



ISU EXPRESS

128 kbps ISDN Service Unit User Manual

Part Numbers

1202081L1	ISU Express, Data Only
1202081L3	ISU Express with POTS Option
1202081L4	ISU Express with POTS and Modem Options
1202081L5	ISU Express with 2xPOTS Option
1202081L8	ISU Express S/T, 110V
1202081L9	ISU Express S/T, 230V
1202081L10	ISU Express S/T with POTS Option, 110V
1202081L11	ISU Express S/T with POTS Option, 230V

Trademarks:

ISU is a trademark of ADTRAN, Incorporated.

Macintosh is a registered trademark of Apple Computer, Incorporated.

Windows is a registered trademark of Microsoft Corporation.

5ESS is a registered trademark of AT&T.

DMS-100 is a trademark of Northern Telecom.



901 Explorer Boulevard
P.O. Box 140000
Huntsville, AL 35814-4000
Phone: (205) 963-8000

© 1997 ADTRAN, Inc.
All rights reserved.
Printed in USA.

FCC regulations require that the following information be provided to the customer in this manual.

1. If your telephone equipment (ISU Express) causes harm to the telephone network, the Telephone Company may discontinue your service temporarily. If possible, they will notify you in advance. If advance notice is not practical, you will be notified as soon as possible. You will be advised of your right to file a complaint with the FCC.
2. Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of your equipment. If they do, you will be given advance notice so as to give you an opportunity to maintain uninterrupted service.
3. If you experience trouble with this equipment (ISU Express), please contact ADTRAN (see inside back cover) for repair/warranty information. The telephone company may ask you to disconnect this equipment from the network until the problem has been corrected, or until you are sure the equipment is not malfunctioning.
4. This unit contains no user-serviceable parts.

To ADTRAN service personnel: For continued protection against risk of fire, replace F1 with the same type and rating of fuse *only*: .2 A, 250 V.

**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 in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio or TV reception, which can be determined by turning the equipment off and on. The user is encouraged to try to correct the interference by one or more of the following measures:

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



Changes or modifications not expressly approved by ADTRAN will void the user's authority to operate this 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 numérique respecte les limites de bruits radioélectriques applicables aux appareils numériques de Class B prescrites dans la norme sur le matériel brouilleur: "Appareils Numériques," NMB-003 édictée 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.

Caution: 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.

Table of Contents

Quick Startup Guide	1
Chapter 1. Understanding ISDN and the ISU Express	3
ISDN Overview	3
The ADTRAN ISU Express	3
ISU Express Interoperability	8
Recommended Operating Protocols	8
Chapter 2. ISDN Ordering Codes (IOCs)	11
Chapter 3. Installation	15
Network Connection	15
DTE Data Connection	16
Telephone Connection	16
Basic Telephone Service	16
Supplementary Services	16
DTMF Keypad	16
Customer Premises Wiring	18
Chapter 4. Configuration	21
Getting Started	21
Menu Navigation	22
Using ISDN Basic Rate Switched Service	25
Configuring the ADTRAN ISU Express for Dial Operation	25
Switch Type	25
Call Type	25
Speech	25
Audio	25
Data 56kbps	26
Data 64kbps	26
Service Profile ID (SPID)	26
Local Directory Number (LDN)	27
Dial Options	27
AT commands	27
V.25 bis	27
Disabled	28

Chapter 4. Configuration (cont.)

Auto Answer	28
Disabled	28
Enabled	28
Dump all calls	28
Answer Tone	28
No Answer tone (Default)	29
Incoming tone	29
Outgoing tone	29
Always tone	29
Connect Timeout	29
Call Screening	29
Call Routing	30
All Types -> DTE	30
Speech -> POTS	30
Speech/Audio -> POTS	30
Configuring the ISU Express for Leased Digital Service	31
Clock mode: Slave/Master	31
Channel rate	31
Options for Both Leased and Switched ISDN Service	32
DTE Options	32
Bit Rate	32
RTS Options	32
CTS Options	32
CD Options	32
DTR Options	33
DSR Options	33
Flow Control for Asynchronous Data	33
Data Format for Asynchronous Data	34
Transmit Clock for Synchronous Data	34
Setting Protocol Options	35
Clear Channel	36
BONDING mode 1	36
TXINIT	37
TXFA	37
TXADD01	37
TXDEQ	37
TANULL	37
TCID	37

Chapter 4. Configuration (cont.)

V.120	37
V.32 bis	37
Error Control (Error Ctrl)	39
Compression	39
Microcom™ Network Protocol Block Size (MNP Blk Size)	39
DSU 57.6 ASYNC	39
T-Link	39
Simple Asynchronous Protocol (SAP)	40
FALLBACK	40
Point-to-Point Protocol (PPP) Async-to-Sync	42
Configuring the ISU Express Using Quick Setup	43
Dial 56K sync	43
Dial 64K sync	44
Dial 112K sync	44
Dial 128K sync	45
V32 19.2 async	45
Dial 57.6 asyn	46
Dial 115.2 asyn	46
Fallback 57.6K	47
More	47
Leased 128K	47
Ldm 128 Master	48
Factory Setup	48
VT 100 Terminal Dialing Options	50
Hang up line	50
Dial number	50
Redial last Number	50
Answer Call	50
Dial stored Number	50
Store/Review Number	50
AT Commands	51
Using an AT Command	52
Using S-Registers	52
Reading an S-Register	52
Reading an S-Register String	52
Changing an S-Register	53
Changing a String S-Register	53
Dialing a Call Using the AT Command Processor	53

Chapter 4. Configuration (cont.)	
Configuring the ISU Express for V.25 bis In-Band Dialing	59
SYNC V.25 Dialing	60
SYNC V.25 HDLC Dialing	60
SYNC V.25 BISYNC Dialing	61
The Status Buffer	61
Test Options	61
Loopback DTE	62
Loopback Network	62
Loopback Protocol	62
Loopback Remote	63
Test Remote	63
Loopback Disable	64
Near End Block Errors/Far-End Block Errors (NEBE/FEBE)	64
Chapter 5. Troubleshooting	65
If Self Test fails	65
If the ISU Express Does Not Read Ready	65
If You are Unable to Connect Calls	71
Chapter 6. Specifications	73
Specifications and Features	73
Appendix A. Loop Status Messages	77
Appendix B. Status Buffer Messages	79
Appendix C. S-Register List	85
Appendix D. Connector Pinouts	95
Appendix E. Ordering ISDN Without IOCs	97
ISDN Service Ordering Information	98
Local Interface Requirements	101
Physical Interface	101
Local Service Requirements	101
Long Distance Service Requirements	102
Deciding What Services to Order	102
5ESS Custom Line Additional Parameters	103
DMS-100 Protocol Version 1 Line Additional Parameters	105

After Your Service is Installed	106
Setting Up the ISU Express for a New Line	106
Appendix F. Upgrading Software	109
Acronyms	111
Glossary	115
Index	125

List of Tables

Table 1-A	DTE Indicators	6
Table 1-B	ISDN and Analog Modem Recommended Operating Modes	8
Table 3-A.	Using the Flash-Hook	17
Table 4-A	Rate Adaption Protocols	41
Table 4-B	AT Commands	54
Table 5-A	Troubleshooting Calls	71
Table A-A	Status Messages	77
Table B-A	Status Buffer Messages	79
Table D-A	EIA-232 Interface	95
Table D-B	RJ-45 ISDN U DIAL	96
Table E-A	5ESS Features	103
Table E-B	DMS Features	105

List of Figures

Figure 1-1	ADTRAN ISU Express	4
Figure 1-2	ADTRAN ISU Express Rear Panel	5
Figure 3-1	Wiring Scheme 1	19
Figure 3-2	Wiring Scheme 2	20
Figure 4-1	Terminal Interface Menu Screens	23
Figure 4-2	ISU Express Loopback Points	63

Quick Startup Guide

Before configuring the ISU Express, be sure the telephone service has provided the switch type, service profile ID (SPID), and local directory number (LDN)

Example: Switch Type: National ISDN-1
SPID1 20555512120100
SPID2 20555512130100
LDN1 5551212
LDN2 5551213

Connect a VT 100 async terminal, or personal computer with a terminal emulator, to the RS-232 port.

1. Type AT, carriage return (Enter). Watch for an OK response.
2. Type AT!V, carriage return (Enter).
3. When the terminal displays the configuration menu, enter the assigned SPIDs and LDNs, and switch type.
4. Connect the ISDN line.
5. From the configuration menu, a call can be placed using the Ctl + D command. Ctl + X exits the VT 100 terminal interface and places the unit on-line.
6. To return to the configuration menu while on-line, type +++ or press TEST on the ISU Express to go off line. Then, type AT!V.



NOTE

If you are on-line in synchronous data mode or setup for V.25 bis dialing, press Test on the ISU Express to enter the terminal setup screen. Then, connect an asynchronous terminal to the RS-232 port and type AT!V, carriage return (Enter).

Chapter 1

Understanding ISDN and the ISU Express

ISDN OVERVIEW

The Integrated Services Digital Network (ISDN) is a public or private switched digital network. ISDN is an international standard for digital communications, allowing a full range of enhanced services supporting voice, data, and image applications through standard interfaces over a single telephone wire. ISDN provides a means of integrating these services and modernizing communication networks for information movement and management efficiency.

THE ADTRAN ISU EXPRESS

The ISU™ Express (ADTRAN ISDN Service Unit) is a stand-alone device that connects data terminal equipment (DTE) and dual tone multifrequency (DTMF) telephone equipment to the ISDN network or to a leased line. The ISU Express includes built-in network termination and terminal adapter functionality. The ISU Express meets the Microsoft Windows® 95 Plug-and-Play specifications. The file `MDMADTN.INF` is required. To obtain this file, contact ADTRAN technical support as shown on the inside back cover of this manual.

See Figure 1-1 for an illustration of the ISU Express.

The ISU Express provides four basic functions:

1. High speed synchronous ISDN modem using one or both bearer (B) channels (up to 128 kbps utilizing BONDING protocol). Part numbers 1202081L1, L3, L4, L5, L8, L9, L10, and L11.
2. High speed asynchronous ISDN modem using one or both B-channels (up to 115.2 kbps, no flow control, using BONDING protocol). Part numbers 1202081L1, L3, L4, L5, L8, L9, L10, and L11.
3. Analog V.32 bis/V.42 bis modem using one B-channel to communicate to analog data service (for example, Bulletin Board Systems). ISU Express with V.32 bis/V.42 bis modem option, part number 1202081L4.
4. Plain old telephone service (POTS) for DTMF analog devices (telephones, modems, fax machines, etc.). The ISU Express can ring up to two POTS devices when the cable distance between the units is no greater than 100 feet. ISU Express POTS option, part number 1202081L3, L4, L5, L10, and L11.

From the network, ISDN is delivered by a single 2-wire 2B1Q U-interface which is connected directly to the ISU Express. ISDN network termination is designed into the ISU Express, eliminating the need and expense of a separate NT1. For network testing, the ISU Express responds to NT1 test commands from the telephone company central office (CO).

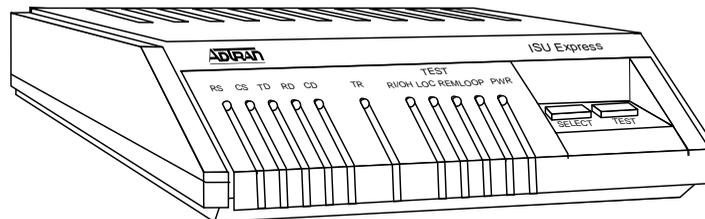


Figure 1-1
ADTRAN IS U Express

The ISU Express transmits data over an EIA-232 interface with a maximum cable length of six feet. The ISU Express performs at synchronous data transfer rates of 2400 bps to 128 kbps and asynchronous rates of 300 bps to 115.2 kbps. At rates over 64 kbps, the BONDING (Bandwidth on Demand Interoperability Group) delay equalization protocol synchronizes data over the two 64 kbps B-channels. The ISU Express supports the transfer of data and images over ISDN. The ISU Express may be viewed as an ISDN *dial modem* that allows cost-effective, high-speed data transmission at rates up to 128 kbps.

The ISU Express has one RJ-45 jack, labeled **ISDN BRI U** or **ISDN BRI S/T** on the rear panel for network connection (see Figure 1-2). ISDN basic rate service divides a standard telephone line into three digital channels capable of simultaneous voice and data transmission. The three channels are comprised of two bearer (B) channels at 64 kbps and one data (D) channel at 16 kbps, known as 2B+D.

The ISU Express 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, a dedicated connection, a nailed-up connection, a private circuit, or a limited distance modem connection. Leased connection or leased application is used in this manual to represent these types of services.

If the ISU Express is equipped with optional POTS interfaces, the rear panel RJ-11 jacks labeled **PHONE** are used for connection to DTMF analog devices such as an analog telephone or a fax machine.

