDN bearer channels. The protocol corrects any delays existing between the two bearer channels and presents a single high-speed data channel to the DTE. For successful high-speed operation, both the near- and far-end DCE need to be configured to use the **BONDING mode 1** protocol. The **BONDING mode 1** protocol negotiation phase has numerous timers to allow transmission delays due to satellite hops, international calls, etc. The timers may be adjusted if necessary by entering into the **BONDING mode 1** submenu.

V.120

The **V.120** protocol is a CCITT- compliant rate adaption method which provides DTE service between the Express NTU and other V.120 compliant devices at rates less than the 64 kbps ISDN Bearer channel rate. V.120 supports synchronous and asynchronous DTE rates. See the section *Recommended Operating Protocols* on page 1-3 and Table 1-1 on page 1-4 for available V.120 rates.

V.110

The **V.110** protocol is a CCITT- compliant rate adaption method which provides DTE service between the Express NTU and other V.110 compliant devices. V.110 supports synchronous and asynchronous DTE rates. See the section *Recommended Operating Protocols* on page 1-3 (in Chapter 1) and Table 1-1 on page 1-4 for available V.110 rates.

FALLBACK

The **FALLBACK** asynchronous rate-adaption protocol provides the capability to automatically establish calls with other ISDN terminal adapters, Switched 56 DSUs, PPP-compatible bridges / routers, as well as other ISUs using a single configuration. This allows for integrating services without changing the configuration on the Express NTU.

The Express NTU must be optioned as follows for FALLBACK operation:

- Any asynchronous bit rate up to 115.2 kbps which is supported by the DTE.
- Flow control must be enabled and supported by the DTE.

FALLBACK supports the following protocols based on the call type: BONDING mode 1, V.120, and PPP async-sync. When answering calls, the Express NTU uses the incoming call type to determine which rate adaption protocols to support.

When originating calls to unknown units, the ISU begins protocol selection based on the local call type. Data 64k is used for FALLBACK

selected from the **Profiles** menu. Upon connection at 64k call type, BONDING, V.120, and PPP async-sync are attempted. If connection is not made at 64k, the Express NTU attempts another call at 56k call type. If connection is made at 56k, V.120, and PPP async-sync are attempted.

Multilink Point-to-Point Protocol

This protocol allows the Express NTU to dial a second number, establishing a second point-to-point link. Once the second PPP is established, multilink PPP is performed over both B-channels. The phone number for the second call should be placed in stored number 1 (SN1). If no number is stored in SN1, the same phone number dialed to establish the first link is used for the second link.

PPP and STAC Compression

When set up to do compression, the Express NTU will negotiate the compression central protocol (CCP) with the network PPP peer. If STAC compression is successfully negotiated with the peer, data packets from the DTE are compressed before being sent out the network. Likewise, compressed packets from the network are decompressed before being transmitted out the DTE.

CONFIGURING THE EXPRESS NTU USING PROFILES (QUICK SETUP)

To configure the DTE Options quickly and easily, use the **Profiles** menu to automatically set up the most common DTE configurations. Press the number corresponding to **Profiles** and press **Enter** to display the **Profiles** options:

Default	Dial V120 asyn
Dial 56k Sync	Dial Bond asyn
Dial 64k Sync	Internet 64k
Dial 112k Sync	Internet 128k
Dial 128k Sync	Remote 64k
Leased 128k	Remote 128k
Ldm 128k Master	Leased V120

For fine-tuning a particular application and DTE settings, see the section *Options for both Leased and Switched ISDN Service* on page 4-8. This section provides detailed step-by-step processes for configuring the DTE Options.

Most Internet service providers supporting ISDN also support PPP protocol. If connecting to an Internet service provider using one B-channel, select **Internet 64K**, which sets the protocol to PPP. If arrangements have been made with the Internet service provider to use two B-channels, select **Internet 128K**, which uses multilink PPP protocol.

Loading a factory profile has no effect on any SPID(s), ISDN Phone Number(s), or Switch Type settings already configured. The settings that are altered when applying a profile are shown on the following pages.

Default (factory)

This option restores the Express NTU to the following factory default setup:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	Data 64k
Call screening	Answer Any
Data protocol	Clear Channel
DTE mode	Synchronous
DTR option	Ignore DTR
DTE flow control	None

The Express NTU can be reset to the factory default settings by setting switch 2 to the off (up) position. See the section *Verify Switch Settings* on page 3-1 for more information.

Factory default erases all stored phone numbers, SPIDs, and LDNs.

Dial 56K sync

When the Express NTU is configured for **Dial 56K sync** service, the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	56 kbps data
Data protocol	Clear channel
DTE mode	Synchronous
DTE connector bit rate	56 kbps
DTE flow control	None
Transmit data clock	Normal

Dial 64K sync

When the Express NTU is configured for **Dial 64K sync** service, the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	64 kbps data
Data protocol	Clear channel
DTE mode	Synchronous
DTE connector bit rate	64 kbps
DTE flow control	None
Transmit data clock	Normal

Dial 112K sync

When the Express NTU is configured for **Dial 112K sync** service, the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	56 kbps data
Data protocol	BONDING mode 1
DTE mode	Synchronous
DTE connector bit rate	112 kbps
DTE flow control	none
Transmit data clock	Normal

Dial 128K sync

When the Express NTU is configured for **Dial 128K sync** service, the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	64 kbps data
Data protocol	BONDING mode 1
DTE mode	Synchronous
DTE connector bit rate	128 kbps
DTE flow control	None
Transmit data clock	Normal

Leased 128K

When the Express NTU is configured for **Leased 128K** service, the following parameters are automatically preset:

Service type	Leased line
Network clock source	Slave
Channel rate	128K
Data protocol	Clear channel
DTE mode	Synchronous
DTE connector bit rate	128 kbps
DTE flow control	None
Transmit clock	Normal

Ldm 128K Master

When the Express NTU is configured for a point-to-point application such as a limited distance modem arrangement, the **Ldm 128 Master** option automatically presets the following parameters:

Service type	Leased line
Network clock source	Master
Channel rate	128K
Data protocol	Clear channel
DTE mode	Synchronous
DTE connector bit rate	128 kbps
DTE flow control	None
Transmit clock	Normal

Dial V120 asyn

When the Express NTU is configured for **Dial V120 asyn** service**,** the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	64 kbps data
Data Protocol	V.120
DTE mode	Asynchronous
DTE connector bit rate	Hardware
DTR option	Ignore DTR
DTE flow control	Hardware

Dial Bond asyn

When the Express NTU is configured for **Dial Bond asyn** service, the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	Data 64k
Data protocol	Bonding Mode 1
DTE mode	Asynchronous
DTR option	Ignore DTR
DTE flow control	Hardware

Internet 64K

When the Express NTU is configured for **Internet 64K** service, the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	64 kbps data
Data protocol	PPP asyn-sync
PPP Mode	PPP
DTE mode	Asynchronous
DTR option	Ignore DTR
DTE flow control	Hardware

More

Select **More** to access the following level of choices:

Internet 128K

When the Express NTU is configured for **Internet 128K** service, the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	64 kbps data
Data protocol	PPP asyn-sync
PPP Mode	Multilink PPP
DTE mode	Asynchronous
DTR Options	Ignore DTR
DTE flow control	Hardware

Remote 64K

When the Express NTU is configured for **Remote 64K** service, the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	64 kbps data
Data protocol	V.120
DTE mode	Asynchronous
DTR Options	Ignore DTR
DTE flow control	Hardware
Transmit data clock	Normal

Remote 128K

When the Express NTU is configured for **Remote 128K** service, the following parameters are automatically preset:

Service type	ISDN dial line
Automatic answering	Enabled
ISDN call type	64 kbps data
Data protocol	Bonding Mode 1
DTE mode	Asynchronous
DTR Options	Ignore DTR
DTE flow control	Hardware

Leased V120

When the Express NTU is configured for **Leased V120** service, the following parameters are automatically preset:

Service type	Leased line
Network clock source	Master
Channel rate	64K
Data protocol	V.120
DTE mode	Synchronous
DTE connector bit rate	64 kbps
DTE flow control	Hardware
Transmit clock	Normal

VT 100 TERMINAL DIALING OPTIONS

After starting the terminal emulation package, type **AT!V** and press **Enter**. Enter the Express Dial menu by pressing **Ctl** + **D**.

Hang up line

Terminates current call.

Dial number

Allows a number to be entered and dialed. Pressing **Enter** after entering a number causes the Express NTU to dial the number and save the dialed number in storage location 9 for redialing purposes.

Redial last number

Allows redial of the last number called or attempted. This number was saved in storage location 9 from the last attempted phone call.

Answer call

Allows selective answer of incoming calls when the Auto Answer is configured for disable. Auto Answer is described in the section *Auto Answer* on page 4-4.

Dial stored number

Allows the dialing of one of ten stored phone numbers.

Store/Review number

Permits entry and review of stored numbers.

AT COMMANDS AND S-REGISTERS

AT Commands and S-Registers on page A-1 describes the use of AT commands and S-registers. It also lists the supported AT commands and their functions and describes each S-register.

CONFIGURING THE EXPRESS NTU FOR V.25 BIS IN-BAND DIALING

V.25 bis dialing is used primarily by DTE with synchronous interfaces (HDLC / SDLC or BSC / BISYNC) not supporting the AT command set, which is commonly used by asynchronous devices. The Express NTU supports V.25 bis in-band dialing in accordance with Fascicle VIII.I - V.25 bis (Malaga-Torremolinos 1984, Melbourne 1988).

