omni series

User's Manual

Version 2.0

ZyXEL

ACCESSING INTERNET & INTRANET

ZyXEL Limited Warranty

ZyXEL warrants to the original end user (purchaser) that this product is free from any defects in materials or workmanship for a period of up to two (2) years from the date of purchase. During the warranty period, and upon proof of purchase, should the product have indications of failure due to faulty workmanship and/or materials, ZyXEL will, at its discretion, repair or replace the defective products or components without charge for either parts or labor, and to whatever extent it shall deem necessary to restore the product or components to proper operating condition. Any replacement will consist of a new or re-manufactured functionally equivalent product of equal value, and will be solely at the discretion of ZyXEL. This warranty shall not apply if the product is modified, misused, tampered with, damaged by an act of God, or subjected to abnormal working conditions.

Note: Repair or replacement, as provided under this warranty, is the exclusive remedy of the purchaser. This warranty is in lieu of all other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular use or purpose. ZyXEL shall in no event be held liable for indirect or consequential damages of any kind or character to the purchaser.

To obtain the services of this warranty, please contact ZyXEL's Service Center, refer to the separate Warranty Card for your Return Material Authorization number (RMA). Products must be returned Postage Prepaid. It is recommended that the unit be insured when shipped. Any returned products without proof of purchase or those with an out-dated warranty will be repaired or replaced (at the discretion of ZyXEL) and the customer will be billed for parts and labor. All repaired or replaced products will be shipped by ZyXEL to the corresponding return address, Postage Paid (USA and territories only). If the customer desires some other return destination beyond the U.S. borders, the customer shall bear the cost of the return shipment. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Note: ZyXEL does not assume any liability arising out of the application or use of any products, or software described herein. Neither does it convey any license under its patent rights nor the patents rights of others. ZyXEL further reserves the right to make changes in any products described herein without notice. This document is subject to change without notice.

Acknowledgments

Trademarks mentioned in this manual are used for informational purposes only.

Trademarks are properties of their respective owners.

FCC Part 15 Information

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

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

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 commercial 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 communications.

If this equipment does cause harmful interference to radio/television 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 the 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 the party responsible for compliance could void the user's authority to operate the equipment. Shielded RS-232 cables are required to be used to ensure compliance with FCC Part 15, and it is the responsibility of the user to provide and use shielded RS-232 cables.

The declarations of CE marking:

CE

The omni series has been approved for connection to the Public Switched Telecommunication Network using interfaces compatible with ITU-TSS recommendation I.420 (Basic Rate ISDN user access). The omni series complies with the following directives:

1. The Council Directive 89/336/EEC of 3 May 1992 on the approximation of the laws of the Member States relation to Electro Magnetic Compatibility. (EMC Directive)
2. Council Directive 91/263/EEC of 29 April 1991 on the approximation of the laws of the Member States concerning telecommunication terminal equipment. (The Telecom Terminal Equipment Directive)

3. 93/68/EEC of 22 July 1993 amending the Directives 89/336/EEC, 91/263 /EEC and 92/31/EEC.(Marking Directive)
4. Council Directive 73/23/EEC and 93/68/EEC of 26 Dec 1996 on the harmonization of the laws of the Member States relation to electrical equipment designed for use within certain voltage limits.
5. The Council Directive 92/31/EEC of 28 April 1992 amending directive on the approximation of the laws of the member states relating to Electro Magnetic Compatibility.

Contacting ZyXEL

If you have questions about your ZyXEL product or desire assistance, contact ZyXEL Communications Corporation in one of the following ways:

- **Phone**: In North America call between 8:00 AM and 5:00 PM PST at (714) 693-0808

  Outside North America, you can dial +886-3-5783942 EXT 252 between 8:00AM and 5:00PM Taiwan time (GMT +8:00).

- **Fax**: ZyXEL in North America: (714) 693-8811 or Taiwan: +886-3-5782439

- **E-mail**:

  - **Sales inquiries**: sales@zyxel.com in North America sales@zyxel.hinet.net outside North America.
  - **Technical support**: support@zyxel.com in North America support@zyxel.hinet.net outside North America.

- **Product information**: Visit our site on the World Wide Web: http://www.zyxel.com.

- **FTP**: Information , such as ZyXEL software and ROM updates for North America can be found at this FTP address: ftp.zyxel.com

For European versions and related files, use the address: ftp.zyxel.co.at

- **Postal Service**: You can send written communications at the following address:

  ZyXEL Communications Corporation

  6, Innovation Road II, Science-Based Industrial Park

  Hsinchu, Taiwan 300, R.O.C.

  or

  ZyXEL Communications Inc.

  4920 E. La Palma Avenue

  Anaheim, CA92807, U.S.A.

Contents

1 Introduction

The ZyXEL omni.net series ISDN Terminal Adapter family includes four ISDN Terminal Adapters; omni.net, omni.net Internal, omni.net data, and omni.net Data Internal.

When used with off-the-shelf Internet or remote access client software, the omni enables mobile or home users to connect to the Internet or branch offices over ISDN lines Hassle Free! Some models also allow you to connect to the analog world via a modem, fax machine, or telephone connected directly to the TA.

To take advantage of constant new developments, the omni employs flash EPROM. This allows for convenient uploading of newly available firmware, effectively extending the life of your hardware investment.

The omni supports both D and B Channels protocols. For the D Channel, it supports DSS1, 1TR6, DMS-100, AT&T Custom, and NI-1. For the B Channels, X.75, V.120, V.110, PPP Async-to-sync Conversion and Bundle (128Kbps).

ZyXEL has also brought its world renown expertise in data compression to the omni. With V.42bis compression on the B Channels using either X.75, V.120, or STAC/LZS compression over PPP/MP the omni can effectively communicate at speeds up to 460Kbps over ISDN lines.

The omni.net, has two analog ports, and the omni.net Internal has one analog port for handling fax machines, modems, and telephones. The omni.net allows different analog devices to communicate over the two B channels to two different locations simultaneously, so you can send a fax and make a voice call at the same time. The analog ports also recognize standard DTMF tones as well as pulse dialing.

Key to Model Differentiation

The following labels will be used throughout the manual whenever information applies or does not apply to specific omni models. If information is specific to a single model within the omni line it will be identified by model name e.g. (omni.net).

(internal) Applies to internal omni models only (omni.net Internal and omni.net Data Internal).

(external) Applies to external omni models only (omni.net and omni.net Data).

(data) Applies to omni data models only (omni.net Data and omni.net Internal data).

(non-data) Applies to omni non-data models only (omni.net and omni.net Internal).

	External	Internal
With a/b adapter	omni.net [1]	omni.net I [2]
w/o a/b adapter	omni.net D	omni.net DI

[1] Includes two a/b adapters.
[2] Includes one a/b adapter.

Key Features of the omni

Speed and Compatibility

- Plug and Play support for Win95 environment.
- Full compatibility with both ISDN and remote PSTN via ISDN.
- Supports leased line operation.
- Multiple signaling protocol compatibility with the following network switches: DSS1, 1TR6, NI-1, AT&T 5ESS, and Northern Telecom DMS 100.
- Supports X.75, V.110, V.120, and PPP Async-to-Sync Conversion B Channel protocols.

- B Channel speeds of 56Kbps (in-band Signaling) and 64Kbps (out-of-band Signaling).
- 112Kbps/128Kbps channel bundling: MLP, CCB, and Multilink PPP(RFC1661).
- V.42bis data compression using the X.75, V.120, and Bundle protocols.
- STAC data compression using PPP/MP
- Two application program interfaces:
  - ZyXEL ISDN AT Commands
  - CAPI 1.1a and CAPI 2.0.

Intelligent Features

- Automatic ISDN/analog call detection (non-data).
- Feature Phone operation, including call back, broker, and three-way conferencing (omni.net).
- Two analog telephone jacks (analog adapters) with metering pulse function (omni.net).
- One analog telephone jack (analog adapter) with metering pulse function (omni.net Internal).
- Built-in internal speaker with volume control (external).
- Push-button switch for quick dial and tear down (external).
- Call-back security with password protection.
- Flash EPROM memory for easy firmware upgrades.

Technical Specifications

- Status Display
  - 10 LED indicators (external).
- Flow Control: Software XON/XOFF or hardware CTS/RTS.

- Configuration Setting: Software programmable with nonvolatile memory for profile storage.
- Diagnostics: Self and loopback tests.

Physical Characteristics

- Line Interface
  - RJ-45 for S/T or U interface, RJ-11 for built-in TA's. (Internal models with S/T interface only).
- DTE Interface
  - DB-25 connector (external).
- Weight (g)
  - 383 (external)
  - 250 (internal)
- Dimensions (cm)
  - L-18.1 x W-13.5 x H-3.7 (external)
  - L-19 x W-2.5 x H-12 (internal)

U-Interface Option

For North American ISDN, ZyXEL provides an optional 2B1Q U-interface which allows direct connection to the network without the use of an external NT-1 device.

Unpacking Your omni

Your omni should come with the equipment listed below. If any item is missing or damaged, contact your dealer or ZyXEL Customer Service Department immediately.

- One omni ISDN Terminal Adapter.
- One power adapter. (external)
- Two RJ-11 telephone cables. (omni.net)

- One RJ-11 telephone cable. (omni.net Internal)
- One RJ-45 ISDN telephone cable.
- One 6' shielded RS-232 25-pin to 25-pin cable. (external)
- One 3.5" driver and utility disk.
- One warranty/registration card.
- One omni User's Manual.

How to Become a Registered Owner

Complete the pre-addressed registration card and place it in the mail. Registered owners will receive future product information and update announcement. Save your dated invoice as proof of purchase.

2 Installing omni External Models

Although graphics are only displayed for the omni.net, all installation steps below apply to both the omni.net and omni.net Data ISDN Terminal Adapters unless specifically noted.

Front Panel

You will find the following LED's on the front panel of the omni external models:

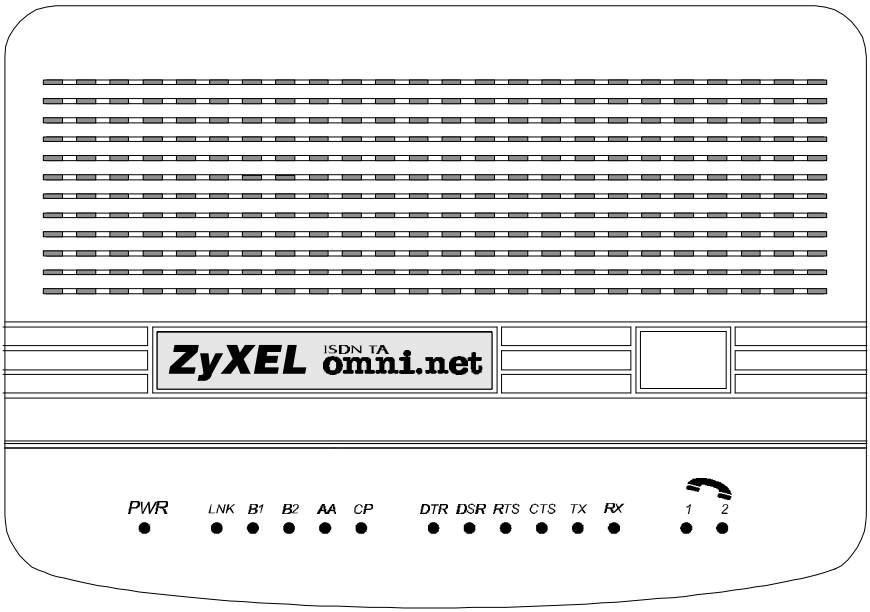


Figure 2-1 omni.net front panel

The LED Indicators

PWR - The power on LED lights up when the power is turned ON.

LNK - The Link LED lights up when the link with the local switch is active and flashes when attempting to make a connection.

B1 - The B1 channel connection LED lights up when the B1 channel is established.

B2 - The B2 channel connection LED lights up when the B2 channel is established.

AA - The auto-answer LED lights up when the TA is in Auto Answer mode and flashes when it rings.

CP - Lights when Data Compression is being used over one or more of the B Channels. Compression types are Hi/fn LZS (formerly Stac) for PPP connections, and V.42bis for V.120 or X.75 connections.

DTR - The data terminal ready LED lights up when the DTE or computer connected to the DTE Port indicates that it is ready for communication by raising the corresponding RS-232 signal.

DSR - The data set ready LED lights up when the modem is ready for communication with the DTE.

RTS - The request to send LED lights up when the DTE has data to be sent to the remote modem. The RTS signal is used in Hardware Handshaking.

CTS - The clear to send LED lights up when the modem is ready to receive data from the remote modem. The CTS signal is used in Hardware Handshaking.

TX - The transmit data LED flashes when the DTE/Computer is transmitting data to the DTE Port.

RX - The receive data LED; lights up when the DTE/Computer is receiving data from the DTE Port.

Phone 1 (omni.net) - The phone 1 LED lights up when the POTS port 1 telephone/handset is off-hook.

Phone 2 (omni.net) - The phone 2 LED lights up when the POTS port 2 telephone/handset is off-hook.

Front Panel Switch

When the TA is in command state, pressing the front panel button causes it to dial the default phone number pre-stored in the NVRAM. The default number pointer to the telephone directory is assigned by the AT*D*n* command.

When the TA is on-line, pressing the button will tear down the connection and bring it into command state.

To restore the TA to its factory default settings and initiate the loop-back test, turn the power ON while pressing and holding the switch. Continue holding the switch for 3 to 5 seconds after turning the power ON.

Back Panel

You will find the following switch and connectors on the back panel of the omni external models:

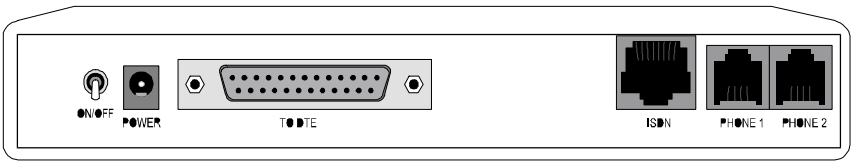


Figure 2-1 omni.net Back Panel

ON/OFF - Power switch; turns the omni ON or OFF.

POWER - Input terminal for power adapter.

To DTE - Serial port DB-25 female connector for connection to the serial port of a DTE (computer/terminal).

ISDN - ISDN RJ-45 terminal jack; connects to a S/T interface or a U interface.

PHONE 1 (omni.net) - RJ-11 terminal jack for analog adapter 1; for connecting to analog equipment. (phone, fax, answering machine, etc.)

PHONE 2 (omni.net) - RJ-11 terminal jack for analog adapter 2; for connecting to analogue equipment.

NOTE: The signal-pin assignment of the RJ-45 and RJ-11 phone jacks are listed in Chapter 18.

Connecting to the Power Supply

To Connect your omni to the power supply, follow the steps given below:

1. Turn off your computer.
2. Make sure the power switch on the TA is in the OFF (down) position.
3. Connect the round end of the power adapter to the POWER JACK on the TA's back panel.
4. Plug the power supply unit to an AC wall jack then power on the TA.
5. Observe the LED light status on the front panel of your TA and make sure PWR LED is on.

NOTE: Use only the power adapter supplied with your TA. Never use a power adapter designed for a different product.

Connecting to Your Computer

Your TA comes with a 25 pin, male to female cable, which is to be used to connect the main serial port of TA to your computer serial port as seen in the figure below:

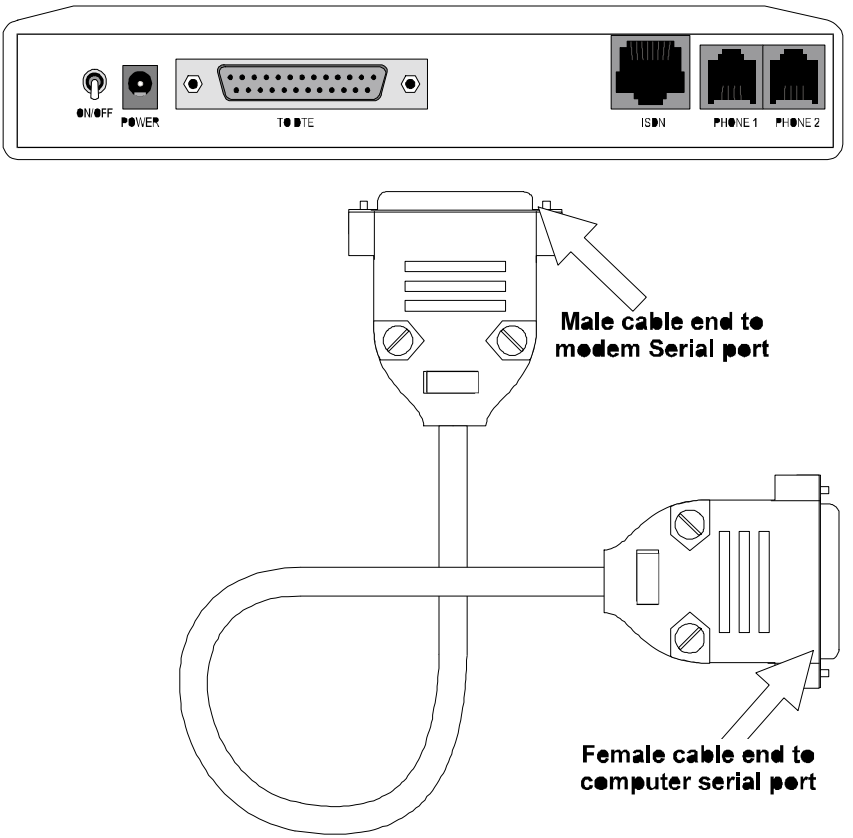


Figure 2-2 Connecting the omni.net to Your Computer

Complete the following steps to connect the TA to your computer:

1. Turn off the power to your computer.
2. Find the 25 pin serial port.
3. Connect the male end of the 25 pin cable to the serial port.
4. Connect the other end of the cable (female end) to your computer's serial port. In case your computer only supplies a 9 pin serial connector, you will need to use a 25 pin to 9 pin converter (9 pin female to 25 pin male).
5. Once the connection is made, turn the computer back on.