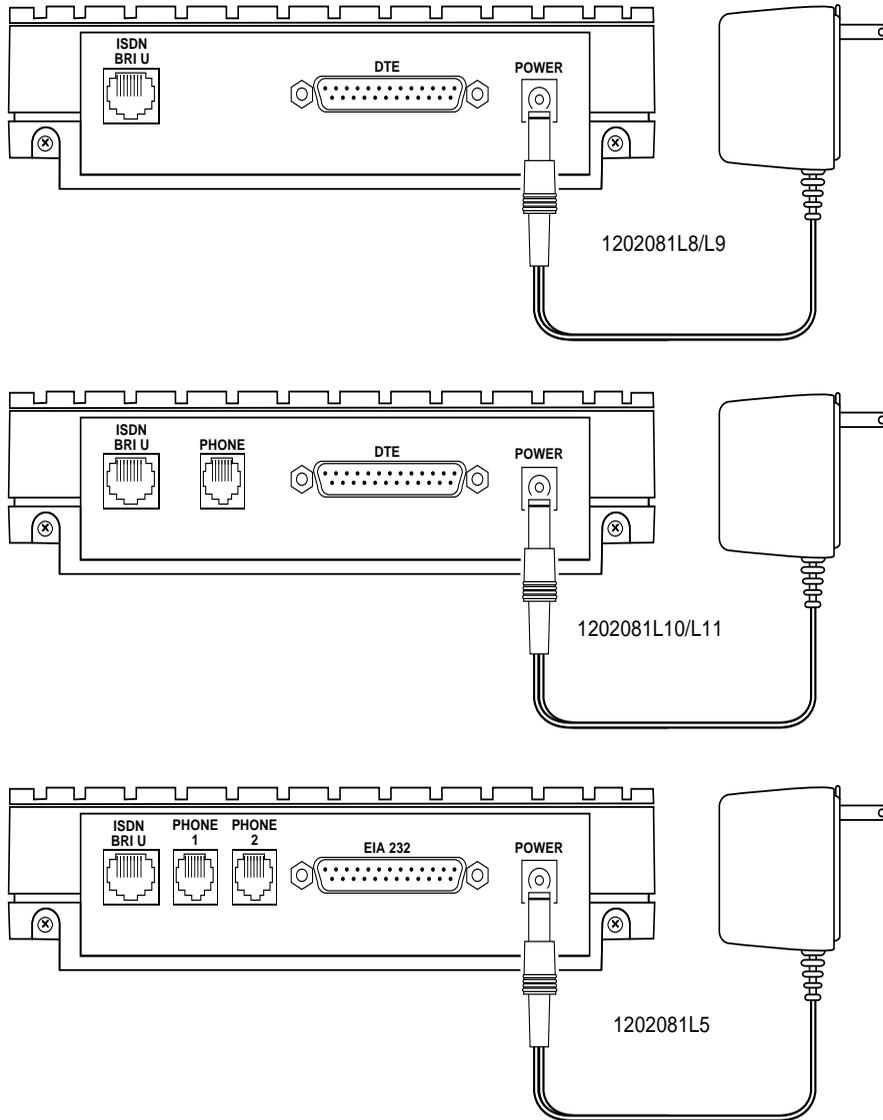


Figure 1-2
ADTRAN ISU Express Rear Panels

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

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

Seven LED indicators located on the front panel of the ISU Express monitor data flow and display the status of key DTE interface leads as described in Table 1-A.

Table 1-A
DTE Indicators

Indicator	Definition
RS	Request to send. Indicates that the DTE is ready to transmit.
CS	Clear to send. Indicates that the ISU Express is ready to transmit.
TD	Transmit data. On when the DTE is transmitting to the ISU Express.
RD	Receive data. On when the ISU Express is receiving data from the far end.
CD	Carrier detect. Indicates that the ISU Express is connected to a remote unit.
TR	Data terminal ready from DTE. On when DTR is active at DTE interface.
RI/OH	Ring indicator. Flashing indicates incoming call is ringing. On the 1202081L2-L5 this LED also indicates DTE off-hook status.

ISU EXPRESS INTEROPERABILITY

Telephone networks are evolving from analog technologies to digital technologies such as ISDN. This transition is time-consuming and costly for telephone companies. Upgrading all locations and facilities is a lengthy process.

The ISU Express bridges this transition by supporting communications with existing and future network services and equipment. The ISU Express supports communications with Switched 56 service and Switched 56 DSUs (2-wire and 4-wire) as well as various ISDN terminal adapters, ISDN terminal equipment, PPP-compatible bridges/routers, and BONDING mode 1-compatible inverse multiplexers.

RECOMMENDED OPERATING PROTOCOLS

The ISU Express 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-B are recommended. As noted in Table 1-B, all asynchronous rates support flow control. However, the 115200 rate (only with SAP/V.120 and a 64 kbps circuit type) requires the use of flow control.

Table 1-B 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-B
ISDN and Analog Modem
Recommended Operating Modes

Call Type	Sync/Async	Protocol	Rates													
			3000	1200	2400	4800	9600	19200	38400	48000	56000	64000	115200	128000	144000	
Dial-64K	SYNC	BONDING									√		√			
		CLEAR CHAN								√	√		√			
		V.120					√	√	√	√						
		TLINK			√	√	√	√			√		√			
		SAP								√						
	ASYNC	PPP ASYNC-SYNC	√	√	√	√	√	√	√			√			√	f
		CLEAR CHAN			√	√	√	√	√			√				
		V.120		√	√	√	√	√	√			√			√	f
		TLINK		√	√	√	√	√								
		SAP								√		√				√
Dial-56K	SYNC	BONDING										√				
		CLEAR CHAN								√	√					
		V.120					√	√	√	√						
		TLINK			√	√	√	√			√					
	ASYNC	PPP ASYNC-SYNC	√	√	√	√	√	√	√			√			√	
		CLEAR CHAN			√	√	√	√	√			√				
		DSU 57.6										√				
		V.120		√	√	√	√	√	√			√			√	f
TLINK		√	√	√	√	√										
DIAL-64K*2 (64K call type with two B channels)	SYNC	BONDING														√
	ASYNC	BONDING													√	
DIAL-56K*2	SYNC	BONDING												√		
	ASYNC	BONDING													√	
DIAL AUDIO†	ASYNC	V.32 BIS	√	√	√	√	√	√	√	f	f		√	f	√	f
LEASED 64K	SYNC	CLEAR CHAN									√	√		√		
		SAP			√	√	√	√	√							
	ASYNC	DSU 57.6										√				
		SAP		√	√	√	√	√	√			√			√	f
LEASED 128K	SYNC	CLEAR CHAN														√
	ASYNC	SAP										√			√	



NOTE

Notes to Table 1-B:

1. *All asynchronous rates support flow control*
2. *All dial-up modes support VT 100 terminal, 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.*
5. *† - Available only in ISU Express with V.32 bis analog modem option.*

Chapter 2

ISDN Ordering Codes (IOCs)

ISDN is a very complex service with many network options. Obtaining service from your local telephone company and long distance providers is sometimes complicated.

ISDN Ordering Codes (IOCs) have been developed to simplify 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. After reviewing the following list, order your ISDN line from the local service provider. Request the appropriate IOC for your application. If your local service provider does not support IOCs, see the appendix, *Ordering ISDN Without IOCs*.

Capability S (previously **Generic Data M**) ordering code is recommended for ISU Express applications. It is the most feature-rich and supports most voice and data applications. However, 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, then **Capability R** (previously **Generic Data I**) may be more cost-effective.

ADTRAN has registered the following ISDN ordering codes to support a variety of tariffs and applications:

Capability S (previously Generic Data M)

- 2B service
- Both B-channels alternating voice and data
- Two directory numbers

Example: ISU Express with POTS and Modem Option
P/Ns 1202081L1, L3, L4, L5, L8, L9, L10, L11

Applications

- 115.2 or 128 kbps data
- 56/64 kbps data with voice or modem capability
- Generic 115.2/128 kbps data transfer, including remote access and LAN/WAN connectivity and telecommuting

Capability R (previously Generic Data I)

- 2B service
- Data only
- Two directory numbers

Example: ISU Express, data only versions
P/Ns 1202081L1, L8, and L9

Applications

- 115.2 or 128 kbps data only, no voice capability
- 115.2 or 128 kbps data transfer applications, including remote access and LAN/WAN connectivity, telecommuting

B1 (previously Generic Data B)

- 1B service
- Data only
- One directory number

Capability C (previously Generic Data C)

- 1B service
- Alternating voice and data
- One directory number

I2 (previously Generic Data I-1DN)

- 2B service
- Data only
- One directory number



NOTE

I2 is not available for services provided by a Northern Telecom switch. Two directory numbers are required for 2B operation. In this case, use Capability R.

J3 (previously Generic Data J-1DN)

- 2B service
- 1B alternating voice/data, 1B data only
- One directory number



NOTE

J3 is not available for services provided by a Northern Telecom switch. Two directory numbers are required for 2B operation. In this case, use J2.

J2 (previously Generic Data J)

- 2B service
- 1B alternating voice/data, 1B data only
- Two directory numbers

M5 (previously Generic Data M-1DN)

- 2B service
- Both B-channels alternating voice and data
- One directory number



NOTE

*M5 is not available for services provided by Northern Telecom or AT&T switches. Two directory numbers are required for 2B operation. In this case, use **Capability S**.*

Chapter 3

Installation

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 Repair and Return department (see end of manual).

NETWORK CONNECTION

The ISU Express supports either dial or leased operation. A single RJ-45 modular jack labeled **ISDN BRI U** on the rear panel of the ISU Express provides connection to either network service.

For the ISU Express S/T (with the jack labeled **ISDN BRI S/T**), an NT1 must be connected between the Express and the network.

Dial operation uses the ISDN Basic Rate interface and allows the ISU Express to dial out over the ISDN network.

The leased mode of operation supports dedicated 2B1Q data service at rates up to 128 kbps by using a nailed up circuit, or a permanent connection between end points. This connection could be a limited distance modem or a point-to-point connection.

See the appendix *Connector Pinouts* for network connection pin assignments.

DTE DATA CONNECTION

Data terminal equipment (DTE) is connected to the ISU Express by using the EIA-232 interface connector. The maximum recommended cable length is six feet. The pin assignments for the DTE interfaces are shown in the appendix *Connector Pinouts*.

TELEPHONE CONNECTION

Basic Telephone Service

The ISU Express supports an analog DTMF telephone type (AT&T 2500) with the optional POTS interface, part number 1202081L3, L4, L5, L10, or L11. The telephone or other analog device like a fax machine or modem plugs into an RJ-11 jack labeled **PHONE** located on the rear of the unit. Using a multipoint line allows the POTS and data port to have unique phone numbers. On the 1202081L3 and L4, the SPID programmed into SPID2 is associated with the analog telephone. On the 1202081L5, SPID1 is phone number 1 and SPID2 is phone number 2.

Supplementary Services

Supplementary services such as call holding, three- or six-way conferencing, call transfer, and call waiting are fully supported by the ISU Express on a touch-tone telephone. Table 3-A explains how the flash-hook is used for handling multi-call situations.

DTMF Keypad

The following functions are performed on a touch-tone phone:

- Disable call waiting: Press * 0
- Enable call waiting: Press * 1
- Redial last number: Press * 5

Table 3-A
Using the Flash-Hook

<p>Calling a second party with an active call.</p> <p>Flash-hook to place active call on hold and dial new number. Hanging up will terminate the call.</p>
<p>Answering an incoming call with an active call at call waiting.</p> <p>Flash-hook to place active call on hold and answer incoming call. Hanging up will terminate both calls.</p>
<p>Conferencing Calls.</p> <p>With an outgoing call on hold and a second outgoing call active, flash-hook to conference calls. Hanging up will transfer second call.</p> <p>With an incoming call on hold and outgoing call active, flash-hook to conference calls. Hanging up will transfer calls.</p> <p>With two incoming calls, one on hold and one active, flash hook to conference calls. Hanging up transfers calls.</p>
<p>Answering calls on hold and holding incoming active calls.</p> <p>Flash-hook places the incoming call on hold and reconnects to outgoing call. Hanging up will terminate both calls.</p>



When connecting to a National ISDN 1 switch, call conferencing and call transferring are assigned a unique feature identifier number. This number may not be the same in all areas. S-registers 90 and 91 contain the feature identifier numbers for conference and transfer. If these features do not work, contact your ISDN provider. They can determine what the numbers are for these features, and they can then be programmed into the ISU Express.

Customer Premises Wiring

Customer premises wiring requirements for the ISU Express vary depending on the application and existing wiring. It may be simpler for the ISDN provider to deliver another line to your location. This would eliminate the need to modify existing wiring. Figures 3-1 and 3-2 illustrate two wiring scheme possibilities.