Recommendation V.25 uses the following DCE / DTE control signals:

Transmitted data	Circuit 103
Received data	Circuit 104
Ready for sending	Circuit 106
Data set ready	Circuit 107
Data terminal ready	Circuit 108 / 2
Calling indicator	Circuit 125

The Express NTU supports the following V.25 bis commands to control automatic calling and answering:

CRN	Call request (number in command)
CRS	Call request (using stored number)
PRN	Program stored number
RLN	List stored number
CIC	Connect incoming call
DIC	Disconnect incoming call

When using stored numbers V.25 bis accesses stored numbers 1 through 9. See the section ***VT 100 Terminal Dialing Options*** *on page 4-23.*

SYNC V.25 Dialing

V.25 bis specifies that the characters should be ASCII, 7 bits, with even parity, and one stop bit. However, for versatility the Express NTU allows the data bits, parity, and stop bits to be changed as defined under **Data** format.

This setting allows for V.25 bis messages in asynchronous (start / stop) data format.

*In **synchronous mode**, the Express NTU is an ISDN version of a synchronous modem. For configuration or troubleshooting, the unit requires connection to an async VT 100 terminal and the dial option must be set to AT Commands. After the unit is completely configured, set the dial option to V.25 bis and exit the VT 100 terminal interface. The unit is now ready to respond to V.25 bis dialing commands. If it is necessary to reenter the VT 100 interface for re-configuration, troubleshooting or to view the status buffer, perform the following steps:*
(1) power the unit off
(2) set dip switch 2 to off (up) for factory default AT commands
(3) power the unit back on
(4) set dip switch 2 to on (down)
*(5) type **AT!V** to activate the terminal interface.*

SYNC V.25 HDLC Dialing

Although V.25 bis allows asynchronous data format, asynchronous DTE is more likely to support the AT command set than V.25 bis.

This setting provides V.25 bis messages in bit-synchronous format (for example, HDLC, SDLC, X.25). The bit-synchronous format is the most commonly used by V.25 bis.

This option specifies that the characters should be 7-bit ASCII, with the 8th bit ignored (it may be either 0 or 1).

The first byte of each packet contains all one bits (A = FF HEX), and the second byte of each packet (the C byte) is either 13 HEX or 03 HEX if not the final packet.

Select V.25 HDLC flags if your terminal equipment requires idle state flags.

: V.25 BISYNC Dialing

This setting allows for V.25 bis messages in byte-synchronous format (BISYNC). V.25 bis specifies that the characters should be ASCII, 7 bits, and odd parity. This setting allows synchronous DTE which does not use HDLC to support serial in-band dialing.

THE STATUS BUFFER

The status buffer is discussed in the section *Configure the Express NTU* on page 3-4.

TEST OPTIONS

Press **Ctrl+T** to display the Express NTU Test menu screen. The Express NTU provides the following test options:

1) Test Remote

2) Loopback Protocol

3) Lpbk Proto Timeout=1 min

4) Loopback Disable = V54 Accepted

5) NEBE / FEBE

Press the number corresponding to the desired option and press **Enter** to select an option.

Test Remote

This test causes the Express NTU to issue a V.54 inband loopback command to a far-end unit and BERT test the link using a built-in pattern generator / checker. This allows a circuit to be tested without any extra test equipment. To use this feature, both units must be configured for

Clear Channel operation and the far-end unit must be able to respond to V.54 loopback commands. See the section *Setting Protocol Options* on page 4-11 to configure the unit for Clear Channel operation. The built-in 2047 pattern generator / checker displays the number of bytes transmitted on the top line and the number of errored bytes received on the lower line of the front panel display. Pressing **0** clears the counts. Pressing **Cancel** ends the test.

Loopback Protocol

This option allows data to be looped back toward the network after passing through a selected protocol such as BONDING. See Figure 4-1 for loopback points.

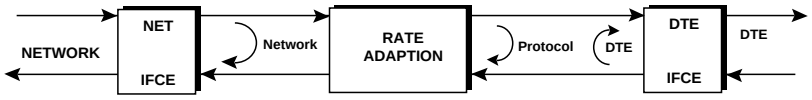


Figure 4-1. Express NTU Loopback Points

Lpbk Proto Timeout = 1 min

This option sets the length of time for the loopback protocol test.

Loopback Disable = V54 Accepted

The Express NTU responds to V.54 loopback commands.

Near-End Block Errors/Far-End Block Errors (NEBE/FEBE)

Use this test to determine the quality of the network connection by viewing the number of near-end block errors (NEBE) and far-end block errors (FEBE) occurring on the ISDN U-interface. A large count indicates problems with network equipment.

Chapter 5 Troubleshooting

TROUBLESHOOTING GUIDELINES

This section provides troubleshooting techniques to possible problems that may be encountered while operating the Express NTU. If problems persist, contact ADTRAN technical support for assistance (see the back cover of this manual).

Power/Line LED is Off

Indicates a problem with the power to the unit. Verify the power cord is connected to the Express NTU and is plugged into a known working 120 volt AC electrical outlet.

Power/Line LED Flashes and B1 and B2 LEDs are Off

This indicates a problem with the physical connection of the ISDN line from the local telephone company to the Express NTU.

1. Verify the large end of the RJ-45 to RJ-11 telephone cable (included with the Express NTU) is connected to the ISDN connector on the rear panel of the Express NTU.
2. Verify the small end of the RJ-45 to RJ-11 telephone cable is connected to the ISDN telephone wall jack installed with Basic Rate ISDN.
3. Contact the local telephone service provider.

Power/Line LED, B1, and B2 LEDs Flash Green

This indicates a configuration problem. Verify the following information is correct:

- Switch Type
- Service Profile Identifiers (SPIDs)
- ISDN Phone Numbers

Auto-detect Switch/SPIDs Remains at Link Down

The Link Down condition persisting for longer than 15 minutes indicates a problem with the ISDN line provided from the telephone company. The ISDN physical layer device has not been able to synchronize to the network. Ensure the RJ-45 to RJ-11 telephone cable is correctly installed between the Express NTU and the ISDN wall jack and that the Express NTU is powered on. If the wall jack does not have ISDN installed on the two middle pins (tip, ring), the Express NTU will never synchronize to the telephone switching equipment. Call the local telephone company and have them check the ISDN line for correct operation.

Difficulty with 230.4 kbps Operation

If the Express NTU does not work when the DTE rate is set to 230.4 kbps inside Windows, verify the following:

1. Verify that switch 1 on the back of the Express NTU is set to off (up).
2. Verify that a high speed serial card with a 16650 UART is being used and the software drivers to support the extended baud rate tables are installed.

When the Express NTU powers up, it performs an internal self-test. This takes about 10 seconds. At the end of the test, the PWR LED should remain on. If self-test fails, ensure that the Express NTU is receiving power.

IF THE EXPRESS NTU DOES NOT READ *READY*

When the Express NTU has been set up and connected to a line, but the Loop LED does not remain on after a few minutes, follow the troubleshooting procedure outlined below.

1. Cycle power on the Express NTU, leaving it off for a minimum of two seconds; then turn the power on for one minute to ensure the Loop LED still does not come on.
2. Disconnect the Express NTU. From a functioning voice phone, call the local directory number(s) provided with your ISDN line. Calling a good ISDN line with nothing connected usually results in a ring or fast busy tone. If someone answers, or you get a not-in-service intercept, there is probably something wrong with the translation of the ISDN line. The phone service provider should be able to help.
3. If the Loop LED still remains off, then there is a physical problem with the ISDN phone line (more than likely, a problem with the layer 1 setup). The problem is one or more of the places listed below:
   - The Express NTU software setup
   - The Express NTU hardware
   - The wiring on your premises
   - The telephone service provider's wiring
   - The telephone service provider's hardware
   - The telephone service provider's software setup

   To isolate the problem, perform the following procedure:

   A. Ensure the ISDN line is plugged into the Express NTU connector marked **ISDN** on the back of the Express NTU.

   B. Make sure the Express NTU is configured for Dial line service.

   C. If possible, try another piece of functioning ISDN equipment with a U-interface on the ISDN line.

   D. Talk to your service provider and ensure you have an

ISDN Basic Rate U-Interface with 2B1Q line coding (wrong options are an S or T interface or AMI line coding).

E. Ensure that your phone line is connected to the actual telephone line (U-interface) provided by your telephone company. Make sure your line is not connected through another piece of equipment such as an NT1 in a wiring closet somewhere.

F. Make sure nothing else is bridged across the ISDN line pair.

G. With a minimum of extra wiring, try connecting to the ISDN line pair at the point where service provider's wiring ends.

H. With the Express NTU connected to the ISDN line and powered up, talk to your service provider's repair group and inform them that your ISDN basic rate line has a physical layer 1 problem. Ask them to check the line. Tell them that you have an NT1-like device a the end of the line.

4. If the *Loop Status* in the Express NTU Status menu continuously reads **Getting TEI #1**, then the Express NTU is physically connected to your local telephone service provider but is unable to establish logical layer 2. The problem is in one or more of places listed below:

   • The Express NTU software setup

   • The telephone service provider's software setup

   • Hardware configuration, if the line is extended from the switch

   To isolate the problem, perform the following procedure:

   A. Ensure the Express NTU is set up for the correct switch type.

   B. Ensure the quality of your ISDN line is satisfactory by checking for near- and far-end block errors (NEBEs and FEBEs). If the counts are non-zero, there may be a physical link problem as described in step 3.