Connecting to Your ISDN Line

The omni comes with a choice of two types of ISDN line interfaces:

- **S/T interface -** This can only connect to your NT-1 (Network Termination) device.

Warning: Do not under any circumstances connect directly to the ISDN wall jack.

- **U interface -** This allows you to connect directly to your ISDN wall jack.

Warning: The ISDN jack is for ISDN line connection only. Connection of a phone line may result in damage to your Terminal Adapter.

Attention: La fiche ISDN est destinée uniquement pour la connexion sur une ligne RNIS. La connexion sur une ligne téléphonique peut endommager votre adaptateur de terminal.

U Interface Model

If you have purchased the U-interface model, you can connect the U-Interface directly to the wall jack.

In most cases, the ISDN jack installed by the phone company is a RJ-11 jack (except in Canada, where RJ-45 jack will be installed), and the U-Interface jack on the back of the omni is a RJ-45 jack. A RJ-45 to RJ-45 (or RJ-11 to RJ-45, depends on your regional distributor's request) phone cable is included with your TA.

To connect your U-interface omni to your ISDN line complete the steps below:

- Connect the RJ-45 connector to the "ISDN U" jack on the back of the omni.
- Connect the other end of the RJ-45 cable (or RJ-11) to your wall jack.

S/T Interface

If you have purchased the omni S/T model, you will need an NT-1 device to connect to the network.

To connect your U-interface omni to your ISDN line complete the steps below:

- Connect the RJ-45 connector to the “ISDN S/T” jack on the back of the omni.
- Connect the other end of the RJ-45 cable (or RJ-11) to your NT-1.

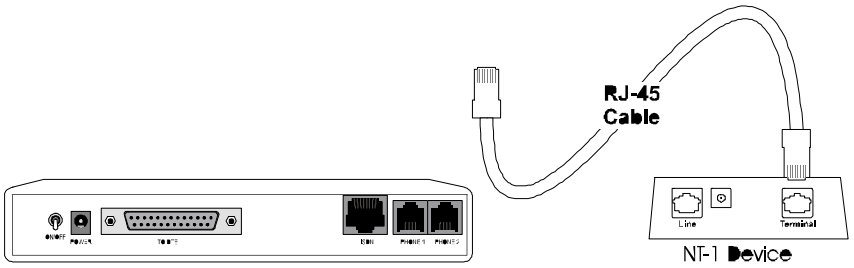


Figure 2-3 Hooking Up an NT-1 Device

Power On and Self Diagnostics

Once you have completed all of the installation steps above, flip the omni’s On/Off switch to the ON (up) position.

The unit should cycle through a self test sequence, where you should see a series of LED lights blinking (LED, B1, B2, AA). After this cycle is complete, the PWR light should stay on.

If the test routine fails, the LNK LED flashes. Refer to Chapter 15, for more information on self-tests and error codes.

If you have a communication program loaded and active (connected to the same serial port as the omni), you should see the **DTR** LED should be ON after the self test.

NOTE: The omni takes longer to initialize than a regular TA because it requires that communication first be established with your local switch when it is powered on.

3 Installing omni Internal Models

Although graphics are only displayed for the omni.net Internal, all installation steps below apply to both the omni.net Internal and omni.net Internal data ISDN Terminal Adapters unless specifically noted.

Both cards have a built in high speed serial port that operates at speeds up to 460800bps.

Selecting the Baud Rate Multiplier

The highest baud rate (COM port speed) that can be selected using software is 115200 bps, far too slow for ISDN applications. The omni.net internal card can be used to double or quadruple the speed set by the software.

You can use the jumpers found on the card to change the COM port speed. The jumper block is located near the lower right hand corner of the card, near the finger connector.

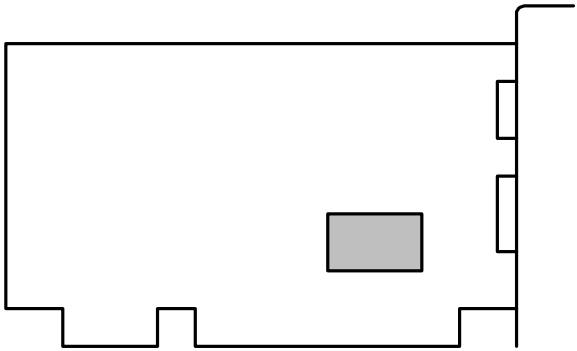
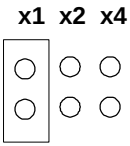
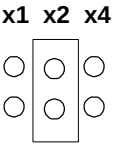


Figure 3-4 Jumper Block Location

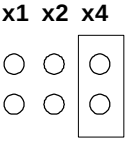
The figures below show the settings for 1x, 2x, and 4x speeds. The default setting for the card is 4x. For example, if the software has set the baud rate at 115200 bps, and the default setting of 4x is used, the actual data transmission rate will be 460800 bps.



The baud rate is set by the software.



Doubles the baud rate set by the software.



Quadruples the baud rate set by the software.

Connecting the TA to your PC

Follow the steps below to connect the TA to your PC:

1. Turn the power off to your computer and remove the housing.
2. Insert the card into a open ISA slot, make sure it is secure, and replace the computer housing.

Plug and Play

The omni series internal cards support the Plug and Play standard. No jumper adjustment is needed for configuration. All I/O and IRQ

settings will be handled by your operating system if it supports the Plug and Play standard.

If your operating system does not support Plug and Play, a DOS configuration utility has been included on the floppy disk that is included with your omni. To configure your omni internal card using the disk follow the steps below:

1. Insert the floppy disk in the appropriate drive.
2. From the C prompt type **a:** and press **Enter**.
3. From the A prompt type **instlpnp** and press **Enter**.
4. The following message will appear:

   ```
   Would you like to create the default
   directory?
   ```

   Press **Y** to continue.
5. The following message will appear:

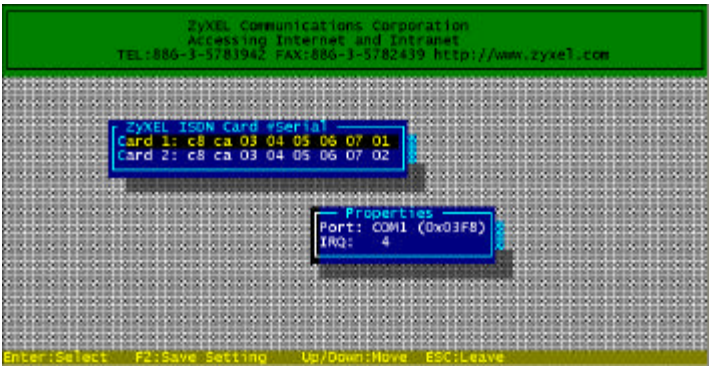
   ```
   Do you want to modify the autoexec.bat file?
   ```

   Press **Y** to continue.
6. Press **Alt-Ctrl-Delete** to reboot your system.
7. The following message will appear:

   ```
   Do you want to reconfigure your ZyXEL PnP
   card?
   ```

   If you press **N** installation is complete.

   If you press **Y** you will see the screen below:



8. If you have more than one card installed, use the arrow keys to select the card you want to configure. When you have made your selection press **Enter**.
9. From the Properties dialogue box press **Enter**, select the desired port, and press **Enter** again.
10. To change the IRQ arrow down and press **Enter**, choose the desired IRQ and press **Enter**.
11. Press **F2** to complete the configuration and save your settings, or press **Esc** and type **Y** to abort.

Connecting to Your ISDN Line

The omni comes with a choice of two types of ISDN line interfaces:

- **S/T interface -** This can only connect to your NT-1 (Network Termination) device.

Warning: Do not under any circumstances connect directly to the ISDN wall jack.

- **U interface -** This allows you to connect directly to your ISDN wall jack.

Warning: The ISDN jack is for ISDN line connection only. Connection of a phone line may result in damage to your Terminal Adapter.

Attention: La fiche ISDN est destinée uniquement pour la connexion sur une ligne RNIS. La connexion sur une ligne téléphonique peut endommager votre adaptateur de terminal.

U Interface Model

If you have purchased the U-interface model, you can connect the U-Interface directly to the wall jack.

In most cases, the ISDN jack installed by the phone company is a RJ-11 jack (except in Canada, where RJ-45 jack will be installed), and the U-Interface jack on the back of the omni is a RJ-45 jack. A RJ-45 to RJ-45 (or RJ-11 to RJ-45, depends on your regional distributor's request) phone cable is included with your TA.

To connect your U-interface omni to your ISDN line complete the steps below:

- Connect the RJ-45 connector to the "ISDN U" jack on the omni.
- Connect the other end of the RJ-45 cable (or RJ-11) to your wall jack.

S/T Interface

If you have purchased the omni S/T model, you will need an NT-1 device to connect to the network.

To connect your U-interface omni to your ISDN line complete the steps below:

- Connect the RJ-45 connector to the "ISDN S/T" jack on the omni.
- Connect the other end of the RJ-45 cable (or RJ-11) to your NT-1.

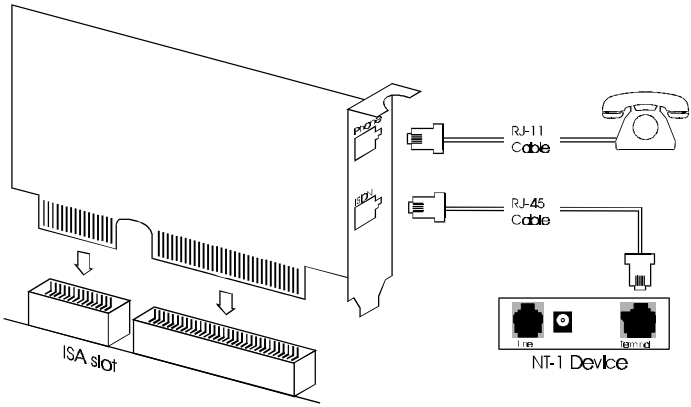


Figure 3-5 omni.net Internal Card Installation (S/T interface)

Power On and Self Diagnostics

Upon power-up the omni will perform a series of self diagnostics. If the test routine fails, the LED will flash. Refer to Chapter 15, for more information on self-tests and error codes.

NOTE: The omni takes longer to initialize than a regular TA because it requires that communication first be established with your local switch when it is powered on.

4 Configuring Your ISDN Line and Network

The set up procedure for the omni needs to be done only once. The settings will be stored in non-volatile RAM. The only time you will need to reconfigure your line is when you perform a hardware reset on your TA or when you change options on your ISDN line.

If your TA is not going to be set up by a computer running Windows 3.x, 95, or NT4.0 you will need some type of terminal program that allows you to send AT commands to the TA and receive responses from the TA.

Configuring Your TA

Complete the following steps to configure your TA using the ZyXEL Configuration Utility Disk:

1. Insert your ZyXEL Configuration Utility Disk into your computers floppy drive.
2. From Windows 3.x choose **Run...** from the **File** menu.
3. From Windows NT4.0 choose **Run...** from the **File** menu.
4. From Windows 95 choose **Run...** from the **Start** menu.
5. Type: **A:\setup.exe** and press **Enter**.
6. Follow the instructions on your screen.

Configuring your TA using a Terminal program

If you are not using the ISDN configuration utility that is packaged with the omni, you will need a terminal program with which to configure the unit. The TA should work with any asynchronous

terminal program that can communicate directly with one of the communication ports on your system. If you do not know how to use a terminal program, refer to the instructions that came with the terminal program.

Make sure the program is set up to communicate with the COM port that the TA is connected to. You can check to see if the DTR LED is on when the terminal program is active. In most cases, if the terminal program is active and ready to communicate with the port that the TA is connected to, it will activate the DTR signal. This will cause the DTR LED to light up. If the DTR LED is not ON, you will need to check the program's settings.

The communication speed can be set to anywhere between 2,400bps and 460,800bps, but 115,200bps is a good default value. The TA will automatically adjust its speed to match your communication speed.

Once the terminal communication program is ready, you can type a simple command to see if the TA responds.

Type:

```
AT<Enter>
```

TA should respond:

```
OK
```

Type:

```
ATI<Enter>
```

TA should respond:

```
1281
```

Type:

```
ATI1<Enter>
```

TA should respond:

```
omni (model) USA: V 1.00a (Firmware version number)
7607 (Firmware checksum will change based on your firmware version)
OK
```

Once the TA accepts the commands that you typed, it is ready to be programmed and ready to operate with your ISDN network. If you do not receive any response from the device, go over your installation procedures again or contact ZyXEL Technical Support.

5 ISDN Communication Basics

In this chapter, we will cover how to initiate and receive calls over digital lines using your TA.

Understanding AT Commands

AT commands are used to configure and control the omni. Command statements are usually sent to the TA by being typed from the computer keyboard.

Command statements must be written in a specific form in order for the TA to recognize them. A command statement begins with the letters “AT” or “at”. It is then followed by one or more commands and then by <Enter>.

AT commands can only be issued when the TA is in “command” or “off-line” mode.

Once the TA has established a connection with the remote device, it goes into “on-line” mode, and the characters sent from your computer (through the TA) are transmitted to the remote device.

In order to issue an AT command statement, you first need to run your communications software and configure it to the port connected to the TA. Refer to your communications software manual if this is not the case.

Once the communication terminal program is running and the TA is connected:

Type:

```
AT<Enter>
```

TA responds:

```
OK
```

This confirms that the TA and your computer are communicating correctly.

Supported AT command types:

Type of AT Command	Example
Basic AT (Hayes compatible).	ATA
Basic AT$ (on line help).	AT$
Extended AT&.	AT&F
Extended AT* command.	AT*I1
S-Register command.	ATS0=1
S-Register bit-mapped command (set S-Register 13 bit 1 equal to 1).	ATS13.1=1
S-Register inquiry command.	ATS0? Or ATS13.1?

You may also browse the list by using AT$.

Quick Tips when issuing AT commands:

The ENTER or RETURN key must be pressed to execute a command.

Multiple AT commands can be combined into one line. For example, AT&O2 and ATB02 can be combined into one line AT&O2B02.

The TA processes commands from left to right. The AT command that appears to the right might over-write the command to the left. For example, ATB13B14 will result in ATB14 since both B13 and B14 can not co-exist.

If you see duplicated characters for each one you type, your TA and software both have their echo feature turned on (the TA defaults to enable command echo). To eliminate the double characters, turn off software command echo.

Use “A/” to repeat the last command. No ‘AT’ prefix is needed for this command.

The omni supports either verbose result code (i.e. “OK”) or numerical result code (i.e. “0"). You can use **ATV*n*** command to set it one way or the other:

Command	Description
ATV0	Select numerical result code.
ATV1	Select verbose result code.

Outgoing Calls

The omni has 3 modes in which to send communication over ISDN network.

- ISDN data.
- Analog port, Phone 1 communication (non-data).
- Analog port, Phone 2 communication (omni.net).

These modes are auto-switching based on the commands you issue. Let’s take a look at how the communication mode is automatically switched. At your terminal program, proceed with the following instructions:

Dialing out using ISDN mode

The command “ATDI” tells your TA that you want to make an ISDN data call and to therefore use the ISDN mode to call out.

Type:

`ATDI17142630398<enter>` *(Make an ISDN call)*

Dialing out using ISDN mode’s optional Speech Bearer Service

Your TA supports ISDN data utilizing Speech Bearer Service. To enable this function, you need to set S-register S83 bit 7 to 1 (ATS83.7=1). This function is useful in the areas where ISDN service providers charge lower usage rate for voice (speech) calls. To enable this function, type:

```
ATS83.7=1<enter>
```

To disable it, type:

```
ATS83.7=0 <enter>
```

Dialing out for Analog Adapter Port 1 (omni.net Internal)

Using the “B” command following the “ATD” will tell your TA to automatically switch call to analog adapter, Phone 1, once dialing is complete.

Type:

```
ATDB17146930762<enter>
```

NOTE: You must have an analog modem connected to your analog port before you issue this command.

Dialing out for Analog Adapter Port 1 (omni.net)

Using the “A” command following the “ATD” will tell your TA to automatically switch call to analog adapter, Phone 1, once dialing is complete.

Type:

```
ATDA17146930762<enter>
```

NOTE: You must have an analog modem connected to your analog port before you issue this command.

Dialing out for Analog Adapter Port 2 (omni.net)

Using the “B” command following the “ATD” will tell your TA to automatically switch calls to analog adapter Phone 2, once dialing is complete.

Type:

```
ATDB17146930762<enter>
```

NOTE: You must have an analog modem connected to your analog port before you issue this command.

Manually switching communication modes (non-data)

The manual switching functions will only be necessary if your communication software does not allow you to change your dial-up string.

Conventional dialing commands: ATD, ATDT and ATDP, used by many existing communication software, can be mapped onto one of the new dialing commands according to the AT&O setting as follows:

AT Command	Dial string it will map to
AT&O0	ATD, ATDT and ATDP are the same as ATDB.
AT&O2	ATD, ATDT and ATDP are the same as ATDI.
AT&O3	ATD, ATDT and ATDP are the same as ATDA.

The factory default is **AT&O2**. This means the TA will select ISDN data mode when you do not specify which communication mode to use (i.e. ATD or ATDT).

Placing the Call

To initiate a call, choose the proper communication mode and configure the mode according to the bearer service (or protocol) you want to use. Here are some simple commands that will be useful when placing a call:

Command	Description
ATB*nn*	Changes ISDN B channel protocol setting.
ATDL	Re-dials the last dialed telephone number.