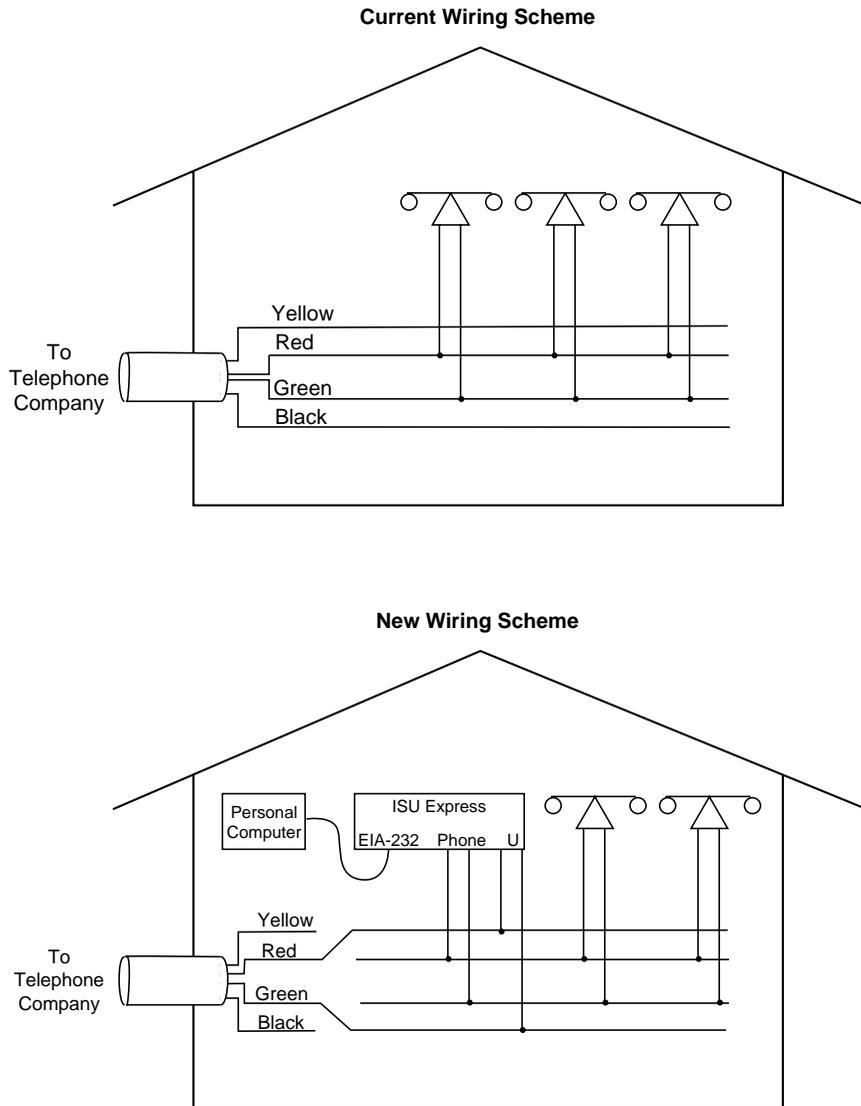


Figure 3-1
*Wiring Scheme 1:
Use existing analog telephone equipment, but replace
single analog telephone service with ISDN service.*

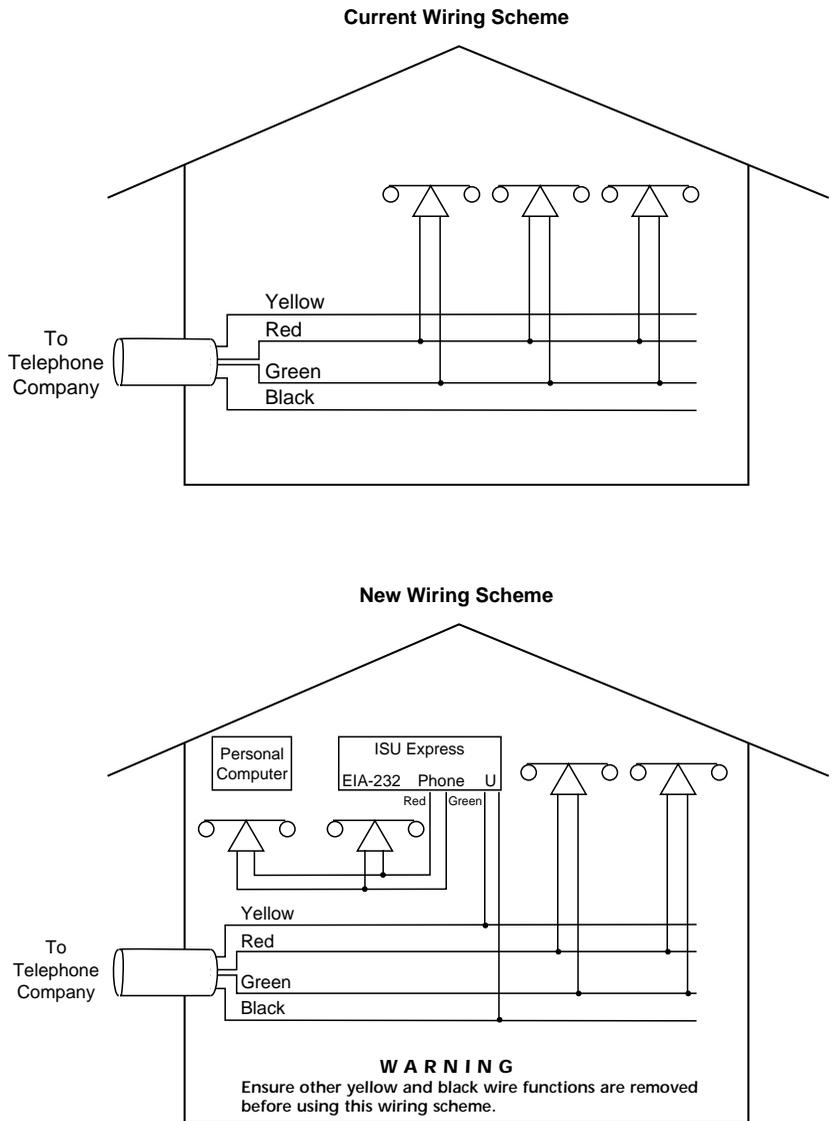


Figure 3-2
*Wiring Scheme 2:
Retain single analog telephone
service and add ISDN service*

Chapter 4

Configuration

GETTING STARTED

Prior to operating the ISU Express, configure the unit properly in one of the following manners: (1) Use the built-in ISU Express 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 port located on the rear panel of the unit.

Connect the ISU Express to an ISDN U-line supplied by the local exchange carrier (LEC), then to the ISDN BRI U connector located on the rear panel of the unit.

To default to factory configuration while powering up the ISU Express, hold down the **SELECT** and **TEST** keys until the **PWR** LED flashes.

The ISU Express has a DTE rate adjustment feature which automatically adjusts the asynchronous bit rate on the EIA-232 connector to match that of the connected terminal. For any terminal rate from 300 bps through 115.2 kbps, type **AT** and **RETURN**. The ISU Express will adjust to that rate.

The ISU Express initiates a self test upon power up. A continuously flashing **LOC** LED signifies a problem has been detected.

When connected to an ISDN U-line, the LOOP LED illuminates and remains on. This signifies that the ISDN U-link is up and the ISU Express is ready for operation. If the LOOP LED does not illuminate and remain on, check your network connections. If the LED remains off, layer one of the link was not successfully established. If the LOOP LED flashes continuously, layer one of the link is established, but layers two and three are not.

MENU NAVIGATION

When connected to an asynchronous VT 100 terminal or VT 100 terminal emulator, use the built-in ISU Express menu system for configuration. To enter into the menus, type **AT!V** **Return**. To go to a particular menu, simply press the *hot key* for that menu. The main branches of the menu tree and their hot keys are:

STATUS (Ctl + V)
TEST (Ctl + T)
CONFIG (Ctl + C)
DIAL (Ctl + D)



NOTE

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

Figure 4-1 shows each menu as it appears on the VT 100 terminal. To exit the menus, press **Ctl + X**. The **Ctl + X** command also places the unit back on-line if a call is connected.

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



NOTE

For reading ease, selectable menu items and messages displayed on the ISU Express menus are in bold type as they appear on the terminal screen.

```

                                ISU EXPRESS Configuration Menu
1) NETWORK options = Dial Line      17) CTS Options = Forced CTS
2) Switch type = National ISDN1    18) CD Options = Normal
3) Call type = Data 64Kbps         19) DIR Options = Idle when Off
4) SPID 1 = 0555100001            20) DSR Options = DSR forced on
5) SPID 2 = 0555300001            21) Flow Control = No Flow Ctrl
6) LDN 1 = 5551000                22) Data Bits = 8 Data bits
7) LDN 2 = 5553000                23) Parity Bits = None
8) Dial options = AT commands      24) Stop Bits = 1 Stop bit
9) Auto answer = Enabled           25) PROTOCOL = U.120
10) Answer tone = No Answer tone   26) QUICK setup
11) Connect Timeout = 1 Minute
12) Call Screening = Answer any
13) Call Routing = Speech/Audio->POTS
14) DTE options = Asynchronous
15) Bit Rate = 9600
16) RTS Options = 1 ms delay
-----
Select = _                        Enter SELECT      Esc NO CHANGE
-----
Ct1-U STATUS   Ct1-T TEST   Ct1-C CONFIG   Ct1-D DIAL   Ct1-X EXIT

```

Configuration Menu

```

                                ISU EXPRESS Status Menu
UNII/LOOP STATUS                   STATUS BUFFER
Loop Rate      = Data 64Kbps        1 = EMPTY
DTE Rate       = 9600                2 = EMPTY
DTE Format      = Asynchronous        3 = EMPTY
Test Status    = No Test             4 = EMPTY
Self Test      = Passed              5 = EMPTY
Software Rev   = ISU Ver A.13        6 = EMPTY
Checksum       = fa23                7 = EMPTY
Loop Status    = Link down           8 = EMPTY
Num Dialed     = No Call             9 = EMPTY
RTS            = ON                  10 = EMPTY
CTS           = OFF                  11 = EMPTY
DCD           = OFF                  12 = EMPTY
DTR           = ON                   13 = EMPTY
                                14 = EMPTY
                                15 = EMPTY
                                16 = EMPTY
                                17 = EMPTY
                                18 = EMPTY
                                19 = EMPTY
                                20 = EMPTY
-----
Ct1-U STATUS   Ct1-T TEST   Ct1-C CONFIG   Ct1-D DIAL   Ct1-X EXIT

```

Status Menu

Figure 4-1
Terminal Interface Menu Screens

```
ISU EXPRESS Test Menu
ENABLE/DISABLE TESTS
7> Lpbk = U54 Accepted

TEST
1> Loopback DTE
2> Loopback Network
3> Loopback Protocol
4> Loopback Remote
5> Test Remote
6> NEBE/FEBE
Menu option: _

Ct1-U STATUS   Ct1-I TEST   Ct1-C CONFIG   Ct1-D DIAL   Ct1-X EXIT
```

Test Menu

```
ISU EXPRESS Dial Menu

1> Hang up line
2> Dial number
3> Redial last #
4> Answer Call
5> Dial stored #
6> Store/Review #
Menu option: _

Ct1-U STATUS   Ct1-I TEST   Ct1-C CONFIG   Ct1-D DIAL   Ct1-X EXIT
```

Dial Menu

Figure 4-1
Terminal Interface Menu Screens (cont.)

USING ISDN BASIC RATE SWITCHED SERVICE

This section explains how to configure the ISU Express using the built-in menu system with ISDN basic rate switched service. After starting the terminal emulation package, type `AT!V` and press `Enter`. Enter the Configuration menu by typing `Ctrl + C`.

Configuring the ADTRAN ISU Express for Dial Operation

To place ISDN modem calls, analog modem calls, or plain old telephone service (POTS) calls over ISDN, the unit must be configured for **Dial Line**.

Switch Type

Find out what kind of ISDN switch your local CO is using by asking your telephone administrator or your telephone company representative. The ISU Express can be configured for a Northern Telecom DMS-100, AT&T 5ESS[®] CO switch, a switch conforming to the National ISDN-1 standard (usually an AT&T 5ESS, NTI DMS-100[™], or Siemens EWSD), or an NEC Switch. The Express S/T will also support Euro ISDN, VN4, TDX, KDD, and NTT switch types.

Call Type

The Call type can be configured four different ways, depending on the type of service used.

Speech

Speech directs the call control software to request a Mu-law speech circuit as the bearer capability for outgoing calls. The **Speech** option is used with an ISDN line configured for voice service. In some areas, voice service costs less than data service. A **Speech** call type does not guarantee an end-to-end digital connection with some local and long distance carriers.

Audio

Audio directs the call control software to request a 3.1 kHz audio circuit as the bearer capability for outgoing calls. The **Audio**

option is used with an ISDN line configured for voice service. In some areas, audio service is less expensive than data service. Selecting an **Audio** call type guarantees a digital end-to-end ISDN connection. Use the **Audio** call type with the optional V.32 bis analog modem.

Data 56kbps

Data 56kbps directs the call control software to request a 64 kbps data circuit that is rate-adapted to 56 kbps. **Data 56kbps** is intended for use in circumstances where interoperability with Switched 56 service is desired.

Data 64kbps

The default call type for ISDN service is **Data 64kbps**. This directs the call control software to request an unrestricted 64 kbps circuit.

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 ISU Express 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.