   C. If possible, try another piece of functioning ISDN equipment with a U-interface on the line.

   D. With the Express NTU connected to the ISDN line

and powered up, talk to your service provider's repair group and tell them you have an ISDN basic rate line that appears physically okay but has no terminal endpoint identifier (TEI). Ask them to check the line translation and ensure that the line supports dynamic TEI allocation. Tell them that you have an NT1 and terminal adapter device connected to the line.

5. If the Loop Status in the Express NTU Status menu continuously reads **Register SPID #1**, then the Express NTU is physically connected to your local telephone service provider and has established logical layer 2. The Express NTU is unable to establish layer 3. The problem is in one or both of the following places:

   • The Express NTU software setup

   • The telephone service provider's software setup

   To isolate the problem, perform the following procedure:

   A. Ensure the Express NTU is set up for the correct switch type.

   B. Make sure the Express NTU is set up with the correct SPID and LDN. For example:

      4) SPID1 = 25655512340101
      5) SPID2 = 25655543210101
      6) LDN 1 = 5551234
      7) LDN 2 = 5554321

   C. If possible, try another piece of functioning ISDN equipment with a U-interface on the line.

   D. With the Express NTU connected to the line and powered up, talk to your service provider's repair group and tell them you have an ISDN basic rate line that appears physically okay but is unable to register its SPID(s). Ask them to check the line translation, ensure the line supports dynamic TEI allocation, and verify the SPIDs. Tell them that you have an NT1 and terminal adapter device connected to the line.

6. If the Loop Status in the Express NTU Status menu continuously reads **Getting TEI #2**, the Express NTU has completely initialized the first phone number but is unable to establish logical layer 2 for the second phone number. The problem is in one or both of the following places:
   - The Express NTU software setup
   - The telephone service provider's software setup

   To isolate the problem, perform the following procedure:

   A. Ensure that the Express NTU is set up with the correct SPID and LDN. For example:

      4) SPID1 = 25655512340101
      5) SPID2 = 25655543210101
      6) LDN 1 = 5551234
      7) LDN 2 = 5554321

   B. Try swapping SPID1 with SPID2 and LDN1 with LDN2. Determine if the problem is the second phone number or the quantity of phone numbers.

   C. If possible, try another piece of functioning ISDN equipment with a U-interface on the line.

   D. With the Express NTU connected to the line and powered up, talk to your service provider's repair group and tell them you have an ISDN basic rate line that appears physically okay but is unable to register its SPID(s). Ask them to check the line translation, ensure the line supports dynamic TEI allocation, and verify the SPIDs. Tell them that you have an NT1 and terminal adapter device connected to the line.

7. If the Loop Status in the Express NTU Status menu continuously reads **Register SPID #2**, the Express NTU has completely initialized the first phone number but is unable to establish logical layer 3 for the second phone number. The problem is in one or both of the following places:
   - The Express NTU software setup
   - The telephone service provider's software setup

   To isolate the problem, perform the following procedure:

   A. Ensure that the Express NTU is set up with the correct SPID and LDN. For example:

4) **SPID1 = 25655512340101**
5) **SPID2 = 25655543210101**
6) **LDN 1 = 5551234**
7) **LDN 2 = 5554321**

B. Try swapping SPID1 with SPID2 and LDN1 with LDN2. Determine if the problem is the second phone number or the quantity of phone numbers.

C. If possible, try another piece of functioning ISDN equipment with a U-interface on the line.

D. With the Express NTU connected to the line and powered up, talk to your service provider's repair group and tell them you have an ISDN basic rate line that appears physically okay but is unable to register its SPIDs. Ask them to check the line translation, ensure the line supports dynamic TEI allocation, and verify the SPIDs. Tell them that you have an NT1 and terminal adapter device connected to the line.

IF YOU ARE UNABLE TO CONNECT CALLS

See Table 5-1 for corrective actions if you cannot connect calls.

Table 5-1. Troubleshooting Calls

Condition	Corrective Action
The Loop LED remains on, but calls cannot be placed.	Most likely a problem exists in the software setup (translation) at the CO switch, or the network setup in the Express NTU.
Local voice calls can be transmitted, but data calls to the same exchange cannot.	The line is probably not set up to support data calls.
Local data calls go through, but long distance calls do not.	Ensure the far end is working. If not already doing so, place the call explicitly specifying the prefix of the long distance service (for example, 10288 for AT&T). If this does not work, then the problem is probably the long distance service provider. Another possibility is that the local service provider is not providing long distance access.
Data calls can be made, but BONDED data calls cannot.	There may be a problem in the software setup (translation) at the CO switch, or the network setup in the Express NTU. Another possibility is that the data circuits provided are not good enough to support the BONDING negotiation process. If the line has two phone numbers, make sure the second SPID and LDN are entered correctly in SPID2 and LDN2 in the Express NTU. Check with the local service provider to ensure that the line supports two data calls. The Express NTU status log buffer shows the sequence of events that occurred. You need to know which piece of equipment first caused the BONDING process to terminate. The status logs from both ends may be necessary to determine this.

Chapter 6 Specifications

SPECIFICATIONS AND FEATURES

This section describes the standard specifications and features incorporated in the Express NTU.

Network Interface
RJ-45 for ISDN Basic Rate U-Interface or RJ-45 for leased 2B1Q service

DTE Interface
EIA-232, EIA-530, V.35

Dialing Selections
- In-band dialing: V.25 bis or AT commands
- Manual or automatic stored number dialing
- DTR assertion

Data Rates
- Network: 64 kbps (one B-channel), 128 kbps (two B-channels)
- DTE: 300 bps to 115.2 kbps asynchronous; 2400 bps to 128 kbps synchronous

Rate Adaption
- CCITT V.120
- CCITT V.110
- BONDING Mode 1
- PPP async-sync
- Fallback
- Multilink PPP
- PPP with compression
- Clear Channel

Interoperability
- BONDING Mode 1-compatible Inverse Multiplexers
- ISDN TAs
- Automatic Fallback Rate Adaption

Switch Compatibility
- LUCENT 5ESS
- NTI DMS-100
- National ISDN-1
- NEC

B-Channel Aggregation
BONDING mode 1 protocol

Display
Available through terminal

Environmental
- Operating Temperature: 0 to 40 °C (32 to 104 °F)
- Storage Temperature: -20 to 70 °C (-4 to 158 °F)
- Relative Humidity: Up to 95% non-condensing

Physical
- Dimensions:
- Weight: 3.0 lbs

Power
- 120 VAC, 60 Hz

Appendix A AT Commands and S-Registers

While a call is not established, the DTE port accepts AT commands. During this time, the CD signal is inactive. When a call is established, the port is used for data. This data mode is indicated by the CD signal active. The Express NTU can be configured and controlled with AT commands from a serial port similarly to analog modems.

To exit data mode and enter command mode, the serial port must transmit a proper escape sequence to the Express NTU. A specified time delay must occur between the last data character and the first escape sequence character. This is the guard time delay, and it can be changed by writing a value to the S12 register. The default value for the guard time is one second. For a valid escape sequence to occur, the DTE must transmit the escape code character three times in succession with delay between each character being less than the guard time. The default escape sequence is **+++**.

Once command mode is entered, AT commands can be transmitted to the Express NTU to configure most of the options, dial remote Express NTUs, or initiate tests to check the Express NTU and the network connections. All command lines must begin with the AT character set in either capital or lower case letters. To return an active call to the online state, type **ATO**.

Commands may be separated with spaces for readability. The maximum length for a command line is 40 characters. Each command line is executed by the Express NTU upon receipt of a terminating character. The default terminating character is a carriage return (ASCII 013), but it can be changed by writing a different value to register S3. Before the terminating character is transmitted, the command line can be edited by using the backspace character (ASCII 008) to erase errors so the proper commands can be entered.

Using an AT Command

Type **AT** followed by the letter of the command and numeric value of the setting desired and then press **Enter**. The following command returns the software version of the unit:

ATI1

Using S-Registers

The configuration of the Express NTU can be changed or reviewed with S-registers. See the section, S-Register List, for a description of each S-register and its corresponding range of values.

Reading an S-Register

Type **ATS** followed by the number of the S-register to be read and a question mark, and press **Enter**.

ATS0?

Reading an S-Register String

The Express NTU uses S-register strings to store strings of digits for stored phone numbers, SPIDs, etc. Type **ATSS** followed by the number of the string S-register to be read and a question mark, and press **Enter.**

ATSS80?

Changing an S-Register

Type **ATS** followed by the number of the S-register to be changed, an equal sign, and the numeric value to be assigned to the register, and then press **Enter**.

ATS0=2

Changing a String S-Register

Type **ATSS** followed by the number of the string S-register to be changed, an equal sign, and the numeric string to be assigned to the register; then press **Enter**.

ATSS80=5551212

Dialing a Call using the AT Command Processor

To dial a call using the DTE terminal and AT commands type **ATD, ATDT,** or **ATDP** and the telephone number on one line; then press **Enter**.

ATD5551212

To end an active call with the AT command processor press the break in key sequence **+++** or the redefined key then type ATH and press **Enter** to hang up the line.