Incoming Calls

When a call comes in, it will be carried by one of the following protocols:

- V.120
- HDLC PPP, MPPP or SLIP

- V.110
- X.75

or the call may be initiated by an analog device (non-data).

This section will provide some general guidelines for setting up the device for call answer handling. Be aware that the TA will not automatically answer a call unless S-register **S0** is set to a value greater than 0 (zero). If S-register S0=0, the TA will only report "RING" to your terminal program. It can also respond with an audible tone (external) that will allow you to decide whether or not you should take any action.

When an ISDN data call comes in, the TA will try to negotiate a connection using the proper ISDN protocol.

When an analog call comes in, the TA will send the call to the analog port as the factory default, Phone 1 and then Phone 2 (non-data).

Digital Data

The omni currently supports Circuit Switched Data (CSD) for ISDN data applications. The CSD protocols supported by the TA include: PPP, MPPP, V.120, X.75, and V.110. PPP is the most popular protocol used in North America; it is used by most Internet service providers. Once the TA answers a call, it will examine the incoming data to determine which protocol to use, and automatically switch to this mode. The TA is able to auto-switch for PPP, MPPP, V.120, X.75, V.110, and above protocols over the speech channel. In most cases, you can rely on the auto-switching feature for your applications. If you need more specific settings for answering calls, refer to the section entitled "Answering a Call using MSN" found later in this chapter.

Determining the Packet Length

The user's information is sent on a frame-by-frame basis for V.120 and X.75. Sometimes we call it "packetized." The maximum frame length on the sending side should not exceed the maximum frame

length that the receiving side allows. Sometimes this information will be exchanged during handshaking. However, few manufacturers, if any, have implemented this mechanism.

If the sending side sends packets greater than what the receiving side allows, the receiving side will discard the frame and reply with a Frame Reject frame (FRMR). FRMR indicates that the information received is too long. Both sides will then reset their link layer negotiation and re-send the frame again. Usually this will happen repeatedly until the call gets disconnected.

The omni has a fixed maximum receiving frame size of 2048 octets which is larger than most devices can support. The default maximum sending frame size is 252 octets for V.120 and 2048 for X.75. If you need to change the maximum sending frame size, the ATCL command should be used.

Type:

```
ATCL252<Enter> (Set the frame size to 252 octets, user value between 1-2048)
```

TA responds:

```
OK
```

Type:

```
ATCL?<Enter> (To inquire about the current setting of the packet length)
```

TA responds:

```
Maximum user data length in a packet (byte) : 252
```

Answering a Call using MSN

When answering an incoming call, the call will first be identified if the caller number matches the MSN settings.

The Multiple Subscriber Number (MSN) supplementary service enables multiple ISDN numbers to be assigned to a single ISDN BRI line. It allows the caller to select, via the public network, one or more distinct terminals from a variety of terminal choices. Since the Omni

supports many different communication protocols and two analog adapters, each of these ports can be assigned to an ISDN number using the following command:

AT&ZIn=s (where 's' is the MSN)	
&ZI0=s	Assigns MSN 's', phone number for X.75.
&ZI1=s	Assigns MSN 's', phone number for V.110.
&ZI2=s	Assigns MSN 's', phone number for V.120.
&ZI3=s	Assigns MSN 's', phone number for PPP, MPPP.
&ZI4=s	Assigns MSN 's' for ISDN data, protocol auto-detection.
&ZI6=s	Assigns MSN 's', phone number for Phone 2 (omni.net).
&ZI7=s	Assigns MSN 's', phone number for Phone 1 (non-data).

AT&ZI? can be used to display the MSN numbers. The factory default for these numbers are UNASSIGNED.

If an incoming SETUP message is offered with addressing information (i.e. the appropriate part of the called_party_number), this address will be compared with the MSN numbers assigned by the AT&ZIn=s commands. The call will be accepted using the specific protocol, if the assigned number of this protocol matches the received called party number.

NOTE: You are not required to enter the complete number string for the AT&ZIn command. The last few distinguishable digits will be enough for the TA to make the decision. Two phone number strings are said to be matched if their least significant "n" digit(s) are identical, where "n" is the number of digits in the shorter string.

Called_Party_Subaddress information within the incoming SETUP message can also be used to select the protocols and/or analog ports. In normal conditions Called_Party_Subaddress information is not used by the TA to select the protocols or services, but only indicates the subaddress (if any) to the DTE. Refer to Chapter 12 for more detailed information.

Data over Speech Channel

If you are expecting ISDN data calls through the Speech (Voice) channel, you need to setup MSN for it. For non-data models if no MSN entries are found in MSN ISDN data lists, all Speech (Voice) calls will be sent to either Phone 1 or Phone 2. Which entry to use would depend on the type of data call that you are expecting. If you only expect PPP calls, you should enter the number that the remote user will use to dial in entry #3 (AT&ZI3=xxx) or entry #5 (A&ZI5=xxx). Once this is set, the TA will attempt to use PPP protocol to handshake with the remote site whenever a caller dials into this number.

Best-effort call answering (non-data)

If some numbers have been set using the &ZIn command (this can be seen by issuing the AT&ZI? command) and they are not matched with the address of the incoming call, the TA will, by default, ignore the call as it may be intended for other devices that share the same S/T interface (S0 bus) with the TA.

If you want the TA to answer inbound calls using all possible protocols, you can set the best-effort call answering bit as follows:

Command	Function
ATS119.3=0	Answer call only when number matched. (default)
ATS119.3=1	Best effort call answering.

Ambiguity resolution switch for voice calls (omni.net)

For a Speech or voice-band-data call, if the &ZI number assignment can tell which of the analog adapters is being addressed, then the call will be delivered to the proper destination. But sometimes, ambiguity of address matching may exist. This may happen if the &ZIn numbers of the various protocols are either unassigned or not matched. In this case, users may wish to set answering priority to an analog port. The **AT&L*n*** command sets the address ambiguity resolution flag as follows:

AT&L0 - Analog adapter 1 has the higher priority to answer a voice or voice-band-analog-data call; if analog adapter 1 is busy, the call will be routed to analog adapter 2.

AT&L1 - Analog adapter 2 has the higher priority to answer a voice or voice-band-analog-data call; if analog adapter 2 is busy, the call will be routed to analog adapter 1.

Multi auto-answering of data calls

When an ISDN data call comes in, the TA can determine the protocol to be used in one of two ways:

1. By way of the information conveyed by the SETUP message (for DSS1, these include the Bearer-Capability, Low-Layer-Compatibility, or High-Layer-Compatibility information elements; for 1TR6, these include the Service Indicator as well as an Additional Octet of the Service Indicator)
2. By the Multi Auto-answering process. The TA determines the protocol by monitoring the B channel signal sent by the calling site.

With either method, the data call can be identified by the TA to be X.75, V.110, V.120, or PPP, MPPP Async-to-Sync conversion.

If the address-matching process is again unable to tell which protocol to use, the TA will go into its “Multi Auto-answering Routine,” by examining the B channel data pattern and hence determine the protocol to use.

When alerted, the TA will send a RING message to the DTE in the following format:

```
RING
FM:17145522863 TO:17142630398
```

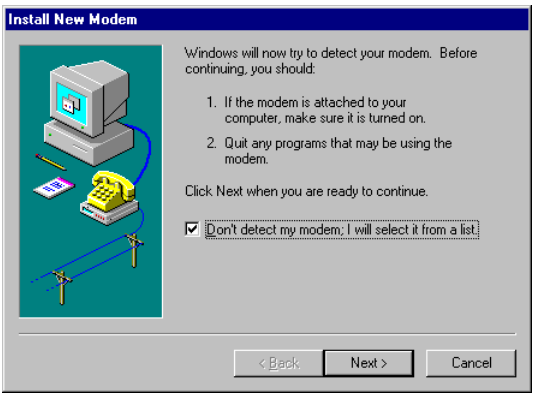
6 Setup for Windows 95 and NT 4.0

This chapter contains step by step procedures for installing the Windows 95 and NT drivers, and configuring Dial-up Networking for all omni series TA's.

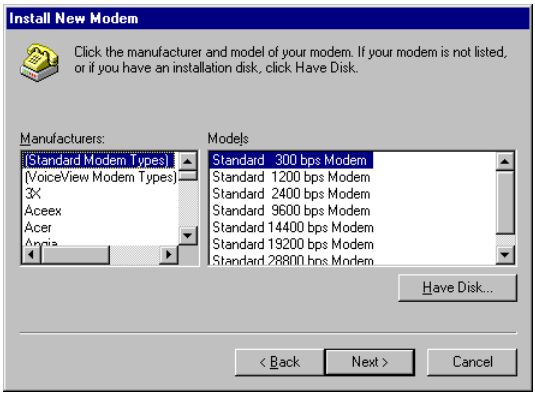
Installing the Windows 95 Driver (INF file)

If your computer supports Plug & Play be sure your TA is powered on before starting your computer. If you are using a non PnP protocol follow the steps below to complete installation:

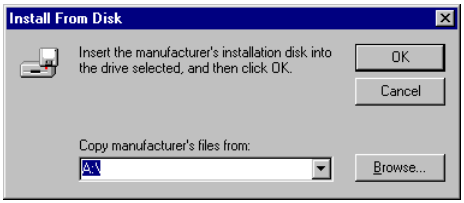
1. From the desk top click the **Start** button, then choose **Settings**, and then click **Control Panel**.
2. Double click on the **Modems** icon then click the **Add** button. The following dialog box will appear.



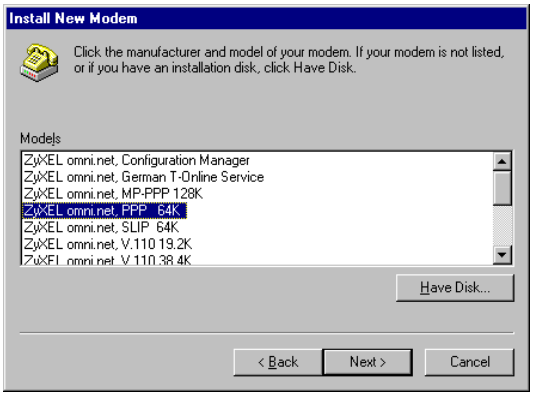
3. Select **Don't detect my modem; I will select from a list.** Then click **Next**.



4. Click the **Have Disk** button.



5. Insert the ZyXEL Windows 95 driver disk into your floppy drive and click OK. If you have downloaded an updated INF file from ZyXEL's FTP, website, or BBS, use **Browse** to find the location of the updated .INF file, click **Open**, then click **OK**.



6. Select the driver with the protocol that your host is using. Generally, the samples listed below will work. However, we

recommend that you check with your ISP to verify the protocol they use.

If you are connecting to an Internet Service Provider (ISP), select:

- ZyXEL omni (your model), PPP 64K

If the ISP has not upgraded to an ASEND compatible server, select:

- ZyXEL omni (your model), V.120 64K

If you are calling another location such as a BBS system, select:

- ZyXEL omni (your model), V.120 64K

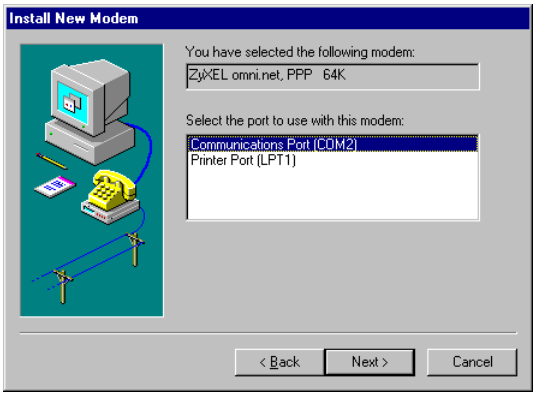
If you dial up to CompuServe, select:

- ZyXEL omni (your model), V.120 64K

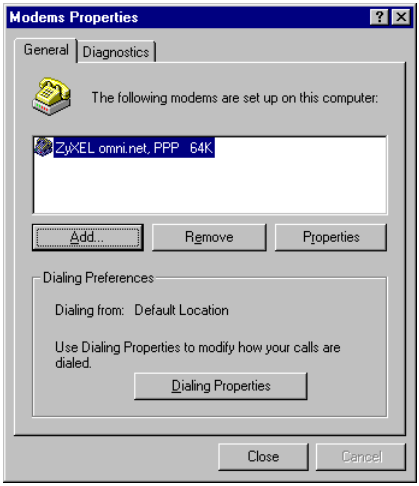
If you are calling MicroSoft Network's (MSN) ISDN line, select:

- ZyXEL omni (your model), PPP 64K

After you have completed the selections above, click **Next**.



1. Select the COM port your TA is connected to and click **Next**. A final dialog will appear. Click **Finish**. You should see a window similar to the one below:

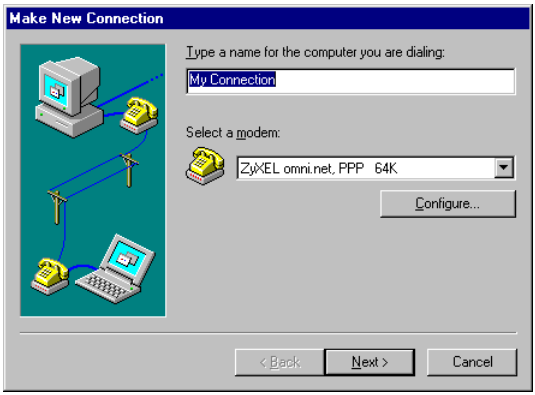


2. Click **Close**. This completes the installation of your omni modem driver.

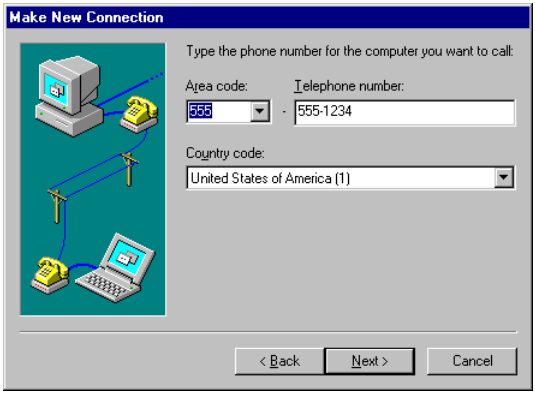
Configuring Windows 95 Dial-Up Networking

This section assumes you have already fully installed Windows 95. If you have not installed the Dial-Up Networking feature in Windows 95, please install it before you continue.

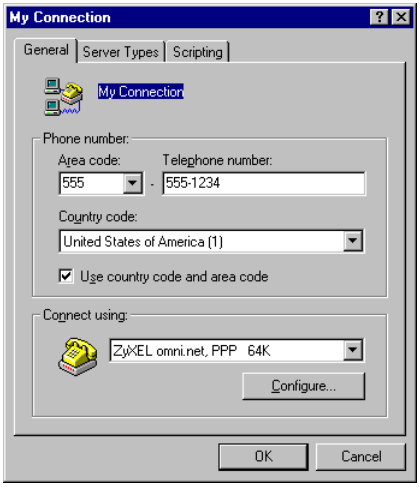
1. From the Windows 95 desk top double click on the **My Computer** icon, then double click on the **Dial-up Networking** icon.
2. From within the Dial-up Networking dialogue box, double click on the **Make New Connection** icon.



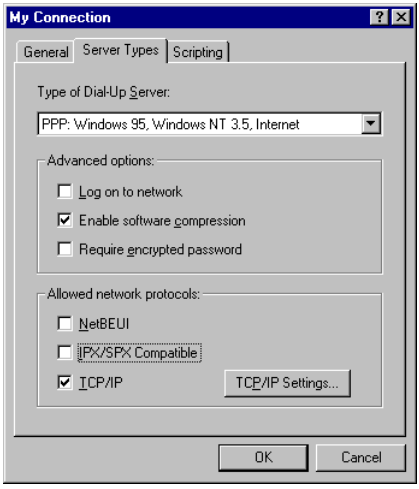
3. Choose a name for your connection and select your modem type from the drop down window. Then click on the **Next** button.



4. Type the phone number of your ISP or of host you will be calling. Click on the **Next** button.
5. Click on the **Finish** button. A new icon is created in the Dial-up Networking folder.
6. Right click on this icon, then select **Properties** from the menu.



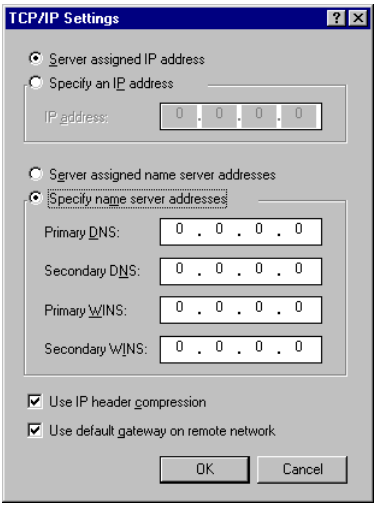
7. Make sure your TA appears in the Connect Using box. Then click on the **Server Type** button.



- These options are mostly host or server specific.
- If you are using PPP, use the default settings shown above.
- If you are connecting to a LAN, then select **Login to Network**.

- If you are logging on to a Microsoft Windows network, select **NetBEUI**.
- If you are logging on to a Novell network, then select **IPX/SPX Compatible**.
- If you are logging on to an Internet connection, then select **TCP/IP**.