Example: SPID 1 = 0 1 9 2 2 4 3 2 3 0
 SPID 2 = 0 1 9 2 2 4 3 2 4 0

PREFIX SUFFIX



NOTE

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

Local Directory Number (LDN)

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
```



NOTE

Dial Options

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

The ISU Express supports two in-band dialing options described as follows. The option will not take effect until exiting the VT 100 interface (Ctrl+X).

AT commands

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

V.25 bis

Configuring the ISU Express 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.



NOTE

*In **synchronous mode**, the ISU Express 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 re-enter the VT 100 interface for re-configuration, troubleshooting or to view the status buffer, press the **Test** button on the front panel of the unit (this enables the AT command mode). Type **AT!V** to activate the terminal interface.*

Disabled

This selection disables in-band dialing over the DTE interface.

Auto Answer

The ISU Express auto answer parameter can be configured in one of the following three ways.

Disabled

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

Enabled

When **Enabled** is selected, the ISU Express 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). If the unit is configured for a call that uses only one B-channel, such as 56 kbps or 64 kbps, the ISU Express will accept an incoming voice call on the secondary phone number (SPID2, LDN2).

Dump all calls

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

Answer Tone

The **Answer tone** option should be set to the **No Answer tone** default. This option is used in the ISU Express with the V.32 bis/V.42 bis modem option (part number 1202081L4).

The **Answer tone** option enables the transmission of a modem answer tone at the start of voice and audio calls. The purpose of this tone is to disable echo suppression and echo canceling on the circuit in order to get a clear digital circuit. This may be necessary on some long distance circuits. The specifics of the tone are 4 seconds, 2100 Hz at a -10 dB level, with phase reversals every 475 ms.

No Answer tone (Default)

This option disables the answer tone on incoming calls.

Incoming tone

Enables the answer tone on incoming calls.

Outgoing tone

Enables the answer tone on outgoing calls.

Always tone

Enables the answer tone on either incoming or outgoing calls.

Connect Timeout

Connect Timeout sets the length of time that the ISU Express waits for a far-end unit to answer an outgoing call.

Call Screening

Call Screening allows the ISU Express to answer all incoming calls (default) or 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 ISU Express displays the Call ID for all dumped calls in the Status buffer. See the section *The Status Buffer* in the chapter *Configuration* 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. Select **Ansr if SN0. . .9** under **Call Screening**.
2. Store your seven-digit number in SN0.
3. Place a call to the ISU Express with the stored number to see

if it answers.

4. If the ISU Express 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.
5. Re-store the number in SN0 as it is displayed in the Call ID message and test **Call Screening** again.

Call Routing

The ISU Express can route incoming calls based on the call type. This menu item only appears on an L3, L5, L10, or L11 (dual POTS) Express configured for an ISDN point-to-point line.

All types - DTE

The Express routes all calls to the DTE.

Speech - POTS

Speech call types are routed to the POTS interface.

Speech/Audio - POTS

Speech and Audio call types are routed to the POTS interface.

CONFIGURING THE ISU EXPRESS FOR LEASED DIGITAL SERVICE

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

Follow this step-by-step procedure to configure the ISU Express for leased line clock mode, channel rate, and DDS loopbacks.

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**

By configuring the ISU Express for **Master** timing, the ISU Express 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 ISU Express 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 ISU Express configured for **Master** timing. If two ISU Express units are connected through channel banks, both units should be configured for **Slave** mode.

The maximum mixed gauge cable length between two ISU Express units operating in leased line mode is 18,000 feet.

Channel rate

In **Leased Line** operation, the data rate for the ISU Express can be configured for 64 kbps or 128 kbps. 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.

OPTIONS FOR BOTH LEASED AND SWITCHED ISDN SERVICE

This section describes the options that apply to both leased digital service and dial operation.

DTE Options

From the DTE Options parameter, select asynchronous or synchronous.



NOTE

Ensure the DTE equipment is set for asynchronous operation before attempting to make an asynchronous call. Failure to do so causes the call attempt to fail.

Bit Rate

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, 12000, and 128000 bps.

RTS Options

Selecting **1 MS delay** causes the clear to send (CTS) signal to change states 1 millisecond after the DTE ready to send (RTS) signal changes states. The **18 MS delay** causes the CTS signal to change state 18 milliseconds after the DTE RTS signal changes state.

CTS Options

Selecting **Forced On** causes the CTS signal on the DTE connector to be continually asserted. Selecting **Follows RTS** causes the CTS signal to follow the state of the RTS lead.

CD Options

Selecting **CD Forced on** causes the carrier detect (CD) signal to always be asserted. Selecting **Normal** causes the CD signal to be asserted when a call has been successfully established. Selecting **Off with LOCD** causes the CD signal to be disasserted for a period of 5 seconds, then reasserted at the termination of a call. Selecting **Off with Link Down** causes the CD signal to be disasserted when the U-interface is not present.

DTR Options

Selecting **Ignore DTR** causes the ISU Express 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*. 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.

DSR Options

Selecting **DSR forced on** causes the data set ready (DSR) signal on the DTE connector to always be asserted. Selecting **OFF Idle+Test** causes DSR to be disasserted if the network interface is in test or there is not an active call. **OFF Link Down** causes DSR to be disasserted if the network interface is disrupted

Flow Control for Asynchronous Data

Selecting **Hardware Flow Control** allows RX data to be pre-

sented to the DTE interface only when RTS is asserted. **Software Flow** control uses XON/XOFF to control data transferred between the DTE and the ISU Express. Selecting **No Flow Ctrl** disables flow control.

Data Format for Asynchronous Data

Use the following options allow the user to select the format of the asynchronous data. A frame consists of a start bit, 7 or 8 **Data bits**, 0 or 1 **Parity bit**, and 1 to 2 **Stop bits**.

Data Bits

These options select the number of data bits in each asynchronous frame. A frame has 7 or 8 data bits.

Parity Bits

The **None** option selects no parity bits in each asynchronous frame. A frame has 0 or 1 parity bit. The **Odd** option selects an odd parity bit in each asynchronous frame. The **Even** option selects an even parity bit in each asynchronous frame.

Stop Bits

These options select the number of **Stop bits** sent in each asynchronous frame. A frame has 1 to 2 stop bits.

Transmit Clock for Synchronous Data

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

With the **External** option selected, the ISU Express slaves to an external transmit timing source. The external clock is provided to the ISU Express by the external transmit clock signal at the DTE EIA-232 connector (ETC pin 24). This signal is echoed by

the ISU Express to the transmit clock signal on the DTE EIA-232 connector (TC pin 15).

This option is provided for situations where equipment connected to the ISU Express DTE connector cannot slave to the ISU Express-provided clock. The ISU Express uses the U-interface as the frequency standard when it must provide a synchronous receive or transmit clock.



NOTE

The externally provided clock must be of the same average frequency as the clock that the ISU Express would provide if internal clock were selected. If this is not the case, bit errors may occur.

SETTING PROTOCOL OPTIONS

The ISU Express communicates with many different types of telecommunication equipment including other ISU Express units, ISDN terminal adapters, Switched 56 DSUs, BONDING mode 1-compatible inverse multiplexers, PPP-compatible bridges/routers, and V.32 bis-compatible analog modems (optional).

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

- BONDING mode 1
(Bandwidth on Demand Interoperability Group)
- TLINK (Dial DDS DSU/CSU)
- SAP (Simple ADTRAN Protocol)
- Clear Channel (no rate adaption protocol)
- CCITT V.120
- DSU 56.7 Async (for communication with ADTRAN DSUs)
- V.32 bis (for communicating with V.32 bis/V.42 bis analog modems). This protocol option requires optional analog modems to be installed.
- Point-to point protocol (PPP) asynchronous to synchronous

conversion

See the section *Recommended Operating Protocols* in the chapter *Understanding ISDN and the ISU Express* for more information on recommended modes of operation.

The desired protocol may be selected with AT commands at the DTE port or from the ISU Express built-in menu system. A description of protocols follows.

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 ISU Express 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.

BONDING mode 1

The **BONDING mode 1** protocol allows the ISU Express to communicate at bit rates in excess of 64 kbps to a maximum of 128 kbps. **BONDING** provides high-speed communication between ISU Express 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 ISU Express 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.

The timers are defined as follows:

TXINIT

This option specifies the length of time the originating endpoint attempts to detect the BONDING negotiation pattern from the answering endpoint before deciding the BONDING call has failed. In general, this timer value should be left at the factory default setting of 10 seconds. Select from values of 1, 2, 5, 10 (default), 20, 50, 100, and 200 seconds.

TXINIT = 10 sec (def)

TXFA

This option specifies the length of time both endpoints attempt to detect the BONDING frame pattern when a call is connected before deciding the BONDING call has failed. In general, this timer value should be left at the factory default setting of 10 seconds. However, when interoperating with other manufacturers' BONDING equipment it may be necessary to lengthen this timer so that it matches TXADD01. Select from values of 1, 2, 5, 10 (default), 20, 50, 100, and 200 seconds.

TXFA = 10 sec (def)

TXADD01

This option specifies the length of time both endpoints wait for the additional call to be connected at the end of negotiation before deciding the BONDING call has failed. The factory default setting of 20 seconds is sufficient for most calls to connect; however, when dialing overseas it may be necessary to lengthen this timer to allow for slower call routing. Select from values of 1, 2, 5, 10, 20, 50 (default), 100, and 200 seconds.

TXADD01 = 50 sec (def)

TXDEQ

This option specifies the length of time both endpoints attempt to equalize the network delay between the bearer channels

before deciding the BONDING call has failed. This timer default setting is 50 seconds. Values of 1, 2, 5, 10, 20, 50 (default), 100, and 200 seconds are available.

TXDEQ = 50 sec (def)

TANULL

This option specifies the length of time the answering endpoint attempts to detect the BONDING negotiation pattern from the originating endpoint before aborting to clear channel mode. In general, this timer value should be left at the factory default setting of 10 seconds. However, it may be necessary to shorten this timer if the DTE equipment connected to the ISU also has timer constraints for completing non-BONDING parameter negotiation. Values of 1, 2, 5, 10 (default), 20, 50, 100, and 200 seconds can be selected.

TANULL = 10 sec (def)

TCID

This option specifies the length of time both endpoints attempt to negotiate an agreeable value for bearer channels and channel capacities before deciding the BONDING call has failed. Values of 1, 2, 5 (default), 10, 20, 50, 100, and 200 seconds can be selected.

TCID = 5 sec (def)

V.120

The V.120 protocol is a CCITT- compliant rate adaption method which provides DTE service between the ISU Express 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* in the chapter *Understanding ISDN and the ISU Express* and Table 1-B for available V.120 rates.

V.32 bis

The V.32 bis protocol allows the ISU to originate and receive

**NOTE**

calls to analog modems on POTS lines. The V.32 bis/V.42 bis modem only supports asynchronous DTE rates. To place an outgoing call to an analog modem, the call type must be changed to **Audio**. See the section *Setting the Call Type* to change call types. The V.32 bis modem operational parameters definitions follow.

The ISU Express with optional V.32 bis/V.42 bis modem (part number 1202081L4) must be used for operation of this protocol.

Error Control (Error Ctrl)

This option sets the type of error control to be negotiated with the far-end modem during train up. **Normal** turns all error control off and makes allowances for flow control. **Reliable** uses MNP error control. If the far-end does not support error control, then the call is terminated. When **Auto-Rel** is selected, the ISU Express attempts to use error control. If the far-end does not use error control, then normal operation is used. **Force MNP** allows only MNP error corrected calls to connect. **Force LAPM** allows only LAPM (V.42) error corrected calls to connect.

Compression

No Compression turns off the compression algorithms in the ISU Express. **Compress MNP5** enables MNP5 data compression. **Compress V42** enables V.42 bis data compression. **MNP5 or V42** allows the ISU Express to negotiate MNP5 or V.42 bis compression.

Microcom™ Network Protocol Block Size (MNP Blk Size)

When error control is enabled, this option sets the amount of data sent in a single packet during MNP error-controlled stream operation. Options available are 64, 128, 192, and 256 bytes.

DSU 57.6 ASYNC

The DSU 57.6 ASYNC protocol allows the ISU Express to communicate asynchronously at 57.6 kbps with ADTRAN 2-wire

and 4-wire Switched 56 DSU products. In addition, the ISU Express communicates with other ISUs over dial and leased connections using this protocol.



NOTE

T-Link

The T-Link protocol allows the ISU Express to communicate with 2-wire Switched 56 DataPath DUs. The T-Link protocol performs two functions:

- It adapts the data rate of sub 64 kbps DTE devices to the 64 kbps bandwidth of the ISDN bearer channel.
- For asynchronous and synchronous DTE rates up to 19.2 kbps, T-Link transmits the status of the DCE-DTE EIA leads to facilitate flow control and maintenance.

In addition to 2-wire Switched 56 DataPath DUs, the ISU Express can communicate with any other device using the T-Link protocol.

Call Type	Rate Adaption Protocols Supported	Typical Units Supported
Data 64k	BONDING mode 1 V.120 PPP async-sync	ISUs ISDN TAs PPP-compatible bridges/routers
Data 56k	V.120 PPP async-sync T-Link	ISDN TAs PPP-compatible bridges/routers 2-Wire SW56 DSUs
Speech or Audio	V.32 bis	V.32 bis-compatible modems

Simple Asynchronous Protocol (SAP)

SAP is a rate-adaption method providing DTE service between ISU Express units at a sub 64 kbps ISDN bearer channel rate. Selecting this menu item causes the ISU Express to use SAP protocol.

The primary usage for SAP is general-purpose asynchronous rate adaption in a dial-up or leased environment.

SAP only operates on a 64 kbps data link.

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, V.32 bis modems (optional), as well as other ISUs using a single configuration. This allows for integrating services without changing the configuration on the ISU Express.

To communicate with analog modems, the ISU Express with V.32 bis/V.42 bis (part number 1202081L2 and L4) modem option must be used.

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

1. Any asynchronous bit rate up to 115.2 kbps which is supported by the DTE.
2. 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, PPP async-sync, T-Link, and V.32 bis.

When answering calls, the ISU Express uses the incoming call type to determine which rate adaption protocols to support. See Table 4-A.

Table 4-A
Rate Adaption Protocols

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 Quick Setup menu. Upon connection

at 64k call type, BONDING, V.120, and PPP async-sync are attempted. If connection is not made at 64k, the ISU Express attempts another call at 56k call type. If connection is made at 56k, V.120, PPP async-sync, and T-Link are attempted. If connection is not made at 56k, then an AUDIO call type is attempted (provided the ISU Express with the V.32 bis modem option is used). If the ISU Express connects the AUDIO call type, the V.32 bis protocol is attempted for V.32 bis/V.42 bis-compatible modems. Once a call connects, if the protocol cannot be negotiated, the ISU Express hangs up the call.

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 ISU Express 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.



NOTE

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 ISU Express. In addition, when the ACCM option is not seen in the configure-request packet from the network, the ISU Express will spoof or add it to the packet.

CONFIGURING THE ISU EXPRESS USING QUICK SETUP

To configure the DTE Options quickly and easily, use the **Quick Setup** menu to automatically set up the eleven most common DTE configurations. For fine-tuning a particular application and DTE settings, see the section *Options for Both Leased and Switched ISDN Service*. This section provides detailed step-by-step processes for configuration the DTE Options.

To assist in configuring DTE options for the ISU Express, eleven common configurations are preset in **Quick Setup**. These include:

Dial 56k Sync	Dial 115.2k Async
Dial 64k Sync	Fallback 57.6k
Dial 112k Sync	Leased 128k
Dial 128k Sync	Ldm 128k Master
V32 19.2 Async	Factory Setup
Dial 57.6k Async	



NOTE

In the following descriptions, an asterisk () following the option indicates the option requires ISDN switch type to be configured. See **Setting the Dial Options**.*

Dial 56K sync*

When the ISU Express 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

RTS line	1 msec delay
CTS line	Forced on
Transmit data clock.....	Normal clock source
V.54 loopbacks	Accepted

Dial 64K sync*

When the ISU Express 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
RTS line	1 msec delay
CTS line	Forced on
Transmit data clock.....	Normal clock source
V.54 loopbacks	Accepted

Dial 112K sync*

When the ISU Express 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
RTS line	1 msec delay
CTS line	Forced on
Transmit data clock.....	Internal clock source
BONDING timer TXINIT	10 seconds
BONDING timer TXFA	10 seconds
BONDING timer TXADD01	50 seconds
BONDING timer TXDEQ	50 seconds
BONDING timer TANULL	10 seconds
BONDING timer TCID	5 seconds
V.54 loopbacks	Accepted

Dial 128K sync*

When the ISU Express 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
RTS line	1 msec delay
CTS line	Forced on
Transmit data clock	Internal clock source
BONDING timer TXINIT	10 seconds
BONDING timer TXFA	10 seconds
BONDING timer TXADD01	50 seconds
BONDING timer TXDEQ	50 seconds
BONDING timer TANULL	10 seconds
BONDING timer TCID	5 seconds
V.54 loopbacks	Accepted

V32 19.2 async*

When the ISU Express is configured for **V.32 19.2 async** service, the following parameters are automatically preset:

Service type	ISDN dial line
ISDN call type	Audio
Data protocol	V.32 bis
DTE mode	Asynchronous
Data bits	8
Parity bits	None
Stop bits	1
DTE connector bit rate	19.2 kbps
DTE flow control	Hardware
RTS line	1 msec delay
CTS line	Follows RTS
Error control	Auto-reliable MNP
Compression	Compress MNP5
MNP block size	256 bytes

**NOTE**

This option is only used with the ISU Express with V.32 bis modem option.

Dial57.6 asyn

When the ISU Express is configured for **Dial57.6 asyn** service, the following parameters are automatically preset:

Service type ISDN dial line
 ISDN call type 64 kbps data
 Data protocol V.120
 DTE mode Asynchronous
 Data bits 8
 Parity bits None
 Stop bits 1
 DTE connector bit rate 57.6 kbps
 DTE flow control None
 RTS line 1 msec delay
 CTS line Forced on

Dial115.2 asyn*

When the ISU Express is configured for **Dial115.2 asyn** service, the following parameters are automatically preset:

Service type ISDN dial line
 ISDN call type 64 kbps data
 Data protocol BONDING mode 1
 DTE mode Asynchronous
 Data bits 8
 Parity bits None
 Stop bits 1
 DTE connector bit rate 115.2 kbps
 DTE flow control None
 RTS line 1 msec delay
 CTS line Forced on

Fallback 57.6k*

When the ISU Express is configured for **Fallback 57.6k** service, the following parameters are automatically preset:

Service type Dial line
Automatic answering yes
ISDN call type 64 kbps data
Data protocol Fallback
DTE mode Asynchronous
Data bits 8
Parity bits None
Stop bits 1
DTE connector bit rate 57.6 kbps
DTE flow control Hardware
RTS line 1 msec delay
CTS line Follows RTS

More

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

Leased 128K

When the ISU Express 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
DDS loopbacks enabled Yes
DTE mode Synchronous
DTE connector bit rate 128 kbps
DTE flow control none
RTS line 1 msec delay
CTS line Forced on
Transmit data clock Normal clock source

Ldm 128 Master

When the ISU Express 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
 DDS loopbacks enabled Yes
 DTE mode Synchronous
 DTE connector bit rate 128 kbps
 DTE flow control..... none
 RTS line 1 msec delay
 CTS line Forced on
 Transmit data clock..... Normal clock source

**NOTE****Factory Setup**

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

Service type..... ISDN dial line
 ISDN switch type AT&T 5ESS
 ISDN call type 64 kbps data
 Dialing mode AT commands
 Data protocol V.120
 DTE connector bit rate 9600 bps
 DTE mode Asynchronous
 Data bits 8
 Parity bits none
 Stop bits 1
 DTE flow control..... none
 RTS line Forced on
 CTS line Forced on 1 msec after RTS
 CD line Turned on when call is up
 DSR line Forced on
 Transmit data clock..... Internal clock source
 BONDING timer TXINIT 10 seconds
 BONDING timer TXFA 10 seconds

BONDING timer TXADD01	10 seconds
BONDING timer TXDEQ	50 seconds
BONDING timer TANULL	50 seconds
BONDING timer TXID	5 seconds
AT Command Escape character	+
AT Command End-of-Line character value	13
AT Command Line Feed character value	10
AT Command Backspace character value	8
Transmit data clock	Normal clock source



NOTE

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

VT 100 TERMINAL DIALING OPTIONS

After starting the terminal emulation package, type **AT!V** and press **Enter**. Enter the Express Dial menu by pressing **Ctrl + 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 ISU Express 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* in the chapter *Configuration*.

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

When AT commands are selected for Dial Options, the DTE port becomes dual purpose. First, while a call is not established, the port accepts AT commands. During this time, the CD signal is inactive. Second, when a call is established, the port is used for data. This data mode is indicated by the CD signal active. See the appendix *AT Commands* for a list of the supported AT commands and their functions. In addition to the built-in menu system, the ISU Express can be configured and controlled with in-band AT commands from an asynchronous DTE port just as modems are.

To exit data mode and enter command mode, the asynchronous DTE device must transmit a proper escape sequence to the ISU Express. 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 +++.

Another way to exit data mode and enter command mode, is to press the TEST key on the front panel. This *only* works if both the LOC and REM LEDs are off.

Once command mode is entered, AT commands can be transmitted to the ISU Express to configure most of the options, dial remote DSUs, or initiate tests to check both the ISU Express and the network connections. All command lines must begin with the AT character set in either capital or lower case letters. To return to an active call and on-line, type AT0.

The command line may contain a single command or a series of commands after the AT attention code. When a series of commands is used, the individual 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 ISU Express 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 ISU Express can be changed or reviewed with S-registers. See the appendix *Current Status Messages* 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 followed by a question mark and press **Enter**.