Command	Function
A	Answer. Places the Express NTU in answer mode.
AT!S	Displays Status Buffer.
AT!S1	Displays Link Status
AT!V	Configuration Menu
D	Dial. Precedes the telephone access number [ATD5551212].
DS	Dial a stored number [DS3].
H	Hang up. Disconnects the current call.
I0	Identify unit. Commands the unit to display model number.
I1	Identify software. Commands the unit to display software version.
O	On-line. Commands the unit to go back on line
S	S Register.
SS	S String register.
_Z	Reset. Resets the AT command processor.
&W	Save. Save current configuration to EEPROM.
_U	Resets ISDN interface.

Command	Function
!S	Dumps status buffer contents to the DTE port.
+++	Break in. Break in AT command processor during an active call. The break in key is defined in S2.
Carrier Detect (CD) Control Line Options	
&C0	CD forced on.
&C1	CD normal.
&C2	CD off with local disconnect (LOCD)
&C3	CD off with link down.
Data Terminal Ready (DTR Control Line Options)	
&D0	Ignore DTR
&D1	DTR off forces command.
&D2	Idle when off. DTR off forces idle (On allows auto answer).

Generic Unit Configurations	
&F0	Default
&F1	Configures unit for Dial 56k sync
&F2	Configures unit for Dial 64k sync
&F3	Configures unit for Dial 112k sync
&F4	Configures unit for Dial 128k sync
&F5	Configures unit for Leased 128k
&F6	Configures unit for Ldm 128k Master
&F7	Configures unit for V120 async
&F8	Configures unit for Dial Bond async
&F9	Configures unit for Internet 64k
&F10	Configures unit for Internet 128k
&F11	Configures unit for Remote 64k
&F12	Configures unit for Remote 128k
&F13	Configures unit for Leased V120
Network Options	
&L0	Dial network
&L1	Leased network
&L2	Leased, backed up by dial network

Command	Function
Calling Number Identifiers	
&N0	Number 1. Read far-end phone number 1 if service subscribed from telephone company.
&N1	Number 2. Read far-end phone number 2 if service subscribed from telephone company.
DTE Data Type Options	
&Q0	DTE is async
&Q1	DTE is sync
Clear-To-Send (CTS) Control Line Options	
&R0	Follows RTS
&R1	Forced CTS
Data Set Ready (DSR) Control Line Options	
&S0	DSR forced on
&S1	DSR if call up
&S2	DSR off if link down
&S3	DSR off if dial up
DTE Connector Data Synchronous Data Clocking Options	
&X0	Internal transmit clock
&X1	External transmit clock
Accessing Stored numbers for Dialing Options*	
&Z0	Stored number 0
&Z1	Stored number 1
&Z2	Stored number 2
&Z3	Stored number 3
&Z4	Stored number 4
&Z5	Stored number 5
&Z6	Stored number 6
&Z7	Stored number 7
&Z8	Stored number 8
&Z9	Stored number 9

Command	Function
Local Echo Options	
E0	Echo off. Does not allow command characters typed to be displayed on the screen.
E1	Echo on. Allows the command characters typed to be displayed on the screen.
Unit Identification	
I0	Identifies unit. Commands the unit to display model number.
I1	Identifies software. Commands the unit to display software version.
I2	Identifies lists.
AT Command Response Message Options	
Q0	Response messages on
Q1	Response messages off
AT Command Response Message Types	
V0	Numeric response messages
V1	Verbal response messages
AT Command Connect Message Options	
X0	Simple connect message
X1-7	Connect messages with bit rate
Ready-To-Send (RTS) Control Line Options	
_D0	1 mS delay
_D1	18 mS delay
MakeBusy Options	
_B0	Make DTE port not busy (same as S135=0)
_B1	Make DTE port busy (same as S135=1)
Service Profile Identification (SPID) Options	
_I0	Access SPID1 for DTE #1
_I1	Access SPID2 for DTE #2
Local Directory Number (LDN) Access Options	
_N0	Access LDN1 for DTE #1
_N1	Access LDN2 for DTE #2

Command	Function
ISDN Switch Type Options	
_S0	5ESS
_S1	DMS-100
_S2	National ISDN-1
ISDN U-interface Operational Mode Options	
_X0	ISU timing slaves to network (NT mode)
_X1	ISU is U-interface timing master (LT mode)
_Z	Resets unit.
Data Flow Control Options	
\Q0	No flow control
\Q1	Software flow control (XON/XOFF)
\Q2	CTS only
\Q3	Hardware flow control (RTS/CTS) factory default
\Q4	Software from DCE only

S-REGISTER LIST

Defaults appear in bold type in the third column.

S0	AUTO ANSWER	Determines how the Express NTU answers an incoming call. **0** = Disable (Express NTU does not answer call). 1 = Enable (Express NTU answers all calls). 2 = Dump all calls.
S2	ESCAPE CHARACTER	Determines which key or character (in ASCII code) defines the escape command. The standard escape character is a plus **(+)** sign (ASCII value of **43** decimal). To change the character set, set S2 to the desired ASCII value. Range = 0 to 127
S3	END OF LINE CHARACTER	Determines which key or character (in ASCII code) ends a command line. The standard end-of-line character is the carriage return (ASCII value of **13** decimal). Range = 0 to 127

S4	LINE FEED CHARACTER	Determines which key or character (in ASCII code) advances the cursor to the next line after ending a command line or after an Express NTU message. The standard character is the line feed (ASCII value of **10** decimal). Range = 0 to 127
S5	BACK SPACE CHARACTER	Determines which key moves the cursor back one space to erase a character. The standard character is the backspace (ASCII value of **8** decimal). Range = 0 to 127
S7	CONNECT TIME	Determines how long the Express NTU waits for an outgoing call to be answered. 15 = 15 seconds **30** = 30 seconds 60 = 1 minute 120 = 2 minutes 240 = 4 minutes
S12	ESCAPE TIME	Determines the delay required immediately before and after entering the escape command for the Express NTU to recognize and execute the command. Range = 0 to 127 (Default = **50**)
S14	MISC BITS	Miscellaneous bits (bit 8 is most significant bit). Bit 2 = 1:Enables on screen echo of AT commands. Bit 2 = 0:Disables on screen echo of AT commands. Bit 3 = 0:Enables AT responses from theExpress NTU. Bit 3 = 1:Disables AT responses from the Express NTU. Bit 4 = 1:Enables AT responses to be displayed in text form. Bit 4 = 0:Enables AT responses to be displayed in numeric form. Bit 7 = 1:Disable PPP ACCM spoofing. Bit 7 = 0:Enable PPP ACCM spoofing. Bit 8 = 1:Ring indicator uses cadence. Bit 8 = 0:Ring indicator remains on.
S15	ASYNC BONDING	Asynchronous BONDING method. **0** = ADTRAN revision 0 (default) 1 = Multi-vendor option
S22	MSG BITS	Miscellaneous message bits (bit 8 is most significant bit). Bit 5= Bit 6 = Bit 7 = 1 Allows connect message with baud rate. Bit 5= Bit 6 = Bit 7 = 0 Connect message without baud rate.

S24	V120 LLC	Enables/disables V120 lower layer compatibility (LLC). **0** = Enabled 1 = Disabled
S25	DTR DETECT TIME	Determines time, in hundredths of a second, that must elapse before the Express NTU recognizes a change in DTR. Range = 0 to 255 (Default = **5**)
S26	VOICE DEFAULT	Determines the speed at which an audio call is received **0** = 56k speech/audio to DTE port 1 = 64k speech/audio to DTE port
S27	PPP MODE	Value determines whether or not PPP will be a single-link or multilink connection. **0**=Single-link operation (default) 1=Multilink operation 2=Use compression
S30	DTE CTS	Controls the operation of the DTE connector CTS line. **0**=Follows RTS 1=Force CTS
S31	DTE RTS	Controls operation of the RTS line. **0**=1 ms delay 17=18 ms delay
S32	DTE DSR	Controls the operation of the Data Set Ready signal on the DTE connectors. **0**=Force DSR on always 1=DSR off OOS + Test 2=DSR off Link Down
S33	DTE CD	Controls the operation of the Carrier Detect line on the DTE connectors. **0**=Force CD on always 1=CD is active during a call (Normal Operation) 2=Off with LOCD 3=Off link down
S34	DTE DTR	Determines how the Express NTU responds to changes in DTR. This is a bit-mapped register. **0**=Ignore DTR 1=Force AT command mode when DTR is off 2=Dump incoming call when DTR is off 4=Hang up incoming call when DTR is off 8=Hang up outgoing call when DTR is off 16=Answer incoming call when DTR is on 28=Idle when off 32=Dial SN0 when DTR is on 64=Dial SN0 when DTR transitions from off to on