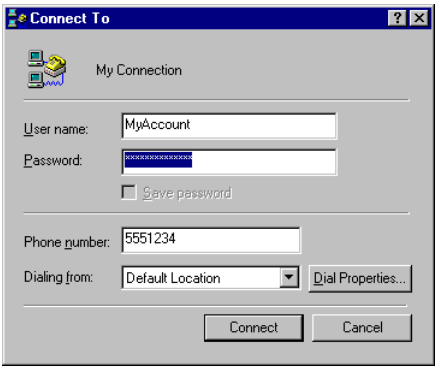
8. Click on **TCP/IP Settings**.



If your host requires you to specify an IP address (Static IP), then click on the **Specify an IP address** radio button and enter your IP address. Otherwise, leave the Server assigned IP address checked. Most servers assign an IP to you when you log in.

Click the **Specify name server address** radio button and enter your primary and secondary DNS (Domain Name Server) IP. Obtain the DNS numbers from your ISP. In most cases, you should leave Use IP header compression and Use default gateway on remote network checked. When all of the selections have been made, click **OK**.

9. This completes the remote connection definition. Locate the new connection icon in your Dial-up Networking folder, and double click on it.

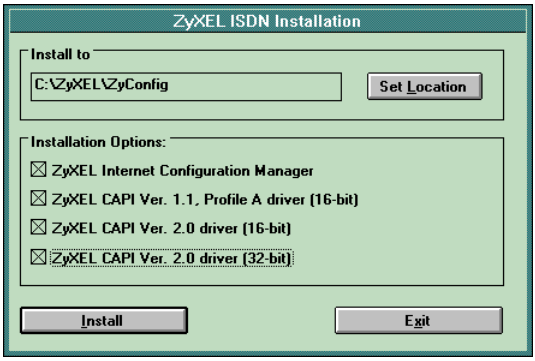


10. If the User name and Password are incorrect or are not there, type them in. Click on the **Connect button** and your TA will dial the number and establish a connection.

CAPI Installation

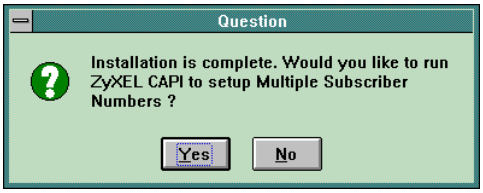
Follow the steps below to install the ZyXEL Internet Configuration Manager and ZyXEL CAPI drivers:

1. From the Win95 **Start** button choose **Run**.
2. From the Run dialogue box type: **A:\Setup.exe** and click **OK**.
3. From the ZyXEL ISDN Installation dialog box choose the appropriate CAPI driver and click the **Install** button.

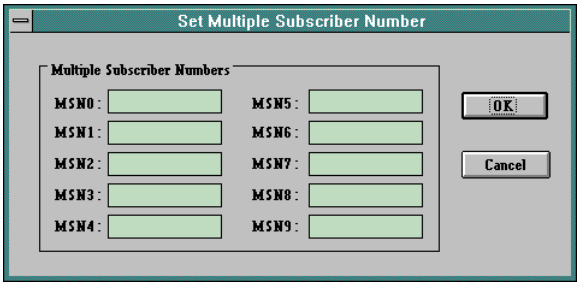


4. From the Question dialogue box click **No** if you do not wish to setup Multiple Subscriber Numbers. This completes CAPI installation. If you click **Yes** continue with the steps below:

   Only CAPI 1.1a requires setup of Multiple Subscriber Numbers.



5. From the Set Multiple Subscriber Numbers dialog box type in the desired numbers and click OK.



7 Point-to-Point Protocol (PPP)

Introduction

Point-To-Point Protocol is designed for simple links which transport packets between two peers. These links provide full-duplex simultaneous bi-directional operation, and are assumed to deliver packets in order. PPP is intended to provide a common solution for easy connection for a wide variety of hosts, bridges and routers.

In the process of configuring, maintaining and terminating the point-to-point link, PPP goes through several distinct phases which are specified in the following simplified state diagram:

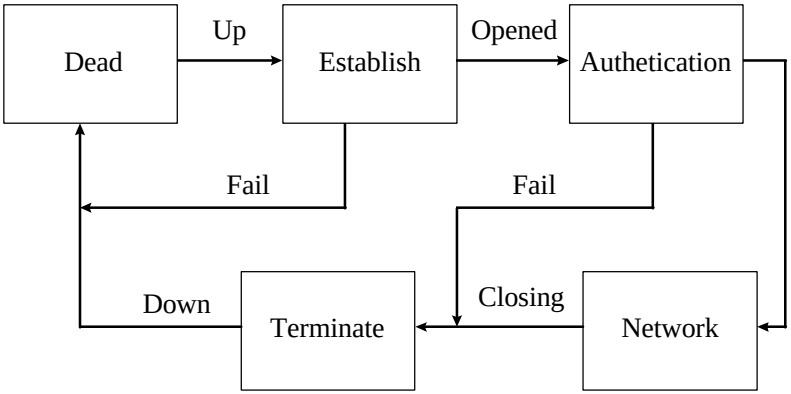


Figure 7-1 Point to Point Link Pathway

Data will be transmitted only when the link is in the open phase. Negotiation details are described in RFC1661.

Feature list

Async to Sync Conversion (external)

PPP uses HDLC-like framing as encapsulation, which can be bit-oriented or character-oriented. Most ISDN routers use bit-oriented HDLC framing, also known as synchronous transmission. However, serial transmission in most personal computers is still character-oriented, also known as asynchronous transmission. In order for an ISDN router and PC to communicate, it's necessary to do asynchronous to synchronous conversion. The omni can be used as a bridge. Any data from a PC to a ZyXEL TA will be converted from asynchronous to synchronous form and vice versa. PPP HDLC framing is described in RFC1662. PPP over ISDN is described in RFC1618.

Related command:

- **ATB40** - Async to Sync PPP conversion.

Authentication conversion

After a link is established, it is necessary to authenticate the peer for security reasons. There are two popular authentication methods. One is Password Authentication Protocol (PAP) and the other is Challenge Handshake Authentication Protocol (CHAP). PAP is less secure because it transmits the username/password in plain text form. Unlike PAP, CHAP transmits the username/password in coded form. Some ISPs may support CHAP as the only method for authentication. For those applications which do not support CHAP, the omni converts PAP into CHAP. By default, the PAP/CHAP conversion is always activated, so the authentication from the TA to PC is always PAP. That means you must configure your software to accept plain text as password authentication. Do not worry about password leakage, the TA will send the password out in hashed form

by CHAP. Sometimes CHAP can not be supported by the ISP. You may set S87.2=1 to use PAP only. If you do not want to do authentication at all, set S118.3=1 to disable the conversion.

NOTE: Disabling authentication may cause problems in Windows 95.

CHAP is described in RFC1994 and PAP is described in RFC1334. The only hash method supported by CHAP is MD5, MS-CHAP isn't supported yet. At this time authentication conversion works for clients only.

Related commands:

- **ATS118.3 = 1** - Disable authentication conversion.
- **ATS118.3 = 0** - Enable authentication conversion depends on S87.2 (default).
- **ATS87.2 = 1** - Accept PAP/None only.
- **ATS87.2 = 0** - Accept CHAP/PAP/None (default).

Compression Control Protocol (CCP)

The ISDN channel can be utilized more effectively when using compression. Compression Control Protocol (CCP) is used by PPP to negotiate compression methods between peers. CCP starts after the PPP reaches the network phase. Both ends must support the same compression method to start packet compression. ZyXEL supports STAC/LZS. Right now STAC/LZS is only supported with single history check mode 0 (none), 3 (sequence) and 4 (extended). Mode 1 (LCB) and mode 2 (CRC) are not supported due to patent limitations. CCP negotiation is described in RFC1962. STAC/LZS is described in RFC1974. The TA will monitor the DTE's activity. If software compression has been negotiated, the TA will automatically disable STAC/LZS compression.

Related commands:

- **AT&K00** - Disable CCP negotiation (default).
- **AT&K44** - Enable CCP negotiation.

Multilink PPP

There are two B channels in basic rate ISDN. This offers the possibility of opening multiple simultaneous channels between systems giving users additional bandwidth on demand. Multilink PPP is a method for bundling both B channel into one PPP link for higher throughput. It must be negotiated in the link establish phase by both peers. If Multilink PPP is negotiated successfully, the second link will be dialed after the first link reach network phase. In some countries the directory number is not the same for both channels. For dialing the second B channel with a different directory number, both numbers must be obtained before dialing out unless the peer supports BACP/BAP, which will be described later in this chapter. Multilink PPP is described in RFC1990.

Related commands:

- **AT&J3** - Enable Multilink PPP.
- **ATDI<num1>[+<num2>]** - Dial Multilink PPP with num1 twice or with num1 and num2 if they differ.
- **ATS61.3 = 0** - Use rotate method to bundle both channels (default).
- **ATS61.3 = 1** - Use split method to bundle both channels.
- **ATEPDn = <num>** - Set End Point Discriminator (EPD) for class n (0-5). I is not required to change the default settings in most cases unless your ISP provides these values.

Call bumping

You can place or answer a voice call from a device that is attached to one of the POTS ports while Multilink PPP is active. The omni drops one of the channels automatically and uses it for voice calls. Once a voice call ends, the TA automatically reestablishes the channel. For fully disconnecting with the central switch, there is a delay time between on-hook phone and channel reestablishment. The delay for reestablishing the channel is 10 seconds. During call bumping, the

traffic for BOD is still under calculation. In other words, the add persist time is calculated from the time when the traffic is above the add threshold whether or not the phone is on-hook or off-hook. However, it won't dial until the phone has been on-hook for 10 seconds.

Call bumping works for both client (dialing) side and server (answering) side. However, the channel reestablishment is only effective on the client side.

Related commands:

ATCE0 - Disable the call bumping function.
ATCE1 - Enable the call bumping function (default).

Bandwidth On Demand (BOD)

The function of bandwidth on demand (BOD) will monitor the traffic on ISDN links while Multilink PPP. If there is light traffic on the link, one of the channels will be dropped automatically. On the other hand, if only one B channel is used and data traffic is high enough, BOD will establish the second B channel to increase the bandwidth of the data link. The wait for the second B channel's carrier is 60 seconds. If the second B channel can't be connected successfully the BOD will try again after 60 seconds. If the second call is connected but negotiation failed, it will be retry three times. If a connection is not established after the third try the Multilink PPP will be disabled automatically.

For BOD, there are four parameters to set high/low threshold and persist time. Traffic utilization is measured in the ISDN link. Highly compressible data may not generate enough traffic to start the second B channel. Both add persist time and subtract persist time must be set to activate BOD.

Related commands:

- **ATJAn** - Add traffic threshold for n K bits per second, n = 48 (default).

- **ATJSn** - Subtract traffic threshold for n K bits per second, n = 32 (default).
- **ATKAmn** - Add persist time for n period in m unit, n = 0 - 127, m = s for seconds and m for minutes.
- **ATKSmn** - Subtract persist time for n period in m unit, n = 0 - 127, m = s for seconds and m for minutes.

BACP/BAP

Bandwidth Allocation Control Protocol and Bandwidth Allocation Protocol is used for call request and link drop under Multilink PPP. BACP is negotiated during the network phase. Without BACP/BAP, the directory numbers of both B channels must be specified before dialing out. In some cases, it is not possible for the ISP to support more than one chassis that is capable of bundling both channels at the same time. With BACP/BAP, the second B channel's directory number can be obtained while requesting a call. The second directory number is not necessary any more. The BACP/BAP is supported on the client side only. The server side of BACP/BAP will be implemented in an upcoming release.

Related commands:

ATBP0 - Disable BACP/BAP negotiation.

ATBP1 - Enable BACP/BAP negotiation (default).

NOTE: The status of BACP/BAP negotiation can't be saved in profile. It's enabled after power on. The status can be changed only by the power cycle of another ATBP command. AT&F and ATZ doesn't change the status.

8 V.110 and Synchronous Mode Communications

V.110 is most popular in Japan. The table below shows the specifications of different ISDN protocols:

	Synchronous (external)	**V.110**	**X.75/V.120**
Layer 1	Transparent	80 Bits Framing	HDLC
Layer 2	None	None	LAPB/LAPD
Layer 3	None	None	ISO8208 T.70 NL/ V.120
Error Control	No	No	Yes
V.42bis	No	No	Yes
Async or Sync	Sync	Async	Async
Bundle	Yes (Note)	No	Yes
Max. Line Speed	64Kbps 128Kbps (Note)	38.4 Kbps	64Kbps 128Kbps
AT-Command Configuration	ATB11&M1 (Sync Data) ATB11&M3*I1 (V.25bis Sync HDLC)	ATB10	ATB0: Transparent ATB01: T.70 NL/ ATB20
Note : BONDING protocol for synchronous mode will be F/W upgradeable at ZyXEL‘s option.			

Answering a V.110 call

Once you set the proper V.110 communication mode, there is no need to configure the ISDN mode to the protocol of an incoming call. The omni will be able to determine the correct protocol to use by examining the data coming in from the remote site if the device is set to auto-answer or once an answer command is issued.

To allow the TA to answer the incoming call, you need to set S0 to a value greater than 0 (i.e. ATS0=1). If S0 is not set (S0=0), the DCE

will report “RING” to your terminal. External models will also make an audible ring notification.

Making V.110 Calls

Before the **ATDIxxx** command is given to place the call, you need to make sure that the TA is in asynchronous mode (AT&M0). Then use the following commands to configure V.110:

AT Command	Description
ATB10	User rate follows DTE speed (see note below).
ATB13	User rate = 2400bps.
ATB14	User rate = 4800bps.
ATB15	User rate = 9600bps.
ATB16	User rate = 14400bps.
ATB17	User rate = 19200bps.
ATB18	User rate = 38400bps.
ATB19	User rate = 57600bps (Japanese version only).

The highest Async V.110 user rate depends on bit 4 of S119 as follows:

S119.4=0	19200 bps.
S119.4=1	38400 bps for areas other than Japan (default).
S119.4=1	57600 bps for Japanese version.

If the DTE speed is higher than what has been set, the user rate on above table will be used.

Synchronous Connections (external)

Use the following commands to choose the data rate for synchronous operation :

ATB11	64000bps

There are two modes of synchronous operation:

1. **Asynchronous commands, synchronous data (AT&M1):** The omni accepts AT commands in asynchronous mode. Once the call is connected, it enters synchronous mode for data transmission.
2. **Synchronous mode (AT&M3*I1):** The omni accepts synchronous commands from V.25 bis or a PC with an add-on synchronous card, and exchanges data synchronously with a remote TA.

Note: The omni does not support network independent clock compensation. The synchronous timing source must be supplied by the omni , which is phase locked to the network synchronous clock.

When in V.25bis command mode, the omni supports the bit-oriented HDLC (High-Level Link Control) synchronous protocol which most synchronous communication links use. Use AT*Ii to enable V.25bis commands. For synchronous applications the TA is set for use with one application, in normal situations. Save the desired settings in the power-on profile and the TA will start up in synchronous mode with V.25bis enabled. A special command set RST is provided to get the TA back to asynchronous AT command mode from V.25bis mode.

When the TA is used as a DCE device with a router or main-frame system, use the following command string for best results:

AT&S1&M3*I1&W0Z0

V.25bis Command Set

Command Messages	
CRN <dial string	Dial command with number provided.
CRS*n*	Dial command with number from memory, 0<=n<=39; n is the memory location.
PRN*n*;<number>	Saves <number> to address n (0<=n<=39).
CIC	Receive incoming calls.
DIC	Reject incoming calls.

Command Messages	
RST	Changes to asynchronous AT command mode.

Indicator Messages	
CNX	Call connect.
INC	Incoming call.
VAL	Valid command.
INV	Invalid command.
CFLxx	Call Failure.
NT	Answer tone is not detected.
AB	Abort call.
ET	Engaged tone.
NS	Number is not stored.
RT	Ring tone.

DTR Drop-Dialing Operation

The omni will automatically dial the phone number stored in the NVRAM when it detects an off-to-on transition of the DTR line. Before you enable the DTR drop action, a phone number must be stored and saved to memory along with an indication of which number to dial on DTR drop. First use AT&Zn=s (n=0-39, s=phone number) to store the phone number into NVRAM. Then, use AT*Dn (n=0-39) to choose which of the in-memory phone numbers should be dialed. Finally issue an AT&D1 to enable DTR drop dialing operation.

Note: Phone numbers must include a prefix for specific call types, e.g. I for ISDN.

An example of DTR drop dialing is given below. The destination phone number is 5551234.

1. Issue the command

   ```
   AT&Z0=I5551234
   ```

   to save phone number to NVRAM.

2. Issue the command

   `AT*D0`

   To set phone number 0 as the DTR drop destination phone number.

3. Issue the command

   `AT&D1`

   Enable DTR dialing operation.

4. Turn the TA off and back on.

9 V.120 ISDN Communications

This chapter describes how to set-up and configure your TA with the V.120 ISDN protocol. The table below shows the specifications of different ISDN protocols:

	V.110	**V.120**	**X.75**
Layer 1	80 Bits Framing	HDLC	HDLC
Layer 2	None	LAPD	LAPB Transparent
Layer 3	None	V.120	ISO8208T.70 NL
Error Control	No	Yes	Yes
V.42bis	No	Yes	Yes
Async or Sync if used with V-Series DTE	Async Only	Async Only	Async Only
Bundle	No	Yes	Yes
Max. Line Speed	Async: 38.4 Kbps	64Kbps 128Kbps	64Kbps 128Kbps
AT-Command Configuration	ATB10	ATB20	ATB00 Transparent ATB01: T.70 NL

Placing outgoing calls

Some switches transmit all network signals through the D channel (out of band signaling), allowing both B channels to be used exclusively for your communication purposes. This allows for throughput of 64Kbps per channel. However, not all switches support out-of-band signaling at this time. For switches that do not

support out-of-band signaling, network signals are transmitted through the B channels. This reduces the bandwidth to 56Kbps.