```
ATS0?
```

Reading an S-Register String

The ISU Express 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 followed by a question mark and press **Enter**.

```
ATSS80?
```

CONFIGURING THE ISU EXPRESS 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 ISU Express 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 ISU Express 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



NOTE

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

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 ISU Express 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.



NOTE

*In **synchronous mode**, the ISU Express 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 re-enter the VT 100 interface for re-configuration, troubleshooting or to view the status buffer, press the **Test** button on the front panel of the unit. This enables the AT command mode; then 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.

SYNC 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 can be displayed at any time after entering the menu structure. Pressing **Ctrl + V** displays the ISU Express Status menu. The last 16 status messages generated during the option of the unit are displayed with relevant status items. See Figure 4-1 and the section *Status Messages*. The most recent status message appears as Status 1 with the remaining status messages appearing in descending order.

Press **Ctrl + C** to return to the Configuration menu.

TEST OPTIONS

The ISU Express provides the following test options:

- Loopback DTE
- Loopback Network
- Loopback Protocol
- Loopback Remote
- Test Remote

The ISU Express can also be configured to ignore or accept V.54 and DDS commands.

Loopback DTE, Loopback (network or protocol), NEBE/FEBE,

and Loopback Enable/Disable test options are available from the built-in menu system. Once in this built-in menu, press **Ctrl + T** to display the ISU Express Test Menu screen. Loopback DTE, Loopback Network, Loopback Protocol, and Test Remote are available from the **Select** and **Test** buttons on the front of the unit.

Loopback DTE

Causes the DTE port to loop back toward user equipment. This allows performance of a bit error rate test (BERT) between the ISU Express and end user equipment to verify proper cable connection, etc.

Using the built-in menu, press **Ctrl + T**, then select **Loopback DTE**.

Alternatively, this test can be executed by using the **Select** and **Test** buttons on the front of the ISU Express. Press **Select** until the LOC LED remains on and the REM LED is off. Then press **Test** to start, and either **Select** or **Test** to end the test.

Loopback Network

Forces the ISU Express to loop back both the B1 and B2 channels toward the network. This can be used to allow a far-end user to perform a BERT all the way through network.

Using the built-in menu, press **Ctrl + T**, then select **Loopback Network**.

This test may also be executed from the front panel by pressing **Select** until the LOC LED is off and the REM LED remains on. Press **Test** to start the test; to end the test press **Test** again or **Select**. If Clear Channel has been selected as protocol, the Loopback Network test will be run; otherwise the Loopback Protocol will run.

Loopback Protocol

Allows data to be looped back toward the network after passing

through a selected protocol such as T-Link or BONDING. See Figure 4-2 for loopback points.

Using the built-in menu, press **Ctrl + T**, then select **Loopback Protocol**.

Front panel execution of this test may be started by pressing **Select** until the LOC LED is off and the REM LED remains on. Press **Test** to start the test; to end the test press **Test** again or press **Select**. If Clear Channel has been selected as protocol, the Loopback Network test will be run; otherwise the Loopback Protocol will run.



Figure 4-2
ISU Express Loopback Points

Loopback Remote

Allows the ISU Express to issue a V.54 in-band loopback command to a far-end unit while still accepting data from the DTE connector. This provides bit error rate testing of an entire link using an external BERT tester. To use this feature, configure both units for Clear Channel operation. The far-end unit must be able to respond to V.54 loopback commands. See the section *Setting Protocol Options* to option the unit for Clear Channel operation.

Using the built-in menu, press **CTRL+T**, then select **Loopback Remote**.

Front panel execution of this test may be accomplished by using **Select** and **Test** buttons on the front of the ISU Express. Press **Select** until the LOC LED and the REM LEDs flash. Press **Test** to start the test; to end the test press **Test** again or **Select**.

Test Remote

Allows the ISU Express to issue a V.54 in-band loopback com-

mand to a far-end unit and BERT test the link using a built-in 2047 pattern generator/checker. This allows for testing a circuit 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* to option the unit for Clear Channel operation. The built-in 2047 pattern generator/checker will flash the LOC LED if any errors are detected.

Using the built-in menu, press **CTRL+T**, then select **Test Remote**.

This test may be executed from the front panel by pressing **Select** until the LOC LED and the REM LEDs remain on. Press **Test** to start the test; to end the test press **Test** again or **Select**.

Loopback Disable

No Remote Loopbacks: The ISU Express will ignore all V.54 and DDS loopback commands.

Using the built-in menu, select **Enable/Disable Tests**, then select **Lpbk = No Rem Lpbks**.

This test option is not available from the front panel.

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.

Using the built-in menu, press **Ctrl+T**, then select **NEBE/FEBE**.

This test option is not available from the front panel.

Chapter 5

Troubleshooting

When the ISU Express 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

If the LOC LED is not on or continuously flashes, the following steps will verify whether or not the problem can be fixed locally.

1. Ensure the ISU Express is receiving power.
2. Power off the ISU Express while holding down **Select** and **Test**, then power back up.
3. Continue holding the **Select** and **Test** buttons until the Loop LED flashes once.
4. If the ISU Express still does not pass self test, Call ADTRAN Technical Support for assistance.

IF THE ISU EXPRESS DOES NOT READ **READY**

When the ISU Express 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 ISU Express, 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 ISU Express. From a functioning voice phone, call the local directory number(s) provided with your 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 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 phone line (more than likely, a problem with the layer 1 setup). The problem is one or more of the places listed below:
 - The ISU Express software setup
 - The ISU Express 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 line is plugged into the ISU Express connector marked **ISDN DIAL** on the back of the ISU Express.
- B. Make sure the ISU Express is configured for Dial line service.
- C. If possible, try another piece of functioning ISDN equipment with a U-interface on the 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 line pair.
 - G. With a minimum of extra wiring, try connecting to the line pair at the point where service provider's wiring ends.
 - H. With the ISU Express connected to the 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 at the end of the line.
4. If the *Loop Status* in the ISU Express Status menu continuously reads **Getting TEI #1**, then the ISU Express 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 ISU Express 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 ISU Express is set up for the correct switch type.
- B. Ensure the quality of your 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 ISU Express 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 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 ISU Express Status menu continuously reads **Register SPID #1**, then the ISU Express is physically connected to your local telephone service provider and has established logical layer 2. The ISU Express is unable to establish layer 3. The problem is in one or both of the following places:
- The ISU Express software setup
 - The telephone service provider's software setup

To isolate the problem, perform the following procedure:

- A. Ensure the ISU Express is set up for the correct switch type.
- B. Make sure the line is multipoint.
- C. Make sure the ISU Express is set up with the correct SPID and LDN. For example:
 - 4) **SPID1 = 205722704646**
 - 5) **SPID2 = 205722704747**
 - 6) **LDN 1 = 7227046**
 - 7) **LDN 2 = 7227047**
- D. If possible, try another piece of functioning ISDN equipment with a U-interface on the line.

- E. With the ISU Express 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 ISU Express Status menu continuously reads **Getting TEI #2**, the ISU Express 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 ISU Express software setup
 - The telephone service provider's software setup

To isolate the problem, perform the following procedure:

- A. Ensure the line is multipoint with two phone numbers.
- B. Ensure that the ISU Express is set up with the correct SPID and LDN. For example:
 - 4) SPID1 = 205722704646
 - 5) SPID2 = 205722704647
 - 6) LDN1 = 2704646
 - 7) LDN2 = 2704747
- C. Try swapping SPID1 with SPID2 and LDN1 with LDN2. Determine if the problem is the second phone number or the quantity of phone numbers.
- D. If possible, try another piece of functioning ISDN equipment with a U-interface on the line.
- E. With the ISU Express 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 ISU Express Status menu continuously reads **Register SPID #2**, the ISU Express 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 ISU Express software setup
- The telephone service provider's software setup

To isolate the problem, perform the following procedure:

- A. Ensure the line is multipoint with two phone numbers.
- B. Ensure that the ISU Express is set up with the correct SPID and LDN. For example:

```
4) SPID1 = 205722704646
5) SPID2 = 205722704647
6) LDN 1 = 2704646
7) LDN 2 = 2704747
```

- C. Try swapping SPID1 with SPID2 and LDN1 with LDN2. Determine if the problem is the second phone number or the quantity of phone numbers.
- D. If possible, try another piece of functioning ISDN equipment with a U-interface on the line.
- E. With the ISU Express 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-A for corrective actions if you cannot connect calls.

Table 5-A
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 ISU Express.
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 data 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.	<p>There may be a problem in the software setup (translation) at the CO switch, or the network setup in the ISU Express.</p> <p>Another possibility is that the data circuits provided are not good enough to support the BONDING negotiation process.</p> <p>If the line has two phone numbers, make sure the second SPID and LDN are entered correctly in SPID2 and LDN2 in the ISU Express.</p> <p>Check with the local service provider to ensure that the line supports two data calls. Looking at the ISU Express status log buffer shows what sequence of events occurred. What you need to know is which piece of equipment first caused the BONDING process to terminate. The status logs from both ends may be necessary to determine this.</p>

Chapter 6

Specifications

SPECIFICATIONS AND FEATURES

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

The ISU Express meets the Microsoft Windows® 95 Plug-and-Play specifications. The file MDMADTN.INF is required. To obtain this file, contact ADTRAN technical support as shown on the inside back cover of this manual.

Network Interface

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

RJ-45 for ISDN Basic Rate S/T-Interface or RJ-45 for leased 2B1Q service (L8-L10)

DTE Interface

EIA-232

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

- T-Link
- CCITT V.120
- SAP
- DSU 57.6 async
- BONDING
- PPP async-sync
- Fallback

Interoperability

- BONDING Mode 1-compatible Inverse Multiplexers
- SW56 DSUs
- ISDN TAs
- V.32 bis/V.42/V.42 bis modem (optional)
- Automatic Fallback Rate Adaption

Switch Compatibility

- AT&T 5ESS
- NTI DMS-100
- National ISDN-1
- NEC
- EuroISDN*
- UN4*
- TDX*
- KDD*
- NTT*

*Express S/T L8-L10 only

B-Channel Aggregation

BONDING mode 1 protocol

POTS Interface Phone #1 or Phone #2 (optional)

- Maximum REN = 5
- Ringing Signal Amplitude = 18 5V p-p (+/- 5V)
- Ringing Signal Frequency = 20 Hz (+/- 3 Hz)

- Supports 3 phones (18 mA loop current each) at 1000 ft, 24 AWG
- Supports 2 phones (26 mA loop current each) at 1000 ft, 24 AWG
- Supports 1 phone (49 mA loop current each) at 1000 ft, 24 AWG
- Supports 4 phones (14 mA loop current each) at 600 ft, 24 AWG

- Supports 3 phones (18 mA loop current each) at 600 ft, 24 AWG
- Supports 2 phones (27 mA loop current each) at 600 ft, 24 AWG

- Supports 5 phones (12 mA loop current each) at 300 ft, 24 AWG
- Supports 4 phones (15 mA loop current each) at 300 ft, 24 AWG
- Supports 3 phones (19 mA loop current each) at 300 ft, 24 AWG
- Supports 2 phones (28 mA loop current each) at 300 ft, 24 AWG
- Supports 1 phone (53 mA loop current each) at 300 ft, 24 AWG

- Supports 5 phones (12 mA loop current each) at 100 ft, 24 AWG
- Supports 4 phones (15 mA loop current each) at 100 ft, 24 AWG
- Supports 3 phones (20 mA loop current each) at 100 ft, 24 AWG

- Supports 5 phones (13 mA loop current each) at 8 ft, 24 AWG
- Supports 4 phones (16 mA loop current each) at 8 ft, 24 AWG
- Supports 3 phones (21 mA loop current each) at 8 ft, 24 AWG

Display

Available through terminal

Environmental

- Operating Temperature: 0°C to 50°C (32°F to 122°F)
- Storage Temperature: -20°C to 70°C (-4°F to 158°F)
- Relative Humidity: Up to 95% non-condensing

Physical

- Dimensions: 1.56" H x 6.5" W x 8.25" D
- Weight: 2.5 lbs

Power

- 120 VAC, 60 Hz, 3 W typical dissipation with POTS and modem options

Appendix A

AT Commands

This Appendix lists the supported AT commands and descriptions of their functions.

Command	Function
A	Answer. Puts the ISU Express in answer mode.
D	Dial. Precedes the telephone access number [ATD5551212].
H	Hang up. Disconnects the current call.
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. Saves current configuration to EEPROM.
+++	Break in. Breaks in AT command processor during an active call. The break in character can be defined in S2.
_U	Resets ISDN interface.
!S	Dumps status buffer contents to the DTE port.

Command	Function
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	Resets all S-registers to factory preset values
&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 64k
&F6	Configures unit for Ldm 64k master
&F7	Configures unit for Dial 57.6k async
&F8	Configures unit for Dial 115.2k async
&F10	Configures unit for Dial V32 19.2k async
&F11	Configures unit for Fallback 57.6k async
Network Options	
&L0	Dial network
&L1	Leased network
&L2	Leased, backed up by dial network
Calling Number Identification	
&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.

Command	Function
---------	----------

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 if link up
&S3	DSR off if dial up

DTE Connector Data Synchronous Data Clocking Options

&X0	Internal transmit clock
&X1	External transmit clock

Assigning 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

Echo Tone Options

E0	Disables local echo
E1	Enables local echo

Unit Identification

I0	Identifies unit. Commands the unit to display model number.
I1	Identifies software. Commands the unit to display software version.

Command	Function
----------------	-----------------

AT Command Response Message Options

Q0	Response messages on
Q1	Response messages off

AT Command Response Message Types

V0	Response messages codes
V1	Response messages words

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) Access Options

_I0=	Access SPID#1 for DTE #1
_I1=	Access SPID#2 for DTE #2

Local Directory Number (LDN) Access Options

_N0=	Access LDN1 for DTE #1
_N1=	Access LDN2 for DTE #2

ISDN Switch Type Options

_S0	5ESS
_S1	DMS-100
_S2	National ISDN-1
_S3	NEC
_S4	Euro ISDN*
_S5	VN4*

Command	Function
---------	----------

ISDN Switch Type Options (cont.)

_S6	TDV*
_S7	KDD*
_S8	NTT*

*Only available on part numbers 1202081L8, 1202081L9, and 1202081L10.

ISDN U-Interface Operational Mode Options

_X0	ISU timing slaves to network (NT mode)
_X1	ISU is U-interface timing master (LT mode)

Data Flow Control Options

\Q0	No flow control
\Q1	Software
\Q2	CTS only
\Q3	Hardware
\Q4	Software from DCE only

Compression Options

%C0	No compression
%C1	MNP use compression
%C2	V.42 bis use compression
%C3	MNP or V.42 bis negotiate compression

MNP Compression Block Size Options

\A0	MNP 64 byte blocks
\A1	MNP 128 byte blocks
\A2	MNP 192 byte blocks
\A3	MNP 256 byte blocks

Error Correction Options

\N0	Normal
\N2	Reliable
\N3	Auto-reliable
\N4	Force LAPM
\N5	Force MNP

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 ISU Express.

Call Connect B1

Bearer channel 1 is connected and is active.

Call Connect B2

Bearer channel 2 is connected and is active.

CALL xxxxxxxx

The ISU is calling phone number xxxxxxxx.

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 ISU Express is in a customer initiated loopback.

LPBK Protcl.Net

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

NEC Ready

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

NET EOC LOOPBACK

The ISU Express has been commanded to perform an ISDN loopback toward the network.

NET REM LOOPBACK

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

Register SPID #2

The ISU Express 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 of the following:

BONDING

Bandwidth on Demand Industry Users Group protocol.

CLEAR CHAN

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

DSTOP

DSU 57.6 Async rate adaption protocol.

DSU57.6

ADTRAN DSU asynchronous protocol.

FALLBACK

FALLBACK rate adaption protocol.

SAP

Simple Adtran Protocol.

TLINK

TLINK 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 ISU Express.

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

ISU Express went back on line.

Bad async BPS

The BONDING protocol determined that the selected asynchronous bitrate 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 uncorrectable.

Bad call type

ISU Express 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

ISU Express attempted to call an invalid phone number.

Bad TLK Version

Invalid TLINK parameters found during end-to-end negotiations.

BaudRate

ISU Express 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 ISU Express 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.

CallID 1 in use

ISU Express tried to place a call using SPID 1 when SPID 1 was already in use.

CallID 2 in use

ISU Express tried to place a call using SPID 2 when SPID 2 was already in use.

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

ISU Express 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 ISU Express 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 ISU Express for V.25 bis dialing.

DTR not up

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

Dump call

ISU Express 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_NOT_IMPLEMENT

The network does not support the requested supplementary service.

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 ISU Express. The far-end phone number is also displayed.

InCmptblFound

TLINK end-to-end negotiations found an optioning incompatibility between the two end units.

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 ISU Express 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 ISU Express 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 ISU Express.

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.

SAP idle timeout

Unit at far-end is not configured to use the SAP protocol.

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 ISU Express while optioned for BONDING.

TEMPORARY_FAILURE

The network has temporarily failed, try the call again.

TIMER_EXPIRY

Call control error.

TLINK ErrorOne

Catastrophic TLINK 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 ISU Express 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

S-Register List

- S0.....AUTO ANSWER** Determines how the ISU Express answers an incoming call.
0 = Disable (ISU Express does not answer call).
1 = Enable (ISU Express answers all calls).
2 = Dump all calls.
- S2.....BREAK IN.....** Determines which key or character (in ASCII code) defines the escape command. The standard escape character is a + sign (ASCII value of 43 decimal). To change the character set, set S2 to the desired ASCII value.
CHARACTER
Range = 0 to 127
- S3.....END OF LINE** 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).
CHARACTER
Range = 0 to 127
- S4.....LINE FEED** Determines which key or character (in ASCII code) advances the cursor to the next line after ending a command line or after an ISU Express message. The standard character is the line feed (ASCII value of 10 decimal).
CHARACTER
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 ISU Express 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 ISU Express to recognize and execute the command.
Range = 0 to 127
- 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 the ISU Express.
Bit 3 = 1: Disables AT responses from the ISU Express.
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: Disables PPP ACCM Spoofing.
Bit 7 = 0: Enables PPP ACCM Spoofing.
Bit 8 = 1: Ring indicator uses cadence.
Bit 8 = 0: Ring indicator remains on.
- 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 : Connects message without baud rate.
- S25DTR DETECT TIME** Determines time, in hundredth of a second, a change in data terminal ready (DTR) entering the escape command for the ISU Express to recognize and execute the command.
Range = 0 to 255
- S30DTE CTS** Controls the operation of the DTE connector clear to send (CTS) line.
0 = Follows RTS
1 = Force CTS
- S31DTE RTS** Controls operation of the request to send (RTS) line.
0 = 1 ms delay
17 = 18 ms delay
- S32DTE DSR.....** Controls the operation of the data set ready (DSR) signal on the DTE connectors.
0 = Force DSR on always
1 = DSR off OOS + Test
2 = DSR off Link Down
3 = DSR off Dial Up
- S33DTE CD** Controls the operation of the carrier detect (CD) 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
- S34DTE DTR** Determines how the ISU Express 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



NOTE

- 8 = Hang up outgoing call when DTR is off
- 16 = Answer incoming call when DTR is on
- 32 = Dial SN0 when DTR is on
- 64 = Dial SN0 when DTR transitions from off to on.