S35	DTE CONN	Determines which is the current operating DTE connector. 0=EIA-530 connector 1=V.35 connector **2**=EIA-232 connector (default for offline operation)
S40	BOND TXINIT	Specifies the number of seconds the originating endpoint attempts to detect the Async BONDING negotiation pattern from the answering endpoint before deciding the Async BONDING call has failed. 0 to 255 (Default = **10**).
S41	BOND TXFA	Specifies the number of seconds both endpoints attempt to detect the async BONDING frame pattern when a call is connected before deciding the async BONDING call has failed. When operating with other manufacturer's async BONDING equipment it may be necessary to lengthen this timer so that it matches TXADD01. 0 to 255 (Default = **10**)
S42	BOND TXADD01	The number of seconds both endpoints wait for the additional call to be connected at the end of negotiation before deciding the async BONDING call has failed. When dialing overseas it may be necessary to lengthen this timer to allow for slower call routing. 0 to 255 (Default = **50**)
S43	BOND TXDEQ	The number of seconds both endpoints attempt to equalize the network delay between the bearer channels before deciding the Async BONDING call has failed. 0 to 255 (Default = **50**)
S44	BOND TANULL	The number of seconds the answering endpoint attempts to detect the Async BONDING negotiation pattern from the originating endpoint before aborting to clear channel mode. It may be necessary to shorten this timer if the DTE equipment connected to the Express NTU also has timer constraints for completing non-BONDING parameter negotiation. 0 to 255 (Default = **10**)

S45	BOND TCID	The number of seconds both endpoints attempt to negotiate agreeable values for bearer channels and channel capacities before deciding the async BONDING call has failed. 0 to 255 (Default = **5**)
S46	V25 MODE	Selects the type of V.25 bis dialing used. **0**=Asynchronous V.25 1=HDLC V.25 2=BISYNC V.25 3=HDLC with flags V.25
S50	LINE MODE	Selects the operating mode of the Express NTU. **0**=Dial service (switched service) 1=Leased service (nonswitched service)
S51	LINE CLOCK	Selects the clock mode in leased mode. **0**=Slave (default) 1=Master (Leased line only, limited distance MODEM application only)
S52	SWITCH TYPE	Selects the network switch type for dial service. 0=AT&T 5ESS 1=Northern Telecom DMS-100 **2**=National ISDN-1 3=NEC
S53	CALL TYPE	Call type (Dial service only). 0=Speech 1=Audio 2=56 Kbps data **3**=64 Kbps data
S54	PROTOCOL TYPE	Rate adaption protocol type. **1**=Clear Channel 2=BONDING Mode 1 5=V.110 6=V.120 11=Fallback 12=PPP async-to sync conversion
S55	DIAL MODE	Selects dialing interface. **1**=AT commands 2=V.25 bis dialing
S56	ECHO TONE	Enables an echo tone which suppresses the echo cancellers in a voice circuit. Can be used to trick the switch to allow sending data over a line optioned for voice ISDN service. **0**=None 1=Answer 2=Originate 3=Both

S58	CALL SCREENING	Allows the Express NTU to screen incoming calls. **0**=Answer any call 1=Answer only calls from numbers matching those stored in SN0 through SN9.
S59	CHANNEL RATE	Sets the available network bandwidth when the Express NTU is in leased mode. **1**=64 kbps 2=128 kbps
SS60	SPID1 LOC	SPID string location.
SS61	SPID2 LOC	SPID string location.
SS62	LDN1 LOC	ISDN phone number string location.
SS63	LDN2 LOC	ISDN phone number string location
S65	AUTOSPID	Sets the AutoSpid determination feature. **0**=Disable (default) 1=Enable
SS67	AREA CODE	Area code location.
S70	DTE MODE	Selects asynchronous or synchronous mode on the DTE connector. 1=Asynchronous **2**=Synchronous
S71	DTE RATE	Selects the DTE connector bit rate. 3 = 1200 6 = 2400 8 = 4800 11 = 9600 15 = 19200 17 = 38400 18 = 48000 19 = 56000 20 = 57600 **21** = 64000 22 = 112000 23 = 115200 24 = 128000 25 = 230400
S72	DATA BITS	Selects the number of asynchronous data bits. **0** = 8 bits 1 = 7 bits
S73	DTE PARITY	Selects the number of asynchronous parity bits. **0**=None 1=Odd 2=Even

S74	DTE STOP	Selects the number of asynchronous parity bits. **0**=None 1=Odd 2=Even
S75	DTE FLOW	Selects asynchronous flow control. 0=None 1=XON/OFF from DTE controls DCE 2=XON/OFF from DCE controls DTE **3**=Hardware 12=Software
S76	DTE CLOCK	Selects DTE connector transmit clock timing source. **0**=Normal (Express NTU supplies timing) 1=External (DTE supplies timing)
SS77	REMOTE NUMERIC PASSWORD	Numeric password string for remote configuration.
The following are the string locations for stored numbers 0 - 9:		
SS80	SN0 LOC	Stored number 0 string
SS81	SN1 LOC	Stored number 1 string. Used for second number dialed in a multilink connection.
SS82	SN2 LOC	Stored number 2 string
SS83	SN3 LOC	Stored number 3 string
SS84	SN4 LOC	Stored number 4 string
SS85	SN5 LOC	Stored number 5 string
SS86	SN6 LOC	Stored number 6 string
SS87	SN7 LOC	Stored number 7 string
SS88	SN8 LOC	Stored number 8 string
SS89	SN9 LOC	Stored number 9 string
S90	CONFERENCE ID	NI-1 feature identification number for conferencing. See the ISDN service provider for this ID.
S91	TRANSFER ID	NI-1 feature identification number for transferring. See the ISDN service provider for this ID.
S92	MESSAGE WAITING ID	NI-1 feature identification number for message waiting indicator. See the ISDN service provider for this ID.
S93	CALL TYPE ROUTING	Determines how incoming call is routed when connected to a point-to-point ISDN line. 0=Route all call types to DTE

Appendix B Current Status Messages

This appendix lists the status line messages and their definitions. Messages shown entirely in capital letters are generated by the ISDN network. Messages with lower case letters are generated by the Express NTU.

Call Connect B1

Bearer channel 1 is connected and is active.

Call Connect B2

Bearer channel 2 is connected and is active.

CALL xxxxxxx

The ISU is calling phone number xxxxxxx.

DEACTIVATED

The network interface is not active.

DISCONNECTED

The network has activated layer 1 but layer 2 is inactive. To activate the unit a setup message must be sent or received.

DISCONNECTING

The current phone call is being disconnected (hung up).

Getting TEI #1

The ISU is receiving its first TEI from the network.

Getting TEI #2

The ISU is receiving its second TEI from the network.

ISDN-1 Ready

The ISU is connected to an ISDN-1 compliant switch and is ready to place / receive calls.

Link down

The network interface is not active.

Link In Sync

The ISU has successfully connected to the network but is waiting for the switch to issue the ACT bit.

LPBK DTE

The DTE connector is looped back in the DTE direction.

LPBK Netw

The Express NTU is in a customer initiated loopback.

LPBK Protcl.Net

The Express NTU has been commanded to perform a loopback in the network direction after letting the incoming data pass through the current protocol.

NEC Ready

The Express NTU is connected to an NEC switch and is ready to place / receive calls.

NET EOC LOOPBACK

The Express NTU has been commanded to perform an ISDN loop-back toward the network.

NET REM LOOPBACK

The Express NTU is performing a V.54 or DDS latching loopback toward the network.

Ready

The unit is ready to make or accept a call.

Register SPID #1

The Express NTU is registering its first SPID with the network.

Register SPID #2

The Express NTU is registering its second SPID with the network.

RINGING

The phone number just dialed is ringing.

xxxx nnnn

A rate adaption is running at the bit rate specified by nnnn.

xxxxx Quitting

A rate adaption protocol is turning off.

xxxxx Ready

A rate adaption protocol is ready.

xxxxx Setup

A rate adaption protocol is setting up.

xxxxx can be any <u>of the following:</u>

BONDING

Bandwidth on Demand Industry Users Group protocol.

CLEAR CHAN

No rate adaption protocol (allows use of maximum bandwidth).

FALLBACK

FALLBACK rate adaption protocol.

V110

V.110 rate adaption protocol.

V120

V.120 rate adaption protocol.

Appendix C Status Buffer Messages

Messages shown entirely in capital letters are generated by the ISDN network. Messages with lower case letters are generated by the Express NTU.

Answer 1/2

The ISU answered a call on either the first or second channel. The calling phone number is displayed if available.

ACCESS_INFO_DISCARDED

The network was unable to deliver access information to the far-end.

Back to online

Express NTU went back on line.

Bad async BPS

The BONDING protocol determined that the selected asynchronous bit rate is not supported.

Bad AT bit field

User issued an AT command with an argument that was out of range.

Bad B-channel

Bonding negotiation determined the delay in one of the Bearer channels was not correctable.

Bad call type

Express NTU placed a call with an improper call type.

Bad DTE baud

The DTE bit rate does not match a valid bit rate for the protocol selected.

Bad DTE bps

Bonding negotiation determined the chosen DTE bit rate is invalid.

BAD_INFO_ELEM

Call control error.

Bad phone number

Express NTU attempted to call an invalid phone number.

BaudRate

Express NTU does not support the negotiated TLINK baud rate.

BEAR_CAP_NOT_AVAIL

The bearer channel requested by the user is not available.

Bearer mode

Incoming call is not of a type the Express NTU can accept.

Bearer info mode

Incoming call information transfer capability is not known.

BONDING (+/- XXX)

The amount of bytes of corrected delay between the B2 and B1 bearer channels (XXX can range from -8000 to +8128 bytes).

BPS mismatch

Bonding negotiation found a bit rate mismatch.

Break to AT cmd

User issued a break-in request (+++).

Break ignored

User issued an extra break-in request.

BUSY

The called number is busy.