When you are making a V.120 call, make sure that the communication supports out-of-band signaling. If it does not support out-of-band signaling, you will need to set your TA to 56K mode using the AT&E1 command (AT&E0 to set it back to 64k mode.) If your TA is on the receiving end, you can keep the setting at AT&E0, 64k data mode. The TA will automatically switch between the two speeds in answer mode.

Configuring the V.120 mode

To configure for a 56K V.120 call, type:

`ATB20<Enter>` *(Select V.120 for communication)*

TA responds:

`OK`

Type:

`AT&E1<Enter>` *(Select 56K data mode)*

TA responds:

`OK`

Now you are ready to dial the phone number. If you need to save the setting into non-volatile RAM, issue the commands:

Type:

`AT&W0<Enter>` *(Save the settings to profile 0) [Profiles available: 0-3]*

TA responds:

`OK`

Type:

`ATZ0<Enter>` *(Save stored settings as the power on settings to profile 0) [Profiles available: 0-3]*

TA responds:

`OK`

All the above commands can be simplified by combining all of the commands onto one line as follows:

```
AT&B20&E1&WZ0<Enter>
```

Dialing in V.120 mode

Finally, use the **ATD*n*** command to make the call (*n* is the phone number you wish to dial). Once the connection is made, you should see the following connect message.

```
CONNECT 115200/V120 56000/LAPD
```

This indicates that the connection is made with:

- DTE speed of 115,200bps.
- V.120 Protocol
- Data Speed of 56,000bps.
- Error Control LAPD.

Answering incoming calls

In most cases, there is no need to configure the TA to properly answer calls. The TA is able to decide which protocol to use by detecting the type of data that is coming in. All you need to do is set S0 to greater than or equal to 1, so the TA will automatically answer an incoming call. If S0=0, the DCE will simply report “RING” to your terminal. External models will also make an audible ring notification.

One exception to this is when the ISDN data call is carried through Speech bearer. In this case, you would need to make an MSN entry for the phone number that you are expecting the Data-over-Speech-bearer call. Use **AT&ZI2=*n***. Refer to the section entitled “Data over Speech Channel” in Chapter 5 for details.

Speeds of 128Kbps

BRI ISDN consists of three (2B+D) logical channels. Each B channel can be used independently for a dial-up connection running at 56Kbps or 64Kbps (bits per second).

The two B channels can be used together for a single data connection to provide 112K (with In-Band Signaling) or 128K (when Out-of-Band Signaling is used). It is called a “Bundle Connection”.

The type of channel bundling described in the V.120 section is supported only between the following ZyXEL products: omni.net series, Omni TA128, or Elite 2864I, and uses Multiple Link Protocol (MLP) and “cFos” channel bundling (CCB).

Identifying your line provisioning

For bundled connections, the two B channels of your ISDN line must be able to handle data circuit switch connections with unrestricted 64K or 56Kbps line speeds. Two separate data calls will be established consecutively.

Making a Bundled Call with V.120

A bundled V.120 connection is initiated at the calling site when **ATB20** (B channel protocol V.120) has been selected and the channel bundling mode has been enabled by an **AT&J3** command. The channel bundling command (AT&J3) must be set on both the calling and receiving sides, otherwise a single channel connection will be made.

Type:

`ATB20<Enter>` *(Set B channel protocol to V.120)*

`AT&J3<Enter>` *(Set the TA to make a bundled call)*

Type:

`AT&WZ<Enter>` *(If you want to save the setting)*

Once this is done, the ATD command will generate two consecutive SETUP messages to invoke bundle initiation.

For the Northern Telecom switch, each BRI phone number can only be called once at any given time. So if you dial this number, it will report “busy” to any other incoming calls. In order to use two B channels for aggregation, we must place two calls with different phone numbers. To do this, separate the two numbers with a “+” sign after the “ATD” command:

```
ATDI[phone_number_1]+[phone_number_2]<Enter>
```

The answering TA determines that the call is a bundle request: when AT&J3 is set, and two consecutive SETUP messages are received. The two data calls are established as one message. The phone company’s ISDN line splits it off into two messages. That is, the ISDN network treats them as two independent calls. Finally, the receiving side receives one bundled message into the computer’s serial port.

The success of a bundle connection initiation is indicated by the connect message reported to the DTE:

```
CONNECT 115200/V120M 128K/LAPD
```

or

```
CONNECT 115200/V120M 128K/LAPD/V42b
```
(with data compression)

If you are not using American ISDN, you can have a choice between Multiple Link Protocol (MLP) or “cFos” channel bundling (CCB) two bundle protocols. You can set them by using the following commands:

```
ATS100=0 MLP channel bundling
ATS100=1 CCB channel bundling
```

Dialing pre-stored phone numbers

Use ATDSn, n=0,1,..,39, to dial the (n+1)th phone number twice for both the bundle connections. Use ATDSn+Sm, (n and n=0,1,...,39)

to dial the (n+1)th phone number for the first connection and the (m+1)th phone number for the second connection.

For example, ATDIS0+S1<Enter> will dial the number stored in location ‘0’, and the number stored in location ‘1’ for the bundle connection.

Error Correction and Data Compression with V.120

With V.120, the default setting is for LAPD error correction only. No data compression will be negotiated. The following AT commands are used to switch the V.42bis data compression on or off for ISDN data calls when using V.120 protocol.

- **AT&K44** - enables V.42bis on ISDN calls.
- **AT&K00** - disables V.42bis on ISDN calls.

With the **&K44** setting, the TA will try to connect using V.42bis data compression. If the remote device doesn’t support V.42, then LAPD error correction will be used.

When a connection is made using V.42bis compression, the following connect message will be displayed.

```
CONNECT 115200/V120 56000/LAPD/V42b.
```

It takes extra time for the calling ISDN TA to negotiate V.42bis. If you know in advance that the called site has no V.42bis capability, it would be better to issue the **AT&K00** command beforehand in order to get a quick connection.

Since the V.42bis algorithm needs an error-free transmission channel between the compression and decompression processes, it can only work with a protocol with error control competence. X.75 and V.120 are such protocols that can be used together with V.42bis data compression. V.110, on the other hand, is just an R-interface layer 1 adaptation protocol without error-control and is thus inadequate for V.42bis.

Bundle Connection with V.42bis Data Compression

If both sites have set **AT&K44** to enable V.42bis negotiation then XID frames will be exchanged through the main B channel which corresponds to the call established by the first SETUP message.

Only one data compression channel will be used in bundle connections. That means the compression is done before packet disassembly and the decompression is done after packet assembly. The compression ratio of V.42bis is commonly recognized as up to 4:1 for text files. If the line speed is 128K bps, then the DTE speed may reach 512K bps. This makes the DTE's normal RS-232 serial port unsuitable for bundle applications. A special I/O card on the computer side is required in this situation.

Selecting V.120 for European ISDN (DSS1)

With European ISDN, V.120 is an option in the Bearer Capability (BC) information element, which is a mandatory information element in the SETUP message. Although we can specify V.120 in the Low-Layer-Compatibility (LLC) information element, some switches just don't deliver the LLC. Other switches do deliver the LLC, but the V.120 selection will be discarded midway.

If the called TA doesn't get any B channel protocol information from the incoming SETUP message and the remote device is a ZyXEL ISDN device, the TA will be able to identify the V.120 protocol automatically with the Multi Auto-answer routine. Otherwise, the handshake will fail.

Selecting V.120 for Germany National ISDN (1TR6)

1TR6 data connections are achieved by setting the **Service Indicator** to 7 (Daten_bertragung 64Kbps) and the **Additional Information** octet is used to select B channel protocols. Since there is no pre-defined code for asynchronous V.120, TA uses the

synchronous V.120 code to fill in the additional information octet. This approach might not work all the time.

10 X.75 ISDN Communications

This chapter will describe how to set-up and configure your TA with X.75 protocol. The table below shows the specifications of different ISDN protocols:

	V.110	V.120	X.75
Layer 1	80 Bits Framing	HDLC	HDLC
Layer 2	None	LAPD	LAPB Transparent
Layer 3	None	V.120	ISO8208T.70 NL
Error Control	No	Yes	Yes
V.42bis	No	Yes	Yes
Async or Sync if used with V-Series DTE	Async Only	Async Only	Async Only
Bundle	No	Yes	Yes
Max. Line Speed	Async: 38.4 Kbps	64Kbps 128Kbps	64Kbps 128Kbps
AT-Command Configuration	ATB10	ATB20	ATB00 Transparent ATB01: T.70 NL

X.75 was originally designed for packet-switched signaling systems in public networks to provide data transmission services. But it is now also used as the link layer for telematic services (as defined in T.90) in ISDN. These services include both ISDN circuit-switched mode (DTE-DTE communication) and ISDN packet-switched mode (DTE-DCE communication).

Answering an X.75 call

There is no need to configure the ISDN mode to the protocol of an incoming call. The omni will be able to determine the correct protocol to use by examining the data coming in from the remote site if the device is set to auto-answer or once an answering command is issued.

One exception to this is when the ISDN data call is carried through Speech bearer. In this case, you would need to make an MSN entry for the phone number from which you are expecting the Data-over-Speech-bearer call. Use **AT&ZI0=*n***. Refer to the section entitled "Data over Speech Channel" in Chapter 5 for details.

To allow the TA to answer the incoming call, you need to set S0 to a value greater than 0 (ie. ATS0=1). The TA will answer the call and use asynchronous to synchronous conversions to and from the DTE. If S0 is not set (S0=0), the DCE will report "RING" to your terminal. External models will also make an audible ring notification.

Making an X.75 Call

CAPI 1.1a specifies X.75 with T.70 NL as its default.

CAPI 2.0 specifies X.75 with transparent layer 3 as its default.

The default data protocol of the TA is ATB20 (V.120). X.75 protocols can be chosen using the following AT commands:

- **ATB00** - X.75 with transparent layer 3.
- **ATB01** - X.75 with T.70 NL.

The ATB0x commands not only specify the outgoing protocol, but also set the default layer 3 for an incoming X.75 call without layer 3 information. It is important for both ends of an X.75 connection to execute the same pre-assigned layer 3 protocol, as it reduces the chance that the TA will make the wrong protocol selection.

For European ISDN (DSS1), the Low-Layer-Compatibility (LLC) information element in the SETUP message can be used to specify the layer 3 protocol. Since this is an option for ISDN switches, some of the switches might not deliver the LLC information element to the remote end. There is no provision for 1TR6 switch to specify the layer 3 protocol for X.75 calls.

Making a Bundled Call with X.75

A bundle connection is initiated at the calling site by sending two consecutive SETUP messages to the network. The two SETUP messages are all the same except for the Call Reference values.

AT&J*n* can be used for bundle configuration as follows:

- **AT&J0** - Disables B channel bundling.
- **AT&J1** - Enables B channel bundling in answer mode only.
- **AT&J2** - Enables B channel bundling in call mode only.
- **AT&J3** - Enables B channel bundling in both call and answer modes.

The bundle protocol can be selected as follows:

- **ATS100=0** - MLP channel bundling.
- **ATS100=1** - CCB channel bundling.

If channel bundling is enabled, the **ATDIs** command will generate two consecutive SETUP messages to invoke bundle initiation.

For Northern Telecom ISDN, each BRI destination phone number can only be called once in any time. In order to use two B channels for aggregation, we must place two calls with different phone numbers. The following command can be used for this purpose:

```
ATDIphone_number_1+phone_number_2
```

If the called site receives two consecutive SETUP messages with the same Calling Party Number and Bearer Capability *(or Origination Address for and Service Indicator for 1TR6)* then it is deemed as a

bundle request. The two data calls are established following normal call control procedures. That is, the network treats them as two independent calls.

The omni uses X.75 Multiple Link Protocol or 'cFos' channel bundling protocol to coordinate the two B channels. The former would need an overhead of two octets for each packet. The success of bundle connection initiation is indicated by the connect message reported to DTE as follows:

```
CONNECT 460800 / X.75M 128K / V42b
```

If a B channel is unavailable at either site then the bundle initiation will fall back to single channel connection. In this case the connect message may be as follows:

```
CONNECT 460800 / X.75 64000 / V42b
```

Dialing Pre-stored Phone Numbers

The 40 phone numbers stored in the NVRAM can also be used to place a bundle call:

- Use **ATDS*n*, -** (*n*=0-39), to dial the (n+1)th phone number twice for both the bundle connections.
- Use **ATDS*n*+, -** (*n*=0-38), to dial the (n+1)th phone number for the first connection and to dial the (n+2)th phone number for the second connection.
- Use **ATDS*n*+S*m***, - (*n*=0-39; *m*=0-39), to dial the (n+1)th phone number for the first connection and the (m+1)th phone number for the second connection.

Invoking V.42bis Data Compression

The following AT commands are used to switch the V.42bis data compression on or off for ISDN data calls when using X.75 or V.120 protocols:

- **AT&K44** - (enable V.42bis on ISDN call)

- **AT&K00** - (disable V.42bis on ISDN call)

For X.75, to negotiate compression parameters with the remote ISDN terminal, we exchange XID frames before the Link Layer is established. The calling site will send an XID frame with V.42bis request to the called site. If the called site understands this XID's meaning, it will reply to an XID frame with a V.42bis request. If it is able to execute V.42bis; it will ignore the XID or reply to the XID frame with a V.42bis reject or empty information field.

The calling site will assume that the remote site is unable to execute V.42bis if it gets no reply for a period of time after sending the request XID. In this situation, normal connection without data compression will be established.

It takes about 2 seconds for the calling TA to send XID and wait until time out. If you know in advance that the called site has no V.42bis capability, it would be better to issue the AT&K00 command beforehand in order to get a quick connection.

Although not defined in X.75, XID frame is based on the encoding in ISO Standard 8885 and is used in V.42/V.42bis. In addition to the compression parameters, XID can be used to negotiate the packet parameters as window size, packet size ect.

Bundle Connection with V.42bis Data Compression

If both sites have set **AT&K44** to enable V.42bis negotiation then XID frames will be exchanged through the main B channel which corresponds to the call established by the first SETUP message.

Only one data compression channel will be used in bundle connections. That means the compression is done before packet disassembly and the decompression is done after packet assembly. The compression ratio of V.42bis is commonly recognized as up to 4:1 for text files. If the line speed is 128K bps, then the DTE speed may reach 512K bps. This makes the DTE's normal RS-232 serial port unsuitable for bundle applications. A special I/O card on the computer side is required in this situation.

11 Handling Analog Calls (non-data)

The omni.net, and omni.net Internal allow connection of analog devices (e.g. telephone, fax, PBX, or modem) to your ISDN line. This chapter will outline the steps you need to take to place and answer analog calls via your ISDN line.

Note: Remember, The omni.net Internal has one analog adapter. Phone 2 information applies to the omni.net only.

The analog adapter(s) use RJ-11 phone jacks. The pin assignment of the jacks are shown in Chapter 18.

German ZyXEL customers: The inner two pins of the RJ-11 are used for the Tip and Ring (or a and b signals in Germany, the two signals that connect to a telephone set). This is the standard pin assignment, but some BZT-approved telephones use the outer two pins for a and b. If this is the case, use the attached TAE adapter which has a unique interface definition or use an RJ-11 cable that connects the inner pins on one end and the outer pins on the other end.

The following table shows some of the most frequently used AT commands for your reference:

AT Command	Description
ATDAs	Automatically dial out for device connects to Phone 1, “s” represents the number string to dial.
ATDBs	Automatically dial out for device connects to Phone 2.
AT&V6	View current setting of analog adapter, Phone 1.
AT&V7	View current setting of analog adapter, Phone 2.
AT&L0 or ATS84.5=0	Assign analog calls to Phone 1 if the line is not in use.
AT&L1 or	Assign analog calls to Phone 2 if the line is not in

AT Command	Description
ATS84.5=1	use.
AT&ZIn=s	MSN setting, assign Called phone number, “s,” to be answered by “n” port (where n=6 for Phone 1 and n=7 for Phone 2).
AT&ZI6=s	Assign the Called phone number for analog adapter, Phone 1.
AT&ZI7=s	Assign the Called phone number for analog adapter, Phone 2.
ATS56=n	Flash timer, in 100 ms unit, to set maximum duration of ON-OFF hook transition to be recognized as “Flash”.
	European switch specific
ATS89.6=0	To disable the metering pulse for analog adapter, Phone 1.
ATS89.6=1	To enable the metering pulse for analog adapter, Phone 1.
ATS89.5=0	To disable the metering pulse for analog adapter, Phone 2.
ATS89.5=1	To enable the metering pulse for analog adapter, Phone 2.

Placing a Call from the Analog Adapter

Making a call from the analog adapter is as easy as picking up the telephone connected to the analog port and dialing. With a terminal program’s assistance you can also use the TA to dial the number for you.

Type:

`ATDB714-693-0808<Enter>` *(Dial the number)*

TA responds:

`CONNECT` *(Dialing is complete)*

Now, just pick up the phone handset and wait for the remote device to answer.

Use **ATDAs** (**ATDBs**) to place a call from analog adapter 1 (analog adapter 2)

Once the analog adapter's hook sensor detects that the telephone device's handset is off hook, it sends a **SETUP** message to the ISDN central exchange to request a connection. One B channel, if available, will be assigned to this connection and the exchange will wait for the dialed number to route the call. At the same time, a dial tone is presented to the adapter port to prompt the user to dial. Both tone and pulse dialing are accepted.

A busy tone will be heard on the handset if:

- A B channel is unavailable.
- The dialed number is undeliverable.
- The called party is busy.
- This indicates the failure of the attempt to connect. To place another call, hang up the phone, then pick up and try again. If the called party is being alerted, a ring-back tone will be heard.