S35DTE CONN Determines which is the current operating DTE connector.
2 = EIA-232 connector

S-registers 36 through 38 require that the option V.32 modem board be installed.

S36ERROR Sets the type of error control to be negotiated with the far-end modem.
CORRECTION

0 = Normal operation no error control. Allows speed matching, buffering, and flow control.
2 = Reliable MNP error control. If the far end does not use MNP error control then the call is ended.
3 = Auto-reliable MNP error control . The ISU Express attempts to use MNP error control. If the far end does not use MNP, then normal operation is used.
4 = Force LAPM. Force the modem to connect only if V.42 (LAPM) error correct can be used.
5 = Force MNP. Force the modem to connect only if MNP 2-4 error correction can be used.

S37V32..... Enables compression in the V.32 modem.
COMPRESSION

0 = No compression
1 = MNP5 compression
2 = V42 compression
3 = MNPS or V42 compression

S38V32 BLOCK SIZE Sets the amount of data sent in a single packet during MNP error controlled stream operation.
0 = Block size of 64 bytes
1 = Block size of 128 bytes

2 = Block size of 192 bytes
3 = Block size of 256 bytes

- S40** **BOND TXINIT** Specifies the number of seconds the originating endpoint attempts to detect the BONDING negotiation pattern from the answering endpoint before deciding the BONDING call has failed.
Range= 0 to 255, 10 sec is default
- S41** **BOND TXFA** Specifies the number of seconds both endpoints attempt to detect the BONDING frame pattern when a call is connected before deciding the BONDING call has failed. When operating with other manufacturers' BONDING equipment, it may be necessary to lengthen this timer so that it matches TXADD01.
Range= 0 to 255, 10 sec is default
- 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 BONDING call has failed. When dialing overseas, it may be necessary to lengthen this timer to allow for lower call routing.
Range= 0 to 255, 50 sec is default
- S43** **BOND TXDEQ** The number of seconds both endpoints attempt to equalize the network delay between the bearer channels before deciding the BONDING call has failed.
Range= 0 to 255, 50 sec is default
- S44** **BOND TANULL** The number of seconds the answering endpoint attempts to detect the 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 ISU Express also has timer constraints for completing non-BONDING parameter negotiation.
Range= 0 to 255, 10 sec is default
- S45** **BOND TCID** The number of seconds both endpoints attempt to

-
- negotiate agreeable values for bearer channels and channel capacities before deciding the BONDING call has failed.
Range= 0 to 255, 5 sec is default
- 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 ISU Express.**
0 = Dial service (switched service)
1 = Leased service (non-switched 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 Rate adaption protocol type.**
TYPE
1 = Clear Channel (no rate adaption)
2 = BONDING mode 1
3 = SAP (simple ADTRAN protocol)
4 = T-link
6 = V.120
7 = V.32
9 = DSU 57.6 kbps asynchronous
11 = FALLBACK

12 = PPP async-to-sync conversion

S55 DIAL MODE Selects dialing interface.

- 0 = None
- 2 = AT commands
- 3 = 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

S57 DDS TEST Allows an ISU Express optioned as a leased line unit to respond to DDS in-band latching loopback or V.54 loopback commands.

- 0 = No checking
- 1 = Check for DDS latching loopbacks
- 2 = Check for V.54 loopbacks
- 3 = Check for V.54 and DDS latching loopbacks

S58 CALL SCREENING Allows the ISU Express 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 ISU Express is in leased mode.

- 3 = 64 kbps
- 5 = 128 kbps

SS60 SPID1 LOC Primary SPID location.

SS61 SPID2 LOC Secondary SPID string location.

SS62 LDN1 LOC Primary local directory number string location.

-
- S563LDN2 LOC**Secondary local directory number string location.
- S70**DTE MODESelects asynchronous or synchronous mode on the DTE connector.
0 = Asynchronous
1 = Synchronous
- S71**DTE RATESelects the DTE connector bit rate.
1 = 300
3 = 1200
6 = 2400
8 = 4800
11 = 9600
15 = 19200
17 = 38400
18 = 48000
19 = 56000
20 = 57600
21 = 64000
22 = 112020
23 = 115200
24 = 128000
25 = 230400
- S72**DATA BITSSelects the number of asynchronous data bits.
0 = 8 bits
1 = 7 bits
- S73**DTE PARITYSelects the number of asynchronous parity bits.
0 = None
1 = Odd
2 = Even
- S74**DTE STOPSelects the number of asynchronous stop bits.
0 = 1 stop bit
1 = 1.5 stop bits
2 = 2 stops bits
- S75**DTE FLOWSelects asynchronous flow control.
0 = None

- 1 = XON/OFF from DTE controls DCE
- 2 = XON/OFF from DCE controls DTE
- 3 = Hardware
- 12 = Software

S76DTE CLOCK..... Selects DTE connector transmit clock timing source.
0 = Internal (ISU Express supplies timing)
1 = External (DTE supplies timing)

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
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.

S91 TRANSFER ID NI-1 feature identification number for transferring.

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
1 = Route speech call types to POTS
2 = Route speech and audio call types to POTS

S94 LOCAL TONES Forces the POTS interface to generate all tones.
Bit 0 =0: In-band tones from ISDN switch (when
 available)
Bit 0 =1: All tones generated locally
Bit 1 =0: Warnings to POTS when unavailable
Bit 1 =1: Disable all warnings to POTS

Appendix E

Connector Pinouts

Table E-A
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-B
RJ-45 ISDN BRI U

Pin 4	Ring
Pin 5	Tip

Appendix F

Ordering ISDN Without IOCs

ISDN is a complex service with multiple options. Obtaining service from your local telephone company and long distance providers can sometimes be complicated. This appendix guides you and your telephone company in specifying and obtaining your ISDN service requirements.

To support most of the features in the ISU Express, your telephone service needs to meet certain requirements. A general description of these requirements follows. Depending on your actual data service needs, some features may be deleted. Other features may not be available in your area. Also, features may be deleted for economic reasons, depending on your needs and local tariffs. Talk to your telephone company first, and find out which of the services listed on the following pages are provided.

The following form has been designed to assist you. Complete and FAX this form to your telephone company to request the proper type of ISDN telephone line for use with the ADTRAN ISU Express.

ISDN Service Ordering Information for the ADTRAN ISU Express

For ADTRAN ISU Express applications, the following guide can be used as an aid in ordering basic ISDN service from your local telephone company.

The ADTRAN ISU Express ISDN Service Unit (part numbers 1200051L1 and 1200051L3) includes NT1 and Terminal Adapter functionality and supports data at rates up to 128 kbps. The ADTRAN ISU Express (part numbers 1200051L2 and 1200051L4) is a traditional Terminal Adapter and do not include NT1 functionality. The ADTRAN ISU Express International (part numbers 1200051L5 and 1200051L6) also do not include NT1 functionality.

Name: _____

Address: _____

City: _____ State: _____

Zip Code: _____ Daytime telephone number: _____

Request an ISDN Basic Rate Interface (BRI) line.

- U-interface reference point
- 2B1Q line coding
- 2B+D Service (supports up to 128 kbps)

The ISU Express supports the following switch types and software protocols.

AT&T 5ESS Custom, 5E6 and later software, National ISDN-1
NTI DMS-100 BCS-32 and later software (PVC1), National ISDN-1
(PVC2)
Siemens EWSD National ISDN-1
NEC Switch NTT Protocol
Euro ISDN ETS300 Protocol

Request that the ISDN line allocate one dynamic terminal endpoint identifier (TEI) per phone number.

For service offered from an AT&T 5ESS, request a multipoint line, with the following features:

Feature	Value
B1 Service	On Demand (DMD)
B2 Service	On Demand (DMD)
Data Line Class	Multipoint
Maximum B-Channels	2
Circuit Switched Voice Bearer (CSV) Channels	Any
Number of CSV calls	1 (recommended for testing purposes)
Circuit Switched Data (CSD) Bearer Channels	Any
Number of CSD calls	2
Terminal Type	Type A

Turn the following features off:

- Packet Mode Data
- Multiline Hunt
- Multiple Call Appearances
- Electronic Key Telephone Sets (EKTS)
- Shared Dictionary Numbers
- Accept *Special* Type of Number
- Intercom Groups
- Network Resource Selector (Modem Pools)
- Message Waiting
- Hunting
- InterLata Competition

For service offered from an Northern Telecom DMS-100, request a multipoint line, with the following features.

Line Type	Basic Rate, Functional
Electronic Key Telephone Sets (EKTS)	No
Call Appearance Handling (CACH)	No
Non-Initializing Terminal	No
Circuit Switched Service	Yes
Packet Switched Service	No
TEI	Dynamic
Bearer Service	Circuit Switched Voice and Data Permitted on any B-Channel (Packet mode data not permitted)

Identify your long distance carrier of choice and request circuit-switched 64 kbps Clear Channel access if possible.

Long distance access should be provided through _____.

Ensure that the telephone company provides you with the following information for configuring the ISU Express:

- ISDN switch type
- ISDN switch protocol version
- ISDN phone number(s)
- Service profile identification (SPID) number(s) with prefixes and suffixes, if applicable (if ISDN line is multipoint)

LOCAL INTERFACE REQUIREMENTS

Physical Interface

- ISDN Basic Rate Interface (BRI) line
- U-interface reference point
- 2B1Q line coding

ISDN service must be provided from one of the following CO switches and protocols:

Switch	Protocol
AT&T 5ESS	Custom (5E6 or later software) National ISDN-1
Northern Telecom DMS-100	BCS-32 or later software (Pvc1) National ISDN-1 (Pvc2)
Siemens EWSD	National ISDN-1

The interface provides the ability to allocate one dynamic (TEI) per phone number.

Local Service

- Bearer capabilities:
 - Circuit mode voice service for speech and 3.1 kHz audio.
 - Circuit mode data service for 56 kbps and 64 kbps unrestricted data.
- Two simultaneous calls supported on the interface. Any mix of speech and data bearer capabilities is supported for both bearer channels on incoming and outgoing calls.
- Service provided inside the LATA for the bearer capabilities.
- Long distance access for the bearer capabilities to and from the long distance providers of choice.

Long Distance Service

If facilities are available, subscribe to long distance service supporting the bearer capabilities previously listed. Request service supporting circuit-switched 64 kbps or 56 kbps access. It is recommended that the same long distance carrier end-to-end throughout the network to be used.

Deciding What Services to Order

If you are new to ISDN, first obtain the features previously listed. Refer to the section *ISDN Service Ordering Information* in this appendix as a basic guide. It is easier to begin operating on a full featured line because more options are available., lowering the chances of downtime when a particular service is turned off. Later, features not actually used can be deleted.

If all of the previous features are not available, compare the actual data service requirements with those which are available. A likely problem is the lack of a clear trunk to provide 64 kbps unrestricted data service. A solution is to use to 56 kbps service. Sometimes voice circuits are suitable for data service at a reduced bit rate.

5ESS Custom Line Additional Parameters

The AT&T 5ESS central office telephone switch supports a proprietary ISDN D-channel call control protocol called Custom which is based on CCITT recommendations. The ISU Express configured for switch type AT&T 5ESS will work with lines providing this protocol on 5ESS switches with software version 5E6 or later.

The ISU Express supports the following configurations on 5ESS custom lines:

- Point-to-point with one phone number (recommended configuration with no POTS interface)
- Multipoint with one phone number

- Multipoint with two phone numbers (recommended configuration with POTS interface)

The requirements for the 5ESS point-to-point line are defined in Table F-A.

Table F-A
5ESS Features

B1 service	On-Demand (DMD)
B2 service	On-Demand (DMD)
Data line class	Point-to-point
Maximum B channels	2
Number of circuit switched voice (CSV) calls	2
Circuit switched voice bearer channels	Any
Number of circuit switched data (CSD) calls	2
Circuit switched data bearer channels	Any
Terminal type data bearer channels	Type A

Multipoint lines require the phone company to create a SPID for each phone number on the line. With the exception of the ability to spread two calls across two phone numbers, multipoint lines offer no special features, and may create complications. However, if you use a multipoint line, the parameters are similar to the point-to-point line, except for the SPIDs.