Call not ringing

User executed an answer command (ATA) but there was not a call present.

CALL_REJECTED

The call has been rejected by the ISDN network.

Can't go online

Express NTU cannot go back on line. User issued an unknown AT command.

CAP_NOT_IMPLEMENTED

The network or far-end does not support the bearer capability requested.

CHAN_DOES_NOT_EXIST

The bearer channel requested is not present.

CHAN_NOT_IMPLEMENTED

The bearer channel requested has not been implemented.

CHANNEL_UNACCEPTABLE

The channel requested has not been subscribed.

CID>0 rcvd

Received an incoming call from a third party during negotiations with a far-end BONDING unit on the use of the second Bearer channel.

DEST NOT ISDN

The number called is not ISDN (warning only).

DEST_OUT_OF_ORDER

The called number is out of order.

Dial1/2

The Express NTU placed a call on either the first or second channel. The number called is displayed following the message.

Discon1/2

The call on either the first or second channel was disconnected from the network. The far-end phone number is displayed if available.

Disconnect Req

Far-end unit disconnected during BONDING negotiation.

DPUMP END RCVD

Indication of a hang-up or disconnect occurring during BONDING. Does not indicate an error condition has occurred.

DTE must be SYNC

For the protocol chosen, the DTE connector must be optioned as synchronous.

DTE not set V25

The DTE equipment is not optioned for the same bit rate as the Express NTU for V.25 bis dialing.

DTR not up

Express NTU tried to place a call in a dialing mode that requires DTR to be in an active state but it is not.

Dump call

Express NTU could not accept an incoming call because it was already involved in a call.

Dump1/2

An incoming call on either the first or second channel was discarded by the ISU. The calling number is displayed if available.

FACILITY_REJECTED

A facility requested cannot be provided by the network.

FACILITY_NOT_SUBSCRIBED

The channel type requested has not been subscribed.

FALLBACK ERROR

Attempt to fallback to normal mode failed.

FBW disconnect

BONDING negotiation has failed due to a disconnect on a B-Channel.

FlowCtl mismatch

Bonding negotiation determined a flow control mismatch.

FlowCtl required

Bonding negotiation determined that flow control needs to be optioned on.

Hangup1/2

The call on either the first or second channel was disconnected by the Express NTU. The far-end phone number is also displayed.

INCOMMING_CALL_BARRED

The network will not allow an incoming call.

INCOMPATIBLE_DEST

The called number cannot accept the type of call that has been placed.

INTRWORKING _UNSPEC

A message was sent by a far-end network that was not understood.

INVALID_CALL_REF

Call control error.

INVALID_ELEM_CONTENTS

Call control error.

INVALID_MSG_UNSPEC

Invalid message, protocol error.

INVALID_NUMBER_FORMAT

The dialed number has an invalid format.

L1 not up

The network interface is not active.

L2 not up

The data link layer interface is not active.

L3 not up

The call control interface is not active.

L2 #2 not up

The data link layer interface for a second call (BONDING) is not active.

L3 #2 not up

The call control layer interface for a second call (BONDING) is not active.

LDN TOO LONG

The local directory number entered has too many digits.

MANDATORY_IE_LEN_ERR

Mandatory information element length error.

MANDATORY_IE_MISSING

Mandatory information element missing.

Need 2 B chan

The DTE bit rate requires the BONDING protocol.

Need 64K call

The BONDING protocol requires the Express NTU to be configured for a 64kbps data call type.

Negotiation fail

The BONDING negotiation has failed.

NETWORK BUSY

The ISDN switch is busy and unable to process a call.

NETWORK_CONGESTION

The phone network is currently congested.

NETWORK_OUT_OF_ORDER

The phone network is out of order.

No 48K Support

The Express NTU does not support 48 kbps TLINK. Local DTE setup error.

NO_CIRCUIT_AVAILABLE

The requested bearer channel is not available.

NONEXISTENT_MSG

Nonexistent message was sent by the Express NTU.

No Sreg number

Attempt to access an S-register without specifying a specific

S-register (example: ATS=1).

No Sreg value

Attempt to change an S-register without specifying a value (example: ATS2=).

NO_ROUTE

The phone network was unable to find a route to the destination number.

NO_USER_RESPONDING

The dialed number is not responding.

NORMAL_CLEARING

The network is disconnecting the current call.

NOT end2end ISDN

The path that the call was routed over is not ISDN from end-to-end (warning only).

NUMBER_CHANGED

The number dialed has been changed.

OUTGOING_CALL_BARRED

The network will not allow the outgoing call to be placed.

PROTOCOL_ERROR

Call control error.

REQ_CHANNEL_NOT_AVAIL

The channel type requested is currently not available.

Remote not ISU

Bonding negotiation determined the far-end unit is not another ISU (asynchronous rates can only be supported between two ADTRAN ISUs).

RESP_TO_STAT_ENQ

Response to status inquiry.

Ring 1/2

An incoming call on either the first or second channel entered the Ring state. The calling phone number is displayed if available.

S cmd not = or ?

User did not use proper syntax.

SERVICE_NOT_AVAIL

The requested service is not available.

SOURCE NOT ISDN

The incoming calling party is not ISDN (warning only).

SReg SetError

Local DTE invalid S-register setting.

Sync BPS < 56K

The synchronous bit rate selected is too slow for the BONDING protocol.

Synch Mismatch

Both ends Bad Synchronization.

TAINIT expired

Bonding timer TAINIT expired.

TANULL expired

Bonding timer TANULL expired, non BONDING equipment attempted to call into the Express NTU while optioned for BONDING.

TEMPORARY_FAILURE

The network has temporarily failed, try the call again.

TIMER_EXPIRY

Call control error.

TXADD01 expired

Bonding timer TXADD01 expired, probably making a long distance call to a foreign country; adjust timer value to correct.

TXFA1 expired

Bonding timer TXFA1 expired, other vendor's BONDING equipment did not operate properly.

TX FLOW ERROR

Flow control needs to be enabled.

TXFA2 expired

Bonding timer TXFA1 expired; other vendors BONDING equipment did not operate properly.

TXINIT expired

Bonding timer TXINIT expired, called non-BONDING equipment.

UNASSIGNED_NUMBER

The phone number dialed does not exist.

Unknown AT & cmd

User issued an unknown AT command.

UNSPECIFIED_CAUSE

Received a cause message from the network that is not understood.

Unsupported baud

The Express NTU does not support the negotiated baud rate.

USER_BUSY

The dialed number is busy.

V120 timeout

The far end unit is not set up for V.120.

V120 connected

The V.120 rate adaption successfully connected to the far-end unit.

WRONG_MESSAGE

Call control error.

WRONG_MSG_FOR_STATE

Call control error.

Appendix D LEDs

LEDS

The Express NTU front panel contains five LEDs associated with the DTE port and the ISDN interface as shown in Figure D-1 and described in Table D-1.

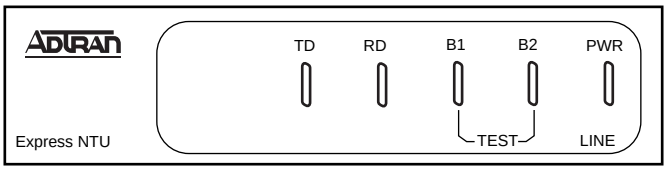


Figure D-1. Front Panel LEDs

Table D-1. Express NTU LEDs

LED	Color	Description
B1 or B2	Slow Green Flash Fast Green Flash Off Solid Green Solid Amber Amber Flash	Attempting SPID registration Attempting TEI registration Ready. No data traffic. B Channel passing data (in use) Loopback protocol test (one or both channels) Remote test originate
PWR/Line	Green (On Solid) Off Flashing	Link Established. Calls can be placed. No Power Link is not established. Calls cannot be placed.
TD	Green	Transmit Data (TxD)
RD	Green	Received Data (RxD)

Appendix E Connector Pinouts

Table E-1. EIA-232 Interface

Pin	Name	I/O	Description
1	Shield	I/O	Shield for cable
2	TD	I	Transmitted Data
3	RD	O	Received Data
4	RTS	I	Request to Send
5	CTS	O	Clear To Send
6	DSR	O	Data Set Ready
7	SG	I/O	Signal Ground
8	CD	O	Carrier Detect
9	NC	N/A	No Connection
10	NC	N/A	No Connection
11	NC	N/A	No Connection
12	NC	N/A	No Connection
13	NC	N/A	No Connection
14	NC	N/A	No Connection
15	TC	O	Transmit Clock
16	NC	N/A	No Connection
17	RC	O	Receive Clock
18	NC	N/A	No Connection
19	NC	N/A	No Connection
20	DTR	I	Data Terminal Ready
21	NC	N/A	No Connection
22	RI	O	Ring Indicator
23	NC	N/A	No Connection
24	ETC	I	External Transmit Clock
25	NC	N/A	No Connection