Accepting an Incoming Call

Voice calls will be sent to one or both of the POTS ports (Phone 1 and Phone 2) when they are received. You can choose the POTS port you want to receive calls by setting the MSN (AT&ZIn=s, as described in the previous table) to a specific phone number, "s".

Sometimes the TA is not able to tell which POTS port to route the incoming voice call. By default (ATS120.2=0), the TA will alert both ports and the first available port will answer. Otherwise (ATS120.2=1), an ambiguity resolution bit (Bit 5 of S84, or &Ln) is used to determine the path.

- **AT&L0** - Phone 1 has the higher priority.
- **AT&L1** - Phone 2 has the higher priority.

Scenarios of an Incoming Voice Call	Outcome

Phone 1 MSN Matched	Phone 2 MSN Matched	Global Call (No Called Party No.)	S120.2 (Default=0)	AT&Ln (Default n=0)	Phone 1	Phone 2
✓	×	×	-	-	Ring	-
×	✓	×	-	-	-	Ring
Unassigned	Unassigned	×	0	-	Ring	Ring
Unassigned	Unassigned	×	1	n=0	Ring	-
Unassigned	Unassigned	×	1	n=1	-	Ring
✓	✓	×	0	-	Ring	Ring
✓	✓	×	1	n=0	Ring	-
✓	✓	×	1	n=1	-	Ring
×	×	×	-	-	-	-
-	-	✓	0	-	Ring	Ring
-	-	✓	1	n=0	Ring	-
-	-	✓	1	n=1	-	Ring

The default MSN sub-address (or EAZ) for 1TR6 (Old German ISDN) of the a/b adapters are as follows:

- Phone 1: EAZ = 4 (&ZI7=4)
- Phone 2: EAZ = 3 (&ZI6=3)

A global call is an inbound voice call without the information of destination phone number (Called-Party-Number) which happens more often than not on some switches when the calling site is on the PSTN (analog telephone). By default, the TA will route the global call to both the POTS ports (make them alert). The one that picks up the phone earlier answers the call.

AT Commands	**Description**
ATS87.0=0	Enable POTS port 1 to accept global calls.(Default)
ATS87.0=1	Disable POTS port 1 to accept global calls.
ATS87.1=0	Enable POTS port 2 to accept global calls.(Default)
ATS87.1=1	Disable POTS port 2 to accept global calls.

Feature Phone (omni.net)

The omni.net supports ZyXEL's powerful and advanced feature phone operation. By connecting to the analog ports, you can get the benefits of analog phone services, plus additional features over your ISDN line.

The Flash key

All feature phone operations start from the **Flash key**. Commands for feature phone operation are listed in the table below:

Commands	Description
Press the Flash key.	1. Hold/Release. 2. Cancel the second dial connection attempt
Press the Flash key and 0 (call waiting).	1. Answer the incoming call and place the existing call on hold. 2. Switch back and forth between the two calls; either two remote calls or one remote call and one local call. 3. Place a call on hold to place a second call.
Press the Flash key and 2 (Intercom and Call Transfer).	1. Dial to another local phone. 2. Transfer the call to another local phone.
Press the Flash key and 3 (Three-way conference)	Create three-way conference connection in Mixing mode (1 remote party and 2 local parties or 2 remote parties and 1 local party).
Press the Flash key and 5 (Call Reject).	1.Reject the second incoming call. 2.Disconnect the current phone connection.

InterCom

With two phones connected, your TA can be used as an intercom. Please follow the instructions below:

1. Pick up the telephone handset.
2. Press the **Flash key** and then press **2** on the phone keypad. The other local phone will start to ring.

InterCom: ☎ ⇧ ➔ Flash ➔ #2

Call Waiting

The call waiting feature enables you to place a call on hold by pressing the **Flash key**. If you press the **Flash key** again, the call waiting function will be disabled and return to the previous call.

Call Waiting: Flash

Placing a second call

When you have an active call on line, you may follow the procedures below to make a second call:

1. Place the current call on hold by pressing the **Flash key** and **0**.
2. Dial the phone number of the second party and wait for them to answer.

Making a second call: Flash ➔ #0 ➔ "555-1234"

Receiving a second call

If call waiting has been enabled, you will receive a signal through the handset whenever a call is trying to come in while you are on-line. To enable the call waiting function, use the AT Commands in the table below:

AT Commands	Description
ATS79.2=0	Disables call waiting for POTS port 1.
ATS79.2=1	Enables call waiting for POTS port 1(Default).
ATS79.3=0	Disable call waiting for POTS port 2.
ATS79.3=1	Enable call waiting for POTS port 2 (Default).

Note: If you disable the call waiting function(S79.2=0 or S79.3=0), the second incoming call will be blocked.

Note: If you configure the POTS port for Modem/Fax connection (S79.4=1 or S79.5=1), the call waiting feature of the respective POTS port will be always disabled.

There are several ways to deal with a second incoming call:

- To accept the call, press the **Flash key** and **0** to accept the second call and place the first call on hold.

  Accept the second call: Flash ➔ #0

- To reject the second call press the **Flash key** and **5**.

  Reject the second call: Flash ➔ #5

- To establish a three way conference call press the **Flash key** and **3**.

  Establish a conference call: Flash ➔ #3

Call Broker

The call broker feature enables you to switch back and forth between the first and second calls by pressing the **Flash key** and **0**.

Call Broker: Flash ➔ #0

Call Reject

To disconnect an active call and return to a call that is on hold press the **Flash key** and **5**. This allows you to disconnect a call without hanging up your handset.

Call Reject: Flash ➔ #5

Call Transfer

The call transfer feature enables you to transfer a call to another local phone by pressing the **Flash key** and **2** and then hanging up the handset.

Call Transfer: Flash ➔ #2 ➔ ☎⇩

Three-way Conference Call

The conference call feature can be used in the two ways. To connect two local parties to a remote party, or to connect one local party to two remote parties.

Two local parties connected to one remote party:

1. Place a call to the other local party by pressing the **Flash key** and **2**.
2. After they answer, place them on hold by pressing the **Flash key** and **0**.
3. Place a call to the remote party.
4. After they answer, press the **Flash key** and **3**.

Conference call (2 local and 1 remote):

☎⇧ ➔ **Flash** ➔ #2 ➔ **Flash** ➔ #0 ➔ "555-1234" ➔ **Flash** ➔ #3

One local party connected to two remote parties:

1. Place a call to either of the remote parties.
2. After they answer, put them on hold by pressing the **Flash key** and **0**.
3. Place a call to the second remote party.
4. After they answer press the **Flash key** and **3**.

Conference call (1 local and 2 remote call):

☎⇧ ➔ "555-1234" ➔ **Flash** ➔ #0 ➔ "555-5678" ➔ **Flash** ➔ #3

12 Advanced ISDN Call Control

Call Control for DSS1

In order to initiate a DSS1 ISDN call, two information elements are necessary:

- **Bearer Capability** - indicates what kind of bearer service is desired. It is also used for compatibility checking in the addressed entity.
- **Called Party Number** - provides necessary information for the telephone company Central Office (CO) to direct the call to the destination.

Other optional information elements which are pertinent to call control include:

- High-Layer-Compatibility.
- Low-Layer-Compatibility.
- Calling-Party-Number.
- Called-Party-Number.
- Calling-Party-Subaddress.
- Called-Party-Subaddress.

Control of Outgoing Service Indicator

The High-Layer-Compatibility and Low-Layer-Compatibility information provides a means for compatibility checking by the called party. They are transferred transparently by the ISDN network between the call originating entity (e.g. the calling user) and the addressed entity.

Outgoing High-Layer-Compatibility can be controlled by setting the value of S-register S(108+n) as follows:

- n=0 - (**S108**) Setting for analog adapter 2 (omni.net).
- n=2 - (**S110**) Setting for ISDN data calls.
- n=3 - (**S111**) Setting for analog adapter 1 (non-data).

S(108+n=)	**Function**
0	No High-Layer-Compatibility info element will be sent (default).
1	Telephony.
4	Facsimile Group 2/3.
40	Teletex service (Rec. F.220).
49	Teletex service (Rec. F.200).
50	International interworking for video services (Rec. F.300 and T.110).
53	Telex service (Rec. F.60).
56	Message Handling Systems (MHS) (Rec. X.400 series).
65	OSI application (Rec. X.200 series).

Example: AT**S111=4** sets Fax compatibility message for Analog Port 1.

Bearer-Capability and Low-Layer-Compatibility information elements will be determined when you configure the B channel protocols using the command **ATBnn**. The outgoing Low-Layer-Compatibility information element can be turned on or off by setting **S80 bit '*n*'** as follows:

- *n* = 4 for the analog adapter 2 (omni.net).
- *n* = 6 for ISDN data calls.
- *n* = 7 for the analog adapter 1 (non-data).

S108.n=	**Function**
S80.*n*=0	Disable outgoing Low-Layer-Compatibility (default).
S80.*n*=1	Enable outgoing Low-Layer-Compatibility.

Example: AT**S80.4=0** disables Low-Layer-Compatibility message for Analog Port 2 (omni.net).

Control of ISDN Phone Number and Sub-address

The Calling-Party-Number information element identifies the origin of a call, and the Called-Party-Number information element identifies the destination of a call.

The Calling-Party-Subaddress information element identifies the Subaddress associated with the origin of a call.

The Called-Party-Subaddress information identifies the Subaddress of the destination call.

Each type of outgoing call can be assigned with one Number/Subaddress pair by using the command **AT&ZO*x*=*s***. The possible values for ***x*** are as follows:

- *x* = **I** - for ISDN data calls.
- *x* = **A** - for the analog adapter 1 (non-data).
- *x* = **B** - for the analog adapter 2 (omni.net).

The number-Subaddress-string '***s***' is defined as:

***s* = [[Y*n*][N*n*]own-number][/[[Z*n*]own-Subaddress]/]**

where **Y*n*** specifies the number type:

- **Y0** - unknown (default if Y*n* is omitted).
- **Y1** - international number.
- **Y2** - national number.
- **Y3** - network specific number.
- **Y4** - subscriber number.

N*n* is the identifier of numbering plan:

- **N0** - unknown (default if N*n* is omitted).

- **N1** - ISDN numbering plan (Rec. E.164) (default for Australia if N*n* is omitted).
- **N3** - data numbering plan (Rec. X.121).
- **N4** - telex numbering plan (Rec. F.69).
- **N8** - national standard numbering plan.
- **N9** - private numbering plan.

Zn - specifies the Subaddress type:

- **Z0** - NSAP (Rec. X.213) with AFI=0x50, IA5 characters (default if Z*n* is omitted).
- **Z2** - user specified, IA5 characters.

The command **AT&ZO*x*=//** will remove the Number/Subaddress assignment.

The number and subaddress assigned by **AT&ZO*x*=*s***, if any, will be used for Calling-Party-Number and Calling-Party-Subaddress information elements respectively while dialing.

The default settings of the phone number and subaddress of all types of calls are **UNASSIGNED -** meaning the SETUP message sent by the TA128 contains neither Calling-Party-Number nor Calling-Party-Subaddress information elements.

The command **AT&ZO?** can be used to browse the current settings of the own numbers and subaddresses.

Call Control for 1TR6 (Old German ISDN)

In order to initiate an 1TR6 ISDN call, two information elements are necessary:

- **Service Indicator** - Determines what kind of bearer services are desired.

- **Destination Address -** Provides information for the telephone company to direct the call to the remote party.

Control of Outgoing Service Indicator

The Outgoing Service Indicator will be assigned when you configure the B channel protocols using the command **ATBnn**.

Since there are a number of combinations of voice or voice-band-data services on the analog adapters, users may want to control the outgoing Service Indicator themselves for some specific applications.

Use the following table to configure **S104/S107** (Service Indicator) and **S108/S111** (Additional Information Octet) according to the terminal types:

	Service Indicator **S107: analog, Phone 1** **S104: analog, Phone 2**	**Addi. S. I.** **S111: analog, Phone 1** **S108: analog, Phone 2**
Telephone	1 (*Fernsprechen*)	1 (*3.1 KHz*)
Modem	2 (*analog - dienste*)	3 (*Daten Über Modem*) or 4 (*Btx Über Modem*)
G3 Fax	3 (*analog - dienste*)	2 (*Fax Gruppe 3*)

Control of ENDGERÄTEAUSWAHLZIFFER (EAZ)

EAZ (or Terminal Selection Code) is the last digit of an ISDN phone number in 1TR6. Usually EAZ=0 indicates a global call. Any terminal on the S0 interface which is service-compatible with the incoming call, can answer the call.

Other values of EAZ (1,2,....,9) provide the possibility for assigning multiple ISDN numbers to a single ISDN BRI line. A calling user can select, via the public network, one or more distinct terminals on a single BRI line.

With its highly integrated, multi-function features, the TA128 can be viewed as a “black box” containing multiple distinct terminals. Each

of these "internal terminals" can be assigned one EAZ using the command **AT&ZI*n*=*m*,** where *n*=0-7 and *m*= 0-9.

Command	Function
&ZI0=*m*	assigns EAZ for X.75.
&ZI1=*m*	assigns EAZ for V.110.
&ZI2=*m*	assigns EAZ for V.120.
&ZI3=*m*	assigns EAZ for PPP, MPPP.
&ZI4=*m*	assigns EAZ for ISDN data, protocol auto-detection.
&ZI5=*m*	assigns EAZ for PPP, MPPP.
&ZI6=*m*	assigns EAZ for Phone 2 (omni.net).
&ZI7=*m*	assigns EAZ for Phone 1 (non-data).

The default EAZ of each protocol is as follows:

- **&ZI0=1** - for Data.
- **&ZI4=2** - for Data.
- **&ZI6=3** - for the analog adapter, Phone 2 (omni.net).
- **&ZI7=4** - for the analog adapter, Phone 1 (non-data).

AT&ZI? can be used to display the EAZ numbers assigned by the AT&ZI*n*=*m* commands.

The EAZ (last digit) of the destination address in an incoming SETUP message will be checked with each protocol's EAZ. If there is a match and the service indicated is compatible with this protocol, the call will be accepted using the protocol.

NOTE: EAZs must be assigned in exact order.

The suffix digit to an ISDN phone number in a dial out command will be used as the destination EAZ (in the Destination Address W-element) in the SETUP message sent to the destination. If this suffix digit is omitted, the switch will assume the EAZ is 0.

Each type of outgoing call can be assigned with one origination EAZ by using the command **AT&ZO*x*=Origination_EAZ**, where *x* = **I** for ISDN data calls, **A** for the analog adapter 1, and **B** for the analog adapter 2.

The command **AT&ZOx=//** removes the assignment of the origination EAZ.

The number assigned by **AT&ZOx=Origination_EAZ**, if any, will be used for the Origination Address W-element while dialing. The default settings of origination EAZ for all types of calls are UNASSIGNED**,** meaning the SETUP message sent by the TA contains no Origination Address W-element.

The command **AT&ZO?** can be used to list the current settings of the origination EAZs.

Answering a Call

Incoming call will be identified as either an ISDN data call or a voice call (including the voice-band-data). ISDN data calls will be routed to the digital communications portion of the TA.

Non-data models will assign voice calls or voice-band-data calls to the analog adapter(s).

Answering a Call for DSS1

The Multiple Subscriber Number (MSN) supplementary service provides the possibility for assigning multiple ISDN numbers to a single ISDN BRI line. Calling users can select, via the public network, one or more distinct terminals on a BRI line.

In some areas however, it is very expensive to get additional subscriber numbers. The subaddress, which is transferred transparently by the ISDN network between the call originating entity (e.g. the calling user) and the addressed entity, can be used for the same purpose as the MSN. Since the TA is highly integrated and multi-functional, it can be imagined as a “black box” that contains

multiple distinct terminals. Each of these "internal terminals" can be assigned one ISDN number using the **AT&ZIn=xxxx**... command.

The number assigned by AT&ZIn=xxxx... can be interpreted as either the MSN or the subaddress. This is determined by the bit 5 of S119 as follows:

- **S119.5=0** - the number is treated as the MSN (default).
- **S119.5=1** - the number is treated as the subaddress.

The factory default for these numbers are unassigned. If an incoming **SETUP** message is offered with addressing information (e.g. the appropriate part of the called party number or the called party subaddress), this address will be compared with the MSN/subaddress numbers assigned by the AT&ZIn=xxxx... commands. The call will be accepted using the specific protocol if the assigned number of this protocol matches with the received called party number or called party subaddress.

NOTE: Two phone number strings are said to be matched if their least significant "n" digit(s) are identical, where "n" is the number of digits of the shorter string. Usually one digit is enough to distinguish the various protocols.

Answering a Call for 1TR6

If an incoming **SETUP** message is offered with addressing information (i.e. the destination address W-element). This address will be compared with the EAZ numbers assigned by the AT&ZI*n=m* commands. The call will be accepted using the specific protocol if the assigned number of this protocol matches the received address.

Best-effort Call Answering

If some numbers have been set using &ZI command (as can be seen by the AT&ZI? command) and they are not matched with the address of the incoming call, the TA will, by default, ignore the call as it may be intended for other devices that share the same S/T interface (S0 bus) with the TA.

If you want the TA to answer inbound calls as often as possible, you can set the best-effort call answering bit as follows:

- **S119.3=0** - Answer calls only when numbers match (by default).
- **S119.3=1** - Best effort call answering.