The 5ESS switch can provide a variety of supplementary features which the ISU Express may not support. Enabling these features may have undesirable consequences. Avoid the following features:

- Packet Mode Data
- Multiline hunt groups
- Electronic key telephone set (EKTS)
- Shared directory numbers
- Intercom groups
- Network resource selector (modem pools)
- Message waiting

- Hunting
- InterLATA competition
- Accept *special* type of number

DMS-100 Protocol Version 1 Line Additional Parameters

The Northern Telecom DMS-100 telephone switch supports a proprietary ISDN D-channel call control protocol called Pvc1 which is based on CCITT recommendations. The ISU Express configured for switch-type DMS-100 is functional on lines providing this protocol on DMS-100 switches with software version BCS-32 or later. The ISU Express supports the following configurations on DMS-100 lines:

- Multipoint with one phone number (1B+D service)
- Multipoint with two phone numbers (for 2B+D service)

The requirements for the DMS-100 multipoint line are defined in the sections *Local Interface*, *Local Service*, and in *Table F-B* all in this appendix. The line should have two service profiles with the following parameters to support BONDING.

Table F-B
DMS Features

Line type	Basic Rate, Functional
Electronic key telephone set (EKTS)	No
Call appearance handling (CACH)	No
Initializing terminal	Yes
Bearer service	Circuit Switched Voice and Data permitted. Packet mode data not permitted.
Circuit switched service	Yes
Packet switched service	No
Protocol Version	Functional PVC 1
TEI	Dynamic

After Service Is Installed

When the line is installed, the following information will be provided by the local phone service provider:

- A seven-digit LDN for the line. If the line is multipoint with two phone numbers, two LDNs are provided.
- If the line is multipoint, a SPID is provided for each LDN.
- Dialing information, including the area code, for the line.
- Any special instructions for dialing outside lines, dialing 4-digit local extension numbers, and prefixes for using the desired long distance provider.

SETTING UP THE ISU EXPRESS FOR A NEW LINE

1. Disconnect the phone line from the ISU Express.
2. Turn on the ISU Express, verify that it passes self test.
3. Turn off the ISU Express; while holding down 0, turn on the ISU Express. Continue to press down 0 for 15 seconds. This will reset all the internal settings to factory defaults.
4. The ISU Express is now set up for 5ESS Custom. If this is not the correct line-type, select **CONFIG, Netw. Options, Dial Line, Switch Type**, and the desired switch type.
5. Enter the SPIDs and LDNs for the ISDN multipoint line. Select **CONFIG, Netw. Options, Dial Line, Terminal ID, Set SPID/Set LDN** and enter the SPIDs and LDNs. Make sure that SPID1 corresponds to LDN1 and SPID2 corresponds to LDN2.
6. Turn the ISU Express off, then on. This is required after changing any of the previous settings. The ISU Express should now be set up for your line. You may wish to verify the settings.

7. Connect the phone line to the **ISDN IFC** connector on the ISU Express. The front panel should read **Link Down** and progress to **Ready** as the line is activated. This process may take a minute.

At this point, if the ISU Express does not read **Ready**, see the section *If the ISU Express Does Not Read Ready* in the chapter *Troubleshooting*.

Appendix G

Upgrading Software

As features are added to the ISU Express, software upgrades may be necessary. The ISU Express 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 ISU Express, a PC running a terminal program supporting XMODEM/CRC is required. Connect the PC to the ISU Express DB25 connector, then set it to 9600 baud, no parity, and one stop bit. Power off the ISU Express and perform the following steps:

- 1 Press **SELECT** for at least five seconds while powering the unit on, and wait for a menu to appear on the PC, or type the following AT command: `AT!F`.
2. If needed, set a new baud rate using the menu.
3. Start downloading. Select the download item from the menu.
4. When the flash is erased, the Express waits for XMODEM/CRC transfer to begin.
5. Use the terminal emulation software to begin uploading the file provided by ADTRAN.

6. The Express performs a checksum to verify the download.
7. A failure to load will be indicated on the terminal. Power the Express off and begin again with step 1.

Acronyms

ACD	Automatic Call Distribution
AMA	Automatic Message Accounting
AMI	Alternate Mark Inversion
ANI	Automatic Number Identification
ANSI.....	American National Standards Institute
B (Channel)	A 64 kbps digital information channel
BONDING	Bandwidth On Demand Interoperability Group
bps	Bits per second
BRI	Basic Rate Interface
CA	Call Appearance
CAS.....	Channel Associated Signalling
CCITT	Consultative Committee for International Telegraphy and Telephony
CCS	Common Channel Signalling
CD	Carrier Detect
CIC	Carrier Identification Code
CLID	Calling Line Identification
CMD	Circuit Mode Data
CMOS	Complimentary Metal-Oxide Semiconductor
CND	Calling Number Delivery
CPE	Customer Premises Equipment
CPU.....	Central Processing Unit
CR	Call Reference
CRC4	Cyclic Redundancy Check 4
CTS	Clear to Send
DCE	Data Communications Equipment

DDS	Digital Data Service
DMA	Direct Memory Access
DMS	Digital Multiplex Switching
DN	Directory Number
DNIC	Data Network Identification Code
DSP	Display Station Protocol
DSR	Data Set Ready
DTE.....	Data Terminal Equipment
EIA	Electronic Industries Association
EID	Endpoint Identifier
EKTS	Electronic Key Telephone Service
ES	Errored Seconds
ESS	Electronic Switching System
ETSI	European Telecommunications Standards Institute
FAX	Facsimile
FEBE	Far End Block Errors
FTP	File Transfer Protocol
FX	Foreign Exchange
HDB3	High Density Bipolar of order 3
HLC	High Layer Compatibility
ID	Identification
I/O	Input/Output
I ² L.....	Integrated Injected Logic
IEC	Inter-Exchange Carrier
IMUX	Inverse Multiplexer
INIC	ISDN Network Identification Code
IOF	Inter Office Facility
ISDN	Integrated Services Digital Network
ISO	International Standardization Organization
kbps	Kilobits per second
kHz	Kilohertz
LAN	Local Area Network
LATA	Local Access and Transport Area
LDN	Local Directory Number
LEC	Local Exchange Carrier

LLC	Logical Link Control (LAN)
LLC	Low Layer Compatibility (ISDN)
Mbps	Megabits per second
MF	Multi-Frequency Signalling
MLHG	Multiline Hunt Group
MOS	Metal-Oxide Semiconductor
MTBF	Mean Time Between Failure
NEBE	Near End Block Errors
NI-1	National ISDN-1
NI-2	National ISDN-2
NIST	National Institute of Science and Technology
NIUF	North American ISDN Users' Forum
NT	Network Termination
OSI	Open Systems Interconnection
PBX	Private Branch Exchange
PC	Personal Computer
PHF	Packet Handling Function
PMD	Packet-Mode Data
POTS	Plain Old Telephone Service
PPSN	Public Packet Switched Network
PRI	Primary Rate Interface
PSTN	Public Switched Telephone Network
PVC	Permanent Virtual Circuit
RAM	Random Access Memory
ROM	Read Only Memory
SPCS	Stored Program Controlled Switching System
SPID	Service Profile Identifier
SS7	Signalling System 7
TA	Terminal Adapter
TE	Terminal Equipment
TEI	Terminal Endpoint Identifier
TTL	Transistor-Transistor Logic
UART	Universal Asynchronous Receiver
UAS	Unavailable Seconds
USART	Universal Synchronous or Asynchronous Receiver
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.

Index

A

- all types -> DTE 30
- always tone 29
- asynchronous operation 32
 - data format
 - stop bits 32
- AT commands 54
- audio 25, 25–26

B

- Bit Rate 32
- bonding mode 1 36

C

- CD forced on 32
- CD options 32
- channel rate 31
- clear channel 36
- clock mode: slave/master 31
- compression 39
- CONFIG. See Figure 4-1
- configuration menu tree. See Figure 4-1
- configuring the ADTRAN ISU 128 rackmount
 - dial 25
- configuring the ISU 128 rackmount
 - using quick 43
- configuring the ISU 128 rackmount Digit
 - for leased 31
- configuring the ISU 128 rackmount for leased
 - Digit

- channel rate 31
 - clock mode: slave/master 31
- connector pinouts. See Appendix D
- CTS options 32
- current status messages. See Appendix A

D

- data 56kbps 26
- data 64kbps 26
- data bits 34
- data format 34
- dial 112K sync 44
- dial 128K sync 45
- dial 56K sync 43
- dial 64K sync 44
- dial operation 15, 25
- dial options
 - V.25bis 27
- Dial115.2 asyn 46
- Dial57.6 asyn 46
- dialing a call by the AT command processor 53
- dialing options 50
 - store/review # 50
- disabled 28
- DSR options 33
- DSU 57.6 ASYNC 39
- DTE 7
- DTE data connection 16
- DTE indicators 7. See also Table 1-A
- DTR options 33
- dump all calls 28

E

enabled 28
error control 39

F

factory setup 48
fallback 40
fallback 57.6k 47
flow control 33
front panel dialing options
 hang up line 50
 redial last number 50

H

hang up line 50
how to use AT commands
 using the S-registers 52

I

incoming tone 29
ISDN 3, 5, 8, 11
ISDN service ordering information 96

L

Ldm 128 master 48
leased 128K 47
leased digital service 31
 channel rate 31
 clock mode: slave/master 31
leased operation 15
loopback disable 64
loopback DTE 61
loopback network 62
loopback protocol 62
loopback remote 63

M

MNP block Size 39
more 47

N

NEBE/FEBE 64
network connection 15
no answer tone (default) 28

O

off with link down 33
off with LOCD 33
ordering ISDN from your telephone
 company. See Appendix E
outgoing tone 29

P

parity bits 34
protocol options 35

Q

quick setup 43
 Dial 112K sync* 44
 Dial 128K sync* 45
 Dial 56K sync* 43
 Dial 64K sync* 44
 Dial115.2 asyn 46
 Dial57.6 asyn 46
 fallback 57.6k 47
 more 47
 factory setup 43, 48
 Ldm 128 master 48
 leased 128K 47
 V32 19.2 async 45

R

rate adaption protocols
 see Table 4-A 36
recommended operating modes 9
 Table 1-B 9
recommended operating protocols. See Table
 1-B
redial last number 50
RTS options 32

S

SAP 40

setting answer tone

- always tone 29
- incoming tone 29
- no answer tone (default) 28
- outgoing tone 29

setting auto answer

- disabled 28
- dump all calls 28
- enabled 28

setting DTE options for asynchronous Operation

- CD options 32
- CTS options 32
- data format
 - Data Bits: 34
 - stop bits 34
- DSR options 33
- DTR options 33
- RTS options 32

setting DTE options for asynchronous operation

- bit rate 32
- CD options 32
- data format 34
- flow control 33

setting DTE options for asynchronous operation

- data format
 - parity bits 34

setting DTE options for synchronous operation

- transmit clock 34

setting protocol options

- BONDING mode 1 36
- TANULL 38
- TCID 38
- TXADD01 37
- TXDEQ 37
- TXFA 37
- TXINIT 37

- clear channel 36
- DSU 57.6 ASYNC 39

- DSU 57.6 async 39
- fallback 40
- SAP 40
- T-Link 40
- V.120 38
- V.32bis 38
 - compression 39
 - error control 39
 - MNP block size 39

setting the call type

- audio 25
- Data 56kbps 26
- Data 64kbps 26
- speech 25

setting the dial options

- AT commands 27
- V.25bis 27

software version 62

specifications 73

speech 25, 25–26

speech -> POTS 30

speech/audio -> POTS 30

status buffer 61

status buffer messages. See Appendix B

stop bits 34

T

T-Link 40

TANULL 38

TCID 38

terminal interface menu screens. See Figure 4-2

test options

- loopback disable 64
- loopback DTE 61
- loopback netw. 62
- loopback protocol 62
- loopback remote 63
- NEBE/FEBE 64
- software ver 61
- software version 62
- test remote 63

test remote 63

transmit clock 34

TXADD01 37
TXDEQ 37
TXFA 37
TXINIT 37

V

V.120 38
V.25bis In-band Dialing 59
V.32bis 38
V32 19.2 async 45
version 1.0 S-register list. See Appendix C

Returning the unit to ADTRAN

ADTRAN will replace or repair this product within five years from the date of shipment if it does not meet its published specifications or fails while in service (refer to ADTRAN Equipment Warranty and Repair and Return Policy and Procedure).

For service, RMA requests, or further information, contact RMA, Technical Support, or Sales in the ADTRAN Customer Service department.

A Return Material Authorization (RMA) is required prior to returning equipment to ADTRAN.

Telephone numbers, addresses, and product support information is provided on the last page of this manual.

Product Support Information

Pre-Sales 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 the Return Material Authorization (RMA) department to issue an RMA number. For information regarding equipment currently in house or possible fees associated with repair, contact RMA directly at the following number:

RMA Department (205) 963-8722

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

ADTRAN, Inc.
RMA Department
901 Explorer Boulevard
Huntsville, Alabama 35806

RMA # _____