I= Input, O= Output, N/A= Not Applicable

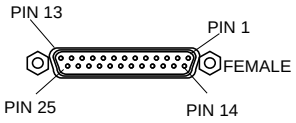


Table E-2. EIA-530 Interface

Pin	Name	I/O	Description
1	Shield	I/O	Shield for cable
2	TD-A	I	Transmitted Data
3	RD-A	O	Received Data
4	RTS-A	I	Request to Send
5	CTS-A	O	Clear To Send
6	DSR-A	O	Data Set Ready
7	SG	I/O	Signal Ground
8	CD-A	O	Carrier Detect
9	RC-B	O	Receive Clock (return)
10	CD-B	O	Carrier Detect (return)
11	ETC-B	I	External Transmit Clock (return)
12	TC-B	O	Transmit Clock (return)
13	CTS-B	O	Clear To Send (return)
14	TD-B	I	Transmit Data (return)
15	TC-A	O	Transmit Clock
16	RD-B	O	Receive Data (return)
17	RC-A	O	Receive Clock
18	NC	N/A	No Connection
19	RTS-B	I	Request To Send (return)
20	DTR-A	I	Data Terminal Ready
21	NC	N/A	No Connection
22	DSR-B	O	Data Set Ready (return)
23	DTR-B	I	Data Terminal Ready (return)
24	ETC-A	I	External Transmit Clock
25	NC	N/A	No Connection

I= Input, O= Output, N/A= Not Applicable

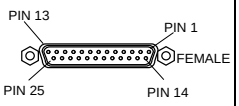
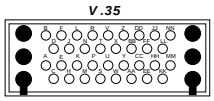


Table E-3. V.35 Interface

Pin	Name	I/O	Description
A	Shield	I/O	Shield for cable
B	SG	I/O	Signal Ground
C	RTS	I	Request To Send
D	CTS	O	Clear To Send
E	DSR	O	Data Set Ready
F	CD	O	Carrier Detect
H	DTR	I	Data Terminal Ready
J*	RI	O	Ring Indicator
P	SD-A	I	Send Data
R	RD-A	O	Receive Data
S	SD-B	I	Send Data (return)
T	RD-B	O	Receive Data (return)
U	TC-A	I	External Transmit Clock
V	RC-A	O	Receive Clock
W	TC-B	I	External Transmit Clock (return)
X	RC-B	O	Receive Clock (return)
Y	ST-A	O	Send Timing
AA	ST-B	O	Send Timing (return)
K,L	NC	N/A	No Connection
M,N	NC	N/A	No Connection
BB	NC	N/A	No Connection
CC	NC	N/A	No Connection
DD	NC	N/A	No Connection
EE	NC	N/A	No Connection
FF	NC	N/A	No Connection
HH	NC	N/A	No Connection
JJ	NC	N/A	No Connection
KK	NC	N/A	No Connection
LL	NC	N/A	No Connection
MM	NC	N/A	No Connection
NN	NC	N/A	No Connection



**Pin J (ring indicator) is needed for most video conferencing applications.*
I= Input, O= Output, N/A= Not Applicable

Table E-4. RJ-45 ISDN Interface

Pin 4	Ring	
Pin 5	Tip	

Appendix F Upgrading Software

As features are added to the Express NTU, software upgrades may be necessary. The Express NTU has flash memory which allows the software to be upgraded from a file obtained by contacting ADTRAN Technical Support. The current version of software can be found in the Status menu.

To upgrade your Express NTU, a PC running a terminal program supporting XMODEM/CRC is required. Connect the PC to the Express NTU DB25 connector, then set it to 57600 baud, no parity, and one stop bit. Power off the Express NTU and perform the following steps:

1. Type the following AT command: `AT!flashload.`
2. Start downloading. Select the download item from the menu.
3. When the flash is erased, the Express waits for XMODEM/CRC transfer to begin.
4. Use the terminal emulation software to begin uploading the file provided by ADTRAN.
5. The Express performs a checksum to verify the download.
6. A failure to load will be indicated on the terminal. Power the Express off and begin again with step 1.

Acronyms

B (Channel) .....A 64 kbps digital information channel
BONDING .....Bandwidth On Demand Interoperability Group
bps.....Bits per second
BRI .....Basic Rate Interface
CCITT.....Consultative Committee for International Telegraphy and Telephony
CD .....Carrier Detect
CIC.....Carrier Identification Code
CPE.....Customer Premises Equipment
CTS .....Clear to Send
DCE.....Data Communications Equipment
DDS .....Digital Data Service
DMA.....Direct Memory Access
DMS.....Digital Multiplex Switching
DSR.....Data Set Ready
DTE.....Data Terminal Equipment
EIA .....Electronic Industries Association
FEBE.....Far End Block Errors
ID .....Identification
I/O .....Input/Output
ISDN.....Integrated Services Digital Network
kbps .....Kilobits per second
kHz.....Kilohertz
LAN .....Local Area Network
LATA.....Local Access and Transport Area
LDN .....Local Directory Number
LLC.....Low Layer Compatibility (ISDN)
Mbps.....Megabits per second
MF .....Multi-Frequency Signalling
NEBE..... Near End Block Errors

NI-1 ..... National ISDN-1
NI-2 ..... National ISDN-2
NT ..... Network Termination
PBX..... Private Branch Exchange
PC ..... Personal Computer
POTS..... Plain Old Telephone Service
RAM ..... Random Access Memory
ROM ..... Read Only Memory
SPID..... Service Profile Identifier
SS7..... Signalling System 7
TA..... Terminal Adapter
TE ..... Terminal Equipment
TEI..... Terminal Endpoint Identifier
WAN ..... Wide Area Network

Glossary

ANSI
American National Standards Institute.

B Channel
64 kbps bearer channel used for voice, circuit, or packet switched data.

bearer service
As defined by CCITT standards, a type of telecommunication service that provides the capability for the transmission of information between user-to-network interfaces. Bearer services defined for ISDN are circuit mode and packet mode.

BONDING mode 1 Protocol
Industry standard B -channel aggregation protocol. Developed by the Bandwidth on Demand Interoperability Group.

CCITT
Consultative Committee for International Telephony and Telegraphy. A body of the International Telegraph Union (ITU) which prepares recommendations, commonly referred to as international standards, to resolve technical telegraph and telephone problems.

central office (CO)
In telephony, the phone company switching facility or center, usually a Class 5 end office, at which subscribers' local loops terminate. Handles a specific geographic area, identified by the first three digits of the local telephone number. Usually the facilities of the local BOC.

clear channel
A channel in which all the 64 kbps are used for transmission. To achieve this, bit robbing signalling must be eliminated.

common channel interoffice signalling (CCIS)
A signalling system developed for use between stored program switching systems. All of the signalling information for a group of trunks is transmitted over a dedicated high-speed data link rather than on a trunk. CCIS reduces call setup time compared to individual trunk signalling.

conditioning
Extra cost options that users may apply to leased or dedicated voice grade 3002-type Telco data circuits, where line impedance is carefully balanced. Allows for higher-quality or speed data transmission. Allows improved line performance in frequency response and delay distortion.

D-channel
The ISDN channel that carries signalling information to control the call setup, teardown, or invocation of supplementary services. The D-Channel may also be used to provide packet mode data service.

DDS
Dataphone Digital Service. AT&T private line service for transmitting data over a digital system. The digital transmission system transmits electrical signals directly, instead of translating the signals into tone of varied frequencies as with traditional analog transmission systems. Digital techniques provide more efficient use of transmission facilities, resulting in lower error rates and costs than analog systems.

digital hub
Designated office where DDS channels are interconnected and where synchronous network timing, testing access, and additional service features are provided.

digital loopback
Technique for testing the digital processing circuitry of a communication device. May be initiated locally or remotely via a telecommunication circuit. Device being tested will echo back a received test message after first decoding and then encoding it. The results are compared with the original message.

four-wire circuits
Telephone lines using two wires for transmitting and two wires for receiving, offering much higher quality than a 2-wire circuit. All long distance circuits are 4-wire. Almost all local phone lines and analog phones are 2-wire.

group 4
A high-speed (56 kbps) facsimile protocol specific to ISDN.

hub
(1) Communications center, (2) major routing station for connecting channels, (3) DDS connecting center.

in-band signalling
Signalling made up of tones which pass within the voice frequency band and are carried along the same circuit as the talk path being established by the signals. Virtually all signalling (request for service, dialing, disconnect, etc.) in the U.S. is in-band signalling. Most of that signalling is MF (multi-frequency) dialing. The more modern form of signalling is out-of-band.

interexchange carrier
Any carrier registered with the FCC authorized to carry customer transmissions between LATAs interstate, or if approved by a state public utility commission, intrastate. Includes carriers such as AT&T Communications, Satellite Business Systems, GTE Telenet, GTE Sprint, and MCI.

information element
The name for the data fields within an ISDN layer 3 message.

interworking
Communication between two types of networks or end equipment. This may or may not involve a difference in signalling or protocol elements supported.

ISDN
Integrated Services Digital Network. A network architecture that enables end-to-end digital connections. The network supports diverse services through integrated access arrangements and defines a limited set of standard, multipurpose interfaces for equipment vendors, network providers, and customers. Interworking with a public switched telephone network is retained.

jitter
The slight movement of a transmission signal in time or phase that can introduce errors and loss of synchronization for high-speed synchronous communications. See phase jitter.