Ambiguity Resolution Switch for Voice Calls (non-data)

For a voice or voice-band-data call, if the &ZI number assignment can tell which of the analog adapters is being addressed, then the call will be delivered to the proper destination. Sometimes, ambiguity of address matching may exist. This may happen if the &ZI numbers of the various protocols are either unassigned or not matched. In this case, users may wish to set the priority of answering a call by the analog adapter, Phone 1, or the analog adapter, Phone 2 (omni.net). The AT&Ln command sets the address ambiguity resolution flag:

Multi-Auto-Answering of Data Calls

For an ISDN data call, if the TA can exclusively determine the protocol to be used by means of the information conveyed by the SETUP message (for DSS1, these include the Bearer-Capability, Low-Layer-Compatibility, or High-Layer-Compatibility information elements; for 1TR6, these include the Service Indicator as well as the Additional Octet of Service Indicator), then the indicated protocol will be used. Otherwise, the Multi-Auto answering process will be invoked. The omni can monitor the B channel signal sent by the calling site.

The data call can be identified by the TA to be X.75, V.110, V.120, or PPP Async-to-Sync, conversion and MPPP.

Data Call Indication

Data calls are accepted the same way as in any TA. When alerted, the omni will send the first RING message to the DTE with a format as follows:

```
RING <CR><LF>
```

```
[FM:[[Prefix]Calling-Party-Number][/Subaddress/]]
[TO:[Called-Party-Number][/Subaddress/]] <CR><LF>
RING <CR><LF>
RING <CR><LF>
......
```

The display of address information between the first RING and the second RING can be disabled by setting **ATS84.4=1**. The term [Prefix] is a predefined number string to be added in front of the Calling-party-number before sending it to the DTE. This is useful for some automatic dial-back-up systems. The number string can be assigned as follows:

- **ATCI**<Prefix> - When and only when the type-of-number denotes an international number will this "Prefix" be added to the Calling-party-number before indicating it to the DTE.
- **ATCI<>** - Disables the international number prefix-adding function. (Default)
- **ATCN**<Prefix> - When and only when the type-of-number denotes a national number will this "Prefix" be added to the Calling-party-number before indicating it to the DTE.
- **ATCN<>** - Disable the national number prefix-adding function. (Default)

NOTE: The angle brackets '<' and '>' are part of this command.

Disable inbound call connection

In some cases, the user may desire the TA to **not** answer any incoming calls. This can be done by setting the bit 0 of S-register S118:

- **S118.0=0** - Enable the TA to answer a call (by default).
- **S118.0=1** - Disable the TA to answer any call.

Point-to-Point Configuration

In some areas, since Direct-Dial-In (DDI) number is less expensive than MSN, users may want to subscribe to point-to-point ISDN to employ the DDI function. In this case, only one TA can be connected to the ISDN line and the TEI (Terminal Equipment Identifier) is always ZERO. This can be done by setting the bit 1 of S-register S119:

S119.1 = 0 - Disable point-to-point DDI function (default).

S119.1 = 1 - Enable point-to-point DDI function.

Placing a Call

To initiate a call, configure the TA according to the Bearer Service (or protocol) you want to use.

- **ATBnn** - for ISDN data calls.

Placing a call for DSS1

The **ATD*x*** command is used for dialing as follows:

ATD*x*[Y*n*][N*n*]called_party_number[/[Z*n*]called-party-subaddress/]

x = **I** (for ISDN data calls), **A** (for the analog adapter 1), or **B** (for the analog adapter 2).

Y*n* specifies the type of number:

- **Y0** - unknown (default if Yn is omitted).
- **Y1** - international number.
- **Y2** - national number.
- **Y3** - network specific number.
- **Y4** - subscriber number.

N*n* is the identifier of numbering plan:

- **N0** - unknown (default if Nn is omitted).
- **N1** - ISDN numbering plan (Rec. E.164).
- **N3** - data numbering plan (Rec. X.121).
- **N4** - telex numbering plan (Rec. F.69).
- **N8** - national standard numbering plan.
- **N9** - private numbering plan.

Z*n* specifies the type of the Subaddress:

- **Z0** - NSAP (Rec. X.213) with AFI=0x50, IA5 characters (default if Zn is omitted).
- **Z2** - user specified, IA5 characters.

The **called_party_number** or an appropriate part of it, will be sent to the addressed entity. The **called_party_subaddress** will be transferred transparently by the ISDN network to the destination.

Use **ATDL** to redial the last dialed telephone number (and/or subaddress).

Placing a call for 1TR6

The **ATD*x*[Y*n*][N*n*]destination_address** command is used for dialing as follows.

x = **I** (ISDN data), **A** (the analog adapter 1), or **B** (the analog adapter 2).

Yn specifies the type of address:

- **Y0** - unknown (default if Yn is omitted).
- **Y1** - international number.
- **Y2** - national number.

Nn is the identifier of numbering/addressing plan:

- **N0** - unknown (default if Nn is omitted).

- **N1 -** ISDN numbering plan (Rec. E.164).

The **destination_address** is the ISDN phone number of the called party. The last digit of this number is the EAZ. Use **ATDL** to redial the last dialed ISDN phone number.

Leased Line ISDN

The B-channel protocols supported for the leased line are V.110, V.120, X.75, PPP and MP which is selected using ATBxx commands as in the dial-up mode. The following AT commands are used to select the Leased Line function:

AT&In	normal/leased line options S14b2-3.
AT&I0	normal dial-up phone line.
AT&I1	leased line function in B1 channel only, dial-up function in B2 channel.
AT&I2	leased line function in B2 channel only, dial-up function in B1 channel.
AT&I3	leased line function in both B1 and B2 channels.

If the leased line mode configuration has been saved as the power-on user's profile and upon power up, the TA will ALWAYS try to make a connection with the remote site using the pre-selected protocol, B-channel (B1 or B2), and originate/answer mode. To change the TA from leased line mode back to dial-up mode, reset the modem to the factory default settings.

For some protocols that are originate/answer mode sensitive, use the following command to configure the originate/answer mode:

AT*Mn	leased line auto-handshake mode selection S14b0.
AT*M0	leased line auto-handshake for Originate mode.
AT*M1	leased line auto-handshake for Answer mode.

If the leased line mode is selected after power up, the following commands can be used to make a leased line connection:

ATDB1	use B1 channel in Originate mode.
ATDB2	use B2 channel in Originate mode.
ATDB3	use both B1 and B2 channels in Originate mode.
ATAB1	use B1 channel in Answer mode.
ATAB2	use B2 channel in Answer mode.
ATAB3	use both B1 and B2 channels in Answer mode.

13 Security Functions

The omni provides security functions that may be enabled to prevent unauthorized connections. Two types of security functions are provided.

Security Types and Levels

Type 1 security is to be used when the remote TA is a ZyXEL ISDN TA.

Type 2 security is to be used with non-ZyXEL remote TA's.

With a Type 1 connection, the dial-in (remote) TA will send in its supervisor password for matching with the local omni's pre-stored password list. With a Type 2 connection, the remote terminal will be prompted to enter the password at the initial connection and the local omni will match the entered password with the pre-stored password list.

The two types of security are summarized in the table below:

	Type 1 Security	**Type 2 Security**
Remote (Calling) Site	ZyXEL ISDN device only.	Can be TA of any brand.
Password Check	Automatic	Interactive
Protocols Supported	X.75, V.120	Any data protocol
AT Commands	***G1** for Level 1 security ***G2** for Level 2 security	***G3** for Level 1 security ***G4** for Level 2 security ***G5** for Level 3 security

Level 1 security

Will only perform password checking. With Level 1 security, the local TA will maintain the connection if the password is matched, otherwise the line will be disconnected.

Level 2 security

Provides Calling Party Number checking and call-back, the call-back number is pre-stored in the password table. If the password has been matched *(in a maximum of 3 tries over a 40 second time period)* with its pre-stored password list, the local TA will check the Calling Party Number (CPN) (or Origination Address for 1TR6) against the pre-stored number corresponding to the password. If they are matched, the local TA will choose either to keep the connection or to disconnect and then call back according to the setting of bit 6 of S119:

- **S119.6=0** - Disconnect and then call back.
- **S119.6=1** - Keep the connection.

If the CPN does not match with what is stored in the table, the local TA will disconnect the call. If CPN is unavailable in the SETUP message, the local TA will disconnect the call and then call back using the pre-stored number corresponding to the dial-in password.

Level 3 security

Once the password is matched the local TA will prompt the remote user to enter a call back number.

The three levels of security are summarized in the table below:

	Level 1	Level 2	Level 3

	Level 1	Level 2	Level 3
Password Check	*Yes*	*Yes*	*Yes*
CPN Check OK and S119.6=0	*N/A*	*Call back*	*Prompts the remote user to enter call back number for calling back.*
CPN Check OK and S119.6=1	*N/A*	*Keep the connection*	
CPN unmatched	*N/A*	*Disconnect*	
CPN not Available	*N/A*	*Call back using the corresponding pre-stored number*	
AT Commands	**G1 for Type 1 *G3 for Type 2*	**G2 for Type 1 *G4 for Type 2*	**G5 for Type 2*

Setting and Modifying Passwords

Up to 40 user passwords can be defined using the **AT*H*n*** command, where "*n*" represents the index to the entry. Numbers between 0-39 are accepted.

The corresponding 40 call-back numbers are defined by **AT&Z*n*=*xxx*** command, where "*n*" represents the index to the entry, and "*xxx*" represents the assigned call-back phone number. Any character (ASCII 0-127) can be used in the password table, the maximum password length is 8 characters for each entry.

Security functions are only accessible through AT commands in terminal mode. A supervisory password is required for adding or modifying entries. The default supervisor password is **ZyXEL** when the TA is shipped from the factory. This supervisory password is sent to the remote if Type 1 security is set at the remote end.

To modify the supervisor password, use **AT*HS**.

You will be asked for the original password and a new password. Then re-enter the new password for verification. For example:

```
Password:
********  (Enter current supervisory password)
Password:
********  (Enter new supervisory password)
Verify:
********  (Enter the new supervisory password again)
OK
```

Use command **AT*H*n*** to modify the "*n*"th user password. You will be prompted to enter the supervisory password first and then the user's password for this entry will be requested and verified. The command **AT*V** will list the 40 user passwords and the supervisor password on the screen for viewing.

Non-password Auto Call Back Function

In addition to the standard modem-like security functions described in the previous section, the omni provides another simpler call back function. The Calling Party Number (origination address) will be checked against the 5 pre-stored call-back numbers before the B channel is connected. If the CPN is matched with any one of the numbers, the incoming call will be rejected (without connection, hence without any charge) and the TA will automatically call back using the matched phone number.

This function can be controlled using the following commands:

AT*GC0 - disable the auto call back function (default).

AT*GC1 - enable the auto call back function.

The pre-stored numbers can be set using the following command:

AT*HCn=xxxx, - n=0,1,..,4

You will be prompted to enter the supervisory password first.

The AT*VC command can be used to list all the pre-stored numbers.

14 Upgrading Your omni

This chapter describes how to upgrade flash EPROM firmware when it is available.

Upgrading with Flash EPROM

Your TA employs a flash EEPROM (Electronic Erasable Programmable Read Only Memory) that lets you conveniently update firmware and program the TA with new features and enhanced functions. If you use Windows, use the ZyXEL Internet Configuration Manager to upgrade new firmware. For other Operating Systems, use a terminal program that supports the X-modem protocol.

Obtain the new firmware from ZyXEL's BBS, WWW, or FTP site. See Contacting ZyXEL on page v for more information. The firmware is distributed in a file **(your model)*d.vvv***, where the extension **vvv** denotes the version of this firmware. The modifier ***d*** in the filename has the following definitions:

- **G -** German national ISDN (1TR6).
- **E** - European ISDN (DSS1), also used in most other countries including Asian countries.
- **A** - American ISDN(AT&T 5ESS, Northern Telecom DMS-100, or National ISDN-1, the active D channel protocol can be chosen by an AT command).

NOTE: The American firmware version supports both the S/T interface and U interface models. During the power-on test, it checks the hardware configuration and follows the initialization procedures of the specific interface.

1. Make sure your TA is turned ON.

2. Start any communications program that supports the Xmodem protocol, and type:

   ```
   ATUPX<Enter>
   ```

   TA responds:

   ```
   You have chosen Xmodem (128 octets of data with checksum) protocol to update your TA. Data in Flash ROM will be erased !!!

   Are you sure (Y/N) ?
   ```

3. Press Y. The following message then appears:

   ```
   Start programming, please upload.
   ```

4. Use the Xmodem protocol to upload the file ONETd.vvv to your TA. This step updates the TA's flash EPROM with the new firmware. When installation is complete, the TA will restart automatically.

Kernel Mode

In the unlikely event that your TA fails to respond to AT commands after upgrading the flash EPROM follow the procedure below:

1. Power on the TA. The reset will prompt the TA to check the integrity of the codes in the flash EPROM.
2. If proper valid firmware can not be verified, the TA will initiate Kernel Mode. Once it is in Kernel mode, you can issue limited "AT" commands. From this point, you can start from item 3 of our upgrading procedure.

15 Diagnostics

The omni can perform its own diagnostic tests, providing you with valuable information. This chapter provides diagnostic tables for interpreting test results.

The following table is a summary of the omni's self-tests for external models:

Test Seq.	LED LNK	LED B1	LED B2	LED AA	Test Description
1	on*	off	off	off	Memory test.
2	off	on*	off	off	ISDN chip interface test.
3	off	off	on*	off	ISDN chip functional test.
4	off	off	off	on*	HDLC functional test.

* The LED lights up while test is in progress and blinks if a test fails.

The following table is a summary of the omni's self-tests for internal models:

Blinks	Test Description
1	Memory test failed.
2	ISDN chip interface test failed.
3	ISDN chip functional test failed.
4	HDLC functional test failed.

NOTE: When a self test fails the LED will blink 1-4 times in succession, followed by a 1.5 second pause. After completing a successful self test the LED will remain off.

Diagnostics

The omni ISDN TA provides several diagnostic capabilities:

- Power-on Self-test.
- Local Digital Loopback Test.

- Diagnostic Command.
- TA Reset.

Power-on Self-test

At each power-up or upon a reset command from the panel, the TA will test the ROM code checksum, system RAM memory, EEPROM, digital circuits and analog circuit calibrations.

The LNK LED will light up for half a second to indicate the success of the TA's power on self-test. After completing a successful self test, the LNK LED will become the normal physical layer (layer 1) active indicator.

ISDN Loopback test (AT&T9)

The AT&T9 command will invoke an ISDN loopback test connection. The loopback point is in the S/T interface chip (Siemens 2086 chip) or the U interface chip (Siemens 2091 chip) just behind the line transformers, thus it checks almost every part of the ISDN TA and RS-232 cable except the passive front-end of the ISDN S/T or U interface.

During this test, data from the terminal or computer is sent through the DTE interface to the ISDN TA's transmitter and is packetized to the proper frame format according to the B channel protocol selected and then loop-backed to the receiver, de-packetized, and sent through the DTE interface back to the terminal or computer's screen. The screen should show the data you have sent to the ISDN TA.

Loopback with Self-test (AT&T10)

The AT&T10 command will invoke an ISDN loopback connection with self-test. The data is generated by the ISDN TA and will go through the same path as the above Loopback Test does. The data pattern is printable ASCII characters. You can see the result on the screen. The loop backed data is compared with the transmitted data. Should an error occur, the LNK LED will start to flash. Sending any

character through the DTE interface to the ISDN TA will discontinue the test.

B1/B2 Loopback with Self-test (AT&T11)

There is an AT command designed for testing the readiness of your ISDN line which uses one B-channel (B1) to place a call and the other B-channel (B2) to receive the call.

Follow these instructions to make your test call:

Type:

```
AT&ZOI=your_isdn_number<Enter>
```

TA responds:

```
OK
```

Type:

```
AT&T11<Enter>
```

TA responds:

```
OK
Dial your_isdn_number
Loop from B1 to B2 through the switch established!
Sending and receiving data.....
B1/B2 loopback test successed.
Disconnecting.....
NO CARRIER
```

The Diagnostic Command (ATCG)

The ATCG command can be used to test and isolate hardware problems. Some of the tests are interactive operations, just follow the indications prompted on the screen. If the TA is operating normally, the test results will be displayed as follows:

```
System address & data bus test ......................                OK
Layer 1 hardware test ..............................                 OK
Layer 2 hardware test ..............................                 OK
Layer 1 activation test.............................                 OK
First B channel hardware test ......................                 OK
Second B channel hardware test......................                 OK

Listen to the Ring and then pick up phone set #1.....                !!
Off-hook action is detected, (Hook Interrupt) .......                OK
Listen to the dial tone and then dial 1234567890*# in sequence.      !!
1234567890*#
```

```
Dialed digits detected, please hang-up the handset….                    !!
On-hook action is detected, (Hook Interrupt)........                    OK

Listen to the RING and then pick up phone set #2 ....                   !!
Off-hook action is detected, (Hook Interrupt) .......                   OK
Listen to the dial tone and then dial 1234567890*#  in sequence.        !!
1234567890*#
Dialed digits detected, please hang-up the handset ..                   !!
On-hook action is detected, (Hook Interrupt) ........                   OK
Listen to the prompt signal of the Internal Speaker and then press the button
switch.......!!
Button switch is pushed (Button Interrupt) ..........                   OK
```

Resetting The omni

If you have modified the TA's setting and cannot get it back because the unit is locking up, or you just want to reset it back to the factory default state, the following reset procedure will help you to reset the TA back to the factory default state.

Hold the DATA/VOICE button down while turning the unit ON, keep holding down the switch for 3 seconds after the power switch is turned ON then release the switch. TA will reset itself back to the factory setting and it will also run a continuous loop-back self-test. Printable characters will show on the terminal screen if it is connected to one. Finally, toggle the power to the TA off then back on.