LATA
Local Access and Transport Area. One of 161 local telephone serving areas in the United States, generally encompassing the largest standard statistical metropolitan areas. Subdivisions established as a result of the AT&T divestiture that now distinguish local from long distance service. Circuits with both end-points within the LATA (intraLATA) are generally the sole responsibility of the local telephone company, while circuits that cross outside the LATA (interLATA) are passed on to an interexchange carrier.

loopback
A diagnostic procedure where data is sent to the device being tested, and the output of the device is fed directly back to its input, looped around, and the returning data is checked against that which was sent.

message
The layer 3 information that is passed between the CPE and SPCS for signalling.

multidrop
A communications arrangement where multiple devices share a common transmission channel, though only one may transmit at a time.

multiplexing
The combining of multiple data channels onto a single transmission medium. Any process through which a circuit normally dedicated to a single user can be shared by multiple users. Typically, user data streams are interleaved on a bit or byte basis (time division) or separated by different carrier frequencies (frequency division).

multipoint circuit
A circuit consisting of three or more stations connected directly electrically.

narrowband ISDN
A collective term for BRA (basic rate access) and PRA (primary rate access) at speeds up to 1.544 Mbps.

NCTE
Network Channel Terminating Equipment. Equipment considered necessary for terminating a telephone circuit or facility at the customer premise on the regulated side of the demarcation. FCC decisions have established that most NCTE is CPE and may therefore be supplied by third-party vendors.

NEXT (Near-End Crosstalk)
Unwanted energy transferred from one circuit to an adjoining circuit. Occurs at the end of the transmission link where the signal source is located. The absorbed energy is usually propagated in the direction opposite to the absorbing channel's normal current flow. Caused by high-frequency or unbalanced signals and insufficient shielding.

non-ISDN line
Any connection from a CPE to a SPCS that is not served by D-Channel signalling.

non-ISDN trunk
Any trunk not served by either SS7 or D-Channel signalling.

NT1
Network Termination 1. A unit that provides physical and electromagnetic termination of the U-interface 2-wire transmission line. Converts between layer 1 formats used at the U- and T- reference points, and performs some maintenance functions.

NT2
Network Termination 2. A unit that provides switching and concentration of subscriber lines at the S-interface. This unit performs the functions of a customer premises switch or multiplexer to multiplex B-channel(s) and D-channel(s) onto one physical path and to route calls to the appropriate B or D-channel.

phase jitter
In telephony, the measurement in degrees out-of-phase that an analog signal deviates from the reference phase of the main data-carrying signal. Often caused by alternating current components in a telecommunications network.

PRA
Primary Rate Access. Connects high-capacity CPE, such as PBXs, to the network. In the U.S., this is composed of twenty-three 64 kbps channels and one 64 kbps D-channel. Also known as primary rate interface (PRI).

point-to-point
Describes a circuit connecting two points directly with no intermediate processing nodes or computers (although switching facilities could exist). A type of connection that links two logical entities (i.e., phone-line circuit).

regenerate
To restore a signal to original shape. Signals need to be restored because they become distorted and acquire noise as they travel or are transmitted. Analog signals cannot be regenerated because it is very hard for telecommunications equipment to distinguish between unwanted noise and wanted noise. Digital signals can be more easily regenerated since they consist of 1s and 0s. If digital signals are flattened or distorted, a simple logic circuit can restore the signal to the original clean square shape.

R-reference point
Non-ISDN (TE2) terminal equipment connects to ISDN at the R-Reference point through a terminal adaptor.

RS-232-C
An EIA-specified physical interface with associated electrical signalling between DCE and DTE. The most commonly employed interface between computer devices and modems.

RS-422-A
Electrical characteristic of balanced-voltage digital interface circuits.

RS-423-A
Electrical characteristics of unbalanced-voltage digital interface circuits.

RS-449
General purpose 37-position and 9-position interface for data terminal equipment and data circuit-terminating equipment employing serial binary data interchange.

RS-449-1
Addendum 1 to RS-449.

serving area
Region surrounding a broadcasting station where signal strength is at or above a stated minimum. The geographic area handled by a telephone central office facility. Generally equivalent to a LATA.

S-interface
S-Reference point. The interface that connects an ISDN terminal (TE1) or Terminal Adapter (TA) to the NT2 reference point as defined in the I.411 Recommendation.

SPCS
Stored Program Controlled Switch. A digital switch that supports call control, routing, and supplementary services provision under software control. All ISDN switches are SPCSs.

synchronous
(1) The condition occurring when two events happen in a specific time relationship with each other, both under control of a master clock; (2) A method of data transmission requiring the transmission of timing pulses to keep the sender and receiver synchronized in their communication used to send blocks of information. Synchronous data transmission is used in high speed data circuits because there is less overhead than asynchronous transmission of characters which contain two extra bits per character to effect timing.

T1
Also T-1. A digital transmission link with a capacity of 1.544 Mbps. T1 uses two pairs of normal twisted wires. T1 normally can handle 24 voice conversations with each conversation being digitized at 64 kbps. With more advanced digital voice encoding techniques, it can handle more voice channels. T1 is a standard for digital transmission in North America.

T1C
3.152 Mbps. Capable of handling 48 voice conversations. T1C is further up the North American digital carrier hierarchy.

T2
6.312 Mbps. Capable of handling 96 voice conversations. T2 is four times the capacity of T1.

T3
44.736 Mbps. Commonly referred to as 45 Mbps. Capable of handling 672 voice conversations. T3 runs on fiber optic and is typically called FT3.

TA
Terminal Adaptor. A DCE that connects to the ISDN S-Interface and enables non-ISDN terminal equipment to communicate over the ISDN line.

TE1
Terminal Equipment Type 1. ISDN-compatible terminals.

TE2
Terminal Equipment Type 2. Non-ISDN terminal equipment linked at the RS-232, RS-449, or V.35 interfaces.

tandem
The connection of networks or circuits in series. The connection of the output of one circuit to the input of another.

T-interface
T-Reference point. Performs the same function as the S-Interface but uses an NT1, rather than an NT2.

twisted pair
Two wires twisted around each other to reduce induction (interference) from one wire to the other. Several sets of twisted pair wires may be enclosed in a single cable. Twisted pair is the normal cabling from a central office to your home or office, or from your PBX to your office phone. Twisted pair wiring comes in various thicknesses. As a general rule, the thicker the cable is, the better the quality of the conversation and the longer the cable can be and still get acceptable conversation quality. However, the thicker it is, the more it costs.

2B+D
The Basic Rate Interface (BRI) in ISDN. A single ISDN circuit divided into two 64 kbps digital channels for voice or data and one 16 kbps channel for low speed data (up to 9600 baud) and signalling. 2B+D is carried on one or two pairs of wires depending on the interface, the same wire pairs that today bring a single voice circuit into your home or office. See ISDN.

23B+D
In ISDN, also known as the Primary Rate Interface. A circuit with a wide range of frequencies that is divided in twenty-three 64 kbps paths for carrying voice, data, video, or other information simultaneously. It bears a remarkable similarity to today's T1 link, except that T1 carries 24 voice channels. In ISDN, 23B+D gives twenty-three channels and one D-channel for out-of-band signalling. However, in T1, signalling is handled in-band. See ISDN.

two-wire circuit
A transmission circuit composed of two wires, signal and ground, used to both send and receive information. In contrast, a 4-wire circuit consists of two pairs. One pair is used to send. One pair is used to receive. All trunk circuits (long distance) are 4-wire. A 4-wire circuit delivers better reception, but also costs more. All local loop circuits (those coming from a Class 5 central office to the subscriber's phone system) are 2-wire, unless a 4-wire circuit is requested.

U-interface
A twisted pair subscriber loop that connects the NT1 reference point to the ISDN network, as defined in the I.411 Recommendation. This interface provides Basic Rate Access with an operating frequency of 160 kbps and an information rate of 144 kbps. Under U.S. regulations, this also marks the line of demarcation between customer-owned equipment and the public network.

V.32
9.6 kbps 2-wire duplex modem standard.

video conferencing
The real-time, usually two-way, transmission of digitized video images between two or more locations. Video conferencing requires a wideband transmission facility. Transmitted images may be freeze-frame (where television screen is repainted every few seconds to every 20 seconds) or full motion. Bandwidth requirements for two-way video conferencing range from 6 MHz for analog, full-motion, full-color, commercial grade TV to 56 kbps for digitally-encoded freeze-frame to 1.544 kbps for very good quality, full-color, full-motion TV.

wideband
Generally, a communications channel offering a transmission bandwidth greater than a voice grade channel. Data transmission speeds on wideband facilities are typically in excess of 9.6 kbps and often at rates such as 56 kbps and 1.544 Mbps.

X.25
A packet data transfer protocol for the B and D Channels. Defines the interface between data terminal equipment and data circuit terminating equipment for terminals operating in the packet mode and connected to public data networks by dedicated circuits.

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Product Support Information

Presales Inquiries and Applications Support

Please contact your local distributor, ADTRAN Applications Engineering, or ADTRAN Sales:

Applications Engineering	(800) 615-1176
Sales	(800) 827-0807

Post-Sale Support

Please contact your local distributor first. If your local distributor cannot help, please contact ADTRAN Technical Support and have the unit serial number available.

Technical Support	(888) 4ADTRAN

Repair and Return

If ADTRAN Technical Support determines that a repair is needed, Technical Support will coordinate with theCustomer and Product Service (CaPS) department to issue an RMA number. For information regarding equipment currently in house or possible fees associated with repair, contact CaPS directly at the following number:

CAPS Department	(256) 963-8722

Identify the RMA number clearly on the package (below address), and return to the following address:

ADTRAN, Inc.
CAPS Department
6767 Old Madison Pike
Progress Center
Building #6, Suite 690
Huntsville, AL 35807

RMA # _____