Using The Embedded Protocol Analyzer

The embedded protocol analyzer (EPA) records and analyzes various protocols on the B-channel, D-channel and DTE-DCE interface. The EPA is designed for hobbyists as well as users with technical backgrounds. The EPA enables you to examine messages exchanged between your TA and the Central Exchange office when making an ISDN call. You can review the packets sent or received through the B-channel (for X.75 or V.120) to or from the remote site. AT commands issued from an application software program can also be checked. This will help you understand their causal relationship with other events.

In addition to its tutorial purpose, the EPA is very useful for diagnostics. If you have compatibility problems with your Central Exchange or with a TA at a remote site, the EPA will be your first aid

resource. According to the EPA's analysis, you may decide to fix the problem yourself (e.g. modify the configuration and try again) or log the analyzed results as a file (a very comprehensive bug report), and then send it to ZyXEL's Tech Support department.

Capturing the Protocol Data

The data captured by the EPA can be classified into three categories:

- B-channel user data protocols.
- D-channel signaling protocols.
- DTE-DCE protocols.

The D-channel signaling protocols include layer 2 and layer 3 call control protocols. Frames and messages exchanged via the D-channel are all recorded for further analysis. These data messages are essential to understanding interactive operations between an ISDN TA and the ISDN network. They contain the compatibility information for the TA and your Central Exchange.

The B-channel user data protocols include X.75 and V.120. Only the layer 2 header (addresses and control bytes) and layer 3 header are captured. Since X.75 may be used with various layer 3 protocols (e.g. T.70, T.90, and ISO8208), only the first 8 octets of the information field are recorded as the layer 3 header, and are displayed in raw data form. The analysis of the protocol data will be carried out by ZyXEL's Technical Support department.

The DTE-DCE protocols (at the R reference point according to the ISDN nomenclature) include the AT commands/responses as well as the CAPI internal interface. The CAPI internal interface is used with the ZyXEL CAPI driver. The ZyXEL CAPI driver communicates with the TA through this internal interface. It is not recommended that users get involved in this internal interface. The AT commands/responses, on the other hand, are in a standard user interface. An analysis of these commands and responses might prove very informative. All messages captured by the EPA are tagged with a time stamp according to a free running timer that starts at the

beginning of data capture. The resolution of this timing information is in 0.01 second intervals.

The following commands determine the kind of protocol data to be captured by the EPA:

AT Command	Description
ATCDn	
CD0	Disable the capture of D-channel protocols.
CD1	Enable the capture of D-channel protocols (default).
ATCBn	
CB0	Disable the capture of B-channel protocols (default).
CB1	Enable the capture of B-channel protocols.
ATCCn	
CC0	Disable the capture of DTE-DCE interface protocols(default).
CC1	Enable the capture of DTE-DCE interface protocols.

The EPA starts to capture data when the command ATCT is issued. This capturing process will continue until the command ATC$ is issued. The EPA maintains 8 Kbytes RAM as a ring buffer. In case the buffer is full, the earliest data captured will be overwritten by the latest data.

Analyzing the Captured Data

To view the analyzed result, use the command ATC$. For your convenience, the relevant AT commands are summarized as follows:

Command	Description
ATCT	Clears buffer and starts the embedded protocol analyzer. Captures data immediately and starts the timer.

Command	Description
ATC$	Invokes the interpretation function of the embedded protocol analyzer and displays the results on the DTE screen.

The analyzed results can be viewed as if it were in a full screen editor. Several number keys are used to control the display. For PC users, it is convenient to use the keys on the numeric keypad (make sure that Num-Lock is on.).

The functions of the control keys follow:

Key	Function	Description
1	End	Display to the end of buffer.
2	Cursor down	Scroll one line up.
3	Page down	Display the next page.
7	Home	Display the first page.
8	Cursor up	Scroll one line down.
9	Page up	Display the previous page.
Q, q	Quit	Quit embedded protocol analyzer.

16 AT Command Set Reference

Operation Modes of the DTE Interface

There are two operation modes for the DTE interface:

- **Simplex mode** - used for conventional AT Command operation.
- **Multiplex mode** - used as an internal interface for ZyXEL CAPI drivers.

Simplex mode

In simplex mode, the TA128 is used just like an ordinary TA. The DTE interface will be either in the command state or in the data state. At most, only one data connection session is possible at any time.

A number of different AT Commands can be used to invoke various functions. The simplex mode is designed for AT Command users. The guides and descriptions throughout the rest of this manual, if not otherwise specified, are applicable to this mode. The power-on default of the DTE interface is in simplex mode as well.

Multiplex mode

The multiplex mode is designed for ZyXEL CAPI drivers. It can also be used by third parties to develop various drivers on different platforms for public domain or for commercial purposes.

The commands or data are packetized. Each packet has its own destination address. All the DTE channels can be accessed individually by way of multiplexing.

Since it is not intended for all users, the specifications and manual for the multiplex mode will be available in a separate text file, and will only be available in the electronic format upon request.

AT Command Descriptions

An AT Command is a command in asynchronous data format issued by the computer to the TA through the asynchronous computer-modem interface. AT Commands control the TA's behavior and actions. To send an AT Command from a computer to the TA, you must be running communication software and the TA must be in the command state.

Exceptions to this are A/, A>, and +++. These commands are not preceded by AT, or followed by any more characters:

- **A/** - re-executes the last command once.
- **A>** - re-executes the last command once or repeats the last call up to 9 times until aborted by pressing down on any key on the keyboard or front panel or until a successful connection with a remote TA has been made.
- **+++** - is the escape sequence code that is entered in data state to return the TA to command state. The TA will accept AT commands only while it is in command state.

The AT command prefix may be typed in either upper ‘AT’ or lower case ‘at’. Do not use a combination of upper and lower cases in the prefix.

The following tables list all of the AT commands supported by the omni. An asterisk * following a command option or value indicates that it is a default setting when the TA is shipped.

Basic "AT" Command Set

Command	Options	Function & Description	Ref.
A/		Re-execute the last command once	

Command	Options	Function & Description	Ref.
A>		Re-execute the last command once or repeat the last call up to 9 times. (See also S8)	
<any key>		Terminate current connection attempt when enter in handshaking state.	
+++		Escape sequence code, entered in data state, wait for TA to return to command state.	
All the Following Commands Require a "AT" Prefix			
A		Go on-line in answer mode. (See also S39.2, S43.6)	
ATA		Return to command state.	
ATAB*n*	B1	Set B1 for leased line in answer mode.	
	B2	Set B2 for leased line in answer mode.	
	B3	Set B1 & B2 for leased line in answer mode.	
B*nn*		Select ISDN Teleservice 'B' must be followed by two digits.	S82 S102
	B0n	X.75	
	B00	X.75 Transparent	
	B01	X.75 T.70	
	B04	BTX (Data X-J)	
	B10	V.110 user rate follows DTE speed (async.) or V.110 user rate determined by in-band negotiation (sync.)	
	B11	V.110 user rate = 64000 bps (sync mode).	S117
	B13	V.110 user rate = 2400 bps.	
	B14	V.110 user rate = 4800 bps.	
	B15	V.110 user rate = 9600 bps.	

Command	Options	Function & Description	Ref.
	B16	V.110 user rate = 14400 bps.	
	B17	V.110 user rate = 19200 bps.	
	B18	V.110 user rate = 384000 bps (async only).	
	B19	V.110 user rate = 576000 bps (async only).	
	B20	V.120	
	B40	PPP async to sync conversion.	
	B41	SLIP async to sync conversion.	
BP*n*	n=0-1	Enable/disable PPP BACP/BAP.	
	BP0	Disable PPP BACP/BAP.	
	BP1	Enable PPP BACP/BAP.	
CB*n*	n=0-1	Configuration of embedded protocol analyzer.	S84.1
	CB0	Disable the capture of B channel protocols.	
	CB1	Enable the capture of B channel protocols.	
CC*n*	n=0-1	Configuration of embedded protocol analyzer.	S84.0
	CC0	Disable the capture of DTE/DCE interface protocols.	
	CC1	Enable the capture of DTE/DCE interface protocols.	
CD*n*	n=0-1	Configuration of embedded protocol analyzer.	S84.2
	CD0	Disable the capture of D channel protocols.	
	CD1	Enable the capture of D channel protocols.	
CE*n*	n=0-1	Call bumping control for PPP/MP and CCB.	S85.0
	CE0	Disable the call bumping function.	

Command	Options	Function & Description	Ref.
	CE1	Enable the call bumping function.	
CE*n*		Call bumping(Call bumping) for MPPP and CCB.	S85.0
	CE0	Disable Call bumping function.	
	CE1	Enable Call bumping function .	
CH?		Display the accumulated charging unit of the last call.	
CI<prefix>		Prefix number string to be added to the Calling-party-number before indicating to the DTE when the type of number denotes international.	
CL*n*	n=0-2048	Maximum size of user data in a packet (number of octets).	
CL?		Inquire current setting of ATCLn	
CN<prefix>		Prefix number string to be added to the Calling-party-number before indicating to the DTE when the type of number denotes national.	
CP*n*		Loopback 4 control.	S83.0
	CP0	Disable Loopback 4.	
	CP1	Enable Loopback 4.	
CR*n*	n=0-30 *	Resumes a previously suspended call, n is the call identifier(Europe)	
CS*n*	n=0-30 *	Suspend a call, n is the call identifier (Europe).	
CT		Clear buffer and start the embedded protocol analyzer. Capture data immediately and start timer.	
C$		Invoke the interpretation function of the embedded protocol analyzer and display the results on DTE.	

Command	Options	Function & Description	Ref.
D*s*		Dial s (numbers and options) that follow (see also S38.0, S35.4). The options of s are listed as follows:	
	,	Pause for a time specified in S6. Remaining digits will be dialed as in-band DTMF.	
	Y0	Unknown type of number	
	Y1	International number	
	Y2	National number	
	Y3	Network specific number	
	Y4	Subscriber number	
	Y6	Abbreviated number	
	Z0	Type of sub-address, NSAP with AFI=$50, IA5 characters	
	Z2	Type of sub-address, user specified, IA5 characters	
	N0	Unknown numbering plan	
	N1	ISDN/Telephony numbering plan (CCITT E.164/E.163)	
	N3	Data numbering plan (CCITT X.121)	
	N8	National standard numbering plan	
	N9	Private numbering plan	
	/	Called party sub-address delimiters	
	Format of “s”	[[Yn][Nn]called_party_number][[W][,]]inband_dtmf_number or [[Yn][Nn]called_party_Number][/[Zn]called_party_subaddress/]	
DA*s*		Dial s (number and options) that follows for the Analog adapter, Phone 1.	

Command	Options	Function & Description	Ref.
DB*s*		Dial s (number and options) that follows for the Analog adapter, Phone 2.	
DB*n*		Connection option if leased-line mode is selected after power-on.	S85.0
	DB1	Use B1 channel in originate mode.	
	DB2	Use B2 channel in originate mode.	
	DB3	Use B1 & B2 channels in originate mode.	
DI*s*		Dial s (number and options) that follows for ISDN data call	
DL		Repeat last ATD command	
DN*n*	n=0-1	Set directory numbers (USA).	
	DN0=xxxxx	Set the DNO value.	
	DN1=	Clear the DNO.	
	DN?	Query present DNs.	
DS*n*	n=0-39	Dial number stored in non-volatile RAM at location 'n'; use “+” to dial two consecutive numbers for bundling or MPPP calls	S44.3
E*n*		Command mode local echo of keyboard commands	S23.0
	E0	Echo off	
	E1 *	Echo on	
H*n*		On/off hook control	
	H0 *	Hang up (on-hook) the TA or ISDN, same as 'ATH'	
	H3	Hang up the analog adapter, Phone 1	
	H4	Hang up the analog adapter, Phone 2	
I*n*		Display inquired information	

Command	Options	Function & Description	Ref.
	I0	Display product code, same as 'ATI' Results: 1291 (USA) 1292 (DSS1) 1293 (1TR6)	
	I1	Display product information and ROM checksum. Results: TA128 <switch>: V x.xx where <switch>= USA, DSS1, or 1TR6	
	I3	Display link status report	
	I9	Display Microsoft PnP code	
	I11	Display PPP status.	
JAn	n=0-255 *48	Add-threshold for MPPP in Kbps unit	S126
JSn	n=0-255 *32	Sub-threshold for MPPP in Kbps unit	S127
KAxn	n=0-63 *0	Add-persist time interval for BOD; BOD disabled if n=0 x= M(in Minute unit) or S(in Second unit)	S85b1-7
KSxn	n=0-63 *0	Sub-persist time interval for BOD; BOD disabled if n=0 x= M(in Minute unit) or S(in Second unit)	S125b1-7
L*n*	n=0-3 2 *	Speaker volume control. The higher the value, the higher the volume	S24.4-5
M*n*	M=0-2	Speaker control	S21.1-2
	M0	Speaker always OFF	
	M1 *	Speaker ON until call is answered	
	M2	Speaker always ON	

Command	Options	Function & Description	Ref.
N*n*	n=0-3 3 *	Ring volume control.'N0' will disable the audio ring function	S24.0-1
O		Return to on-line state	
P*n*	n=0-6	D channel protocol selection (USA) for American Version	S86
	P0 *	Northern Telecom proprietary ISDN	
	P1	National ISDN 1 (1 SPID)	
	P2	National ISDN 1 (2 SPID)	
	P3	Reserved	
	P4	AT&T custom point-to-point	
	P5	AT&T custom point-to-multipoint (1 SPID)	
	P6	AT&T custom point-to-multipoint (2 SPID)	
Q*n*	n=0-1	Result code displayed	S23.7
	Q0 *	TA returns result code	
	Q1	TA does not return result code	
Sr.b=*n*		Set bit 'b' of S-register 'r' to value 'n'. 'n' is a binary digit '0' or '1'	
Sr.b?		Display value of bit 'b' of S-register 'r'	
Sr=*n*		Set S-register 'r' to value 'n'. 'n' must be a decimal number between 0 and 255.	
Sr?		Display value stored in S-register 'r'.	
SPIDr=nnn …		User enters Service Profile ID nnn… (SPID), for USA switches.	
	SPID0	First SPID number.	
	SPID1	Second SPID Number, if any.	
SPID?		Display the SPID setting(s).	

Command	Options	Function & Description	Ref.
UPX		Download firmware to the Flash EPROM using Xmodem protocol.	
V*n*		Sets display type for Result Codes.	S23.6
	V0	Display result code in numeric form. (See also S35.7 and the result code table of 'ATXn').	
	V1 *	Display result code in verbose form.	
X*n*	n=0-7 5 *	Result code options, see the Options Table.	S23.3-5
Z*n*	n=0-4	Reset TA and set power-on profile.	S15.5-7
	Zn	Reset TA and load user profile n (0-3).	
	Z4	Reset TA and load factory settings.	
$		Basic command summary help.	

Description of ATI3 Output:

The Link Status Report output appears as follows:

```
ZyXEL ISDN TA LINK STATUS REPORT


Connect DTE Speed          :
Error Control Level        :
Protocol Link Speed        :
Octets Received            : 0
Octets Sent                : 0
Cause                      :
Cause Value                : 0
HDLC FCS Error             : 0
HDLC Receive Over-run      : 0
HDLC Transmit Under-run    : 0
```

Output Parameter	Output Value Description

Output Parameter	Output Value Description
Connect DTE Speed	Current on-line DTE speed.
Error Control Level	Error control protocol used for current session.
Protocol Link Speed	Current on-line DCE speed, line speed.
Octets Received	Number of data octets received from remote.
Octets Sent	Number of data octets sent to remote.
Cause	Verbose disconnection reason for the last session.
Cause Value	Numerical disconnection reason for the last session.
HDLC FCS Error	Errors in frame (block) checksum (If there were many FCS Errors, you may have experienced problems on the line).
HDLC Transmit Under-run	For TA's processor power measurement.
HDLC Receive Over-run	For TA's processor power measurement.

Extended "AT&" Command Set

Command	Options	Function & Description	Ref.
&C*n*		Carrier Detect (CD) options	S21.4
	&C0	CD always ON (See also S42.7)	
	&C1 *	CD tracks presence of carrier (See also S38.3, S42.7)	
&D*n*		Data Terminal Ready (DTR) options. (See also S25)	S21.6-7
	&D0	Ignore DTR signal, assume DTR is always ON.	
	&D1	108.1, DTR OFF-ON transition causes dial of the default number. (See also 'AT*Dn' and S48.4)	
	&D2 *	108.2, Data Terminal Ready, DTR OFF causes the TA to hang up.	

Command	Options	Function & Description	Ref.
	&D3	Same as &D2 but DTR OFF causes the TA to hang up and reset from profile 0.	
&E*n*		B channel line speed for ISDN data call	S118.2
	&E0 *	64Kbps	
	&E1	56Kbps (Default for American ISDN)	
&F		Load factory settings to RAM as active configuration.	
&H*n*		Data flow control, DTE/DCE.	S27.3-5
	&H0	Flow control disabled.	
	&H3 *	Hardware (CTS/RTS) flow control	
	&H4	Software (XON/XOFF) flow control.	
&I*n*		Dial up/leased line options.	
	&I0 *	Dial-up line mode.	
	&I1	Leased line mode for B1 channel.	
	&I2	Leased line mode for B2 channel.	
	&I3	Leased line mode for B1 & B2 channel.	
&J*n*		Bundle selection (See also S100)	S87.5-6
	&J0 *	Bundle connection is disabled.	
	&J1	Bundle connection is enabled in answer mode only.	
	&J2	Bundle connection is enabled in call mode only.	
	&J3	Bundle connection is enabled in both directions.	
&K*nn*		V.120/X.75 compression control. &K must be followed by two digits.	S83.2
	&K00	Disable V.42bis.	
	&K44	Enable V.42bis.	

Command	Options	Function & Description	Ref.
&L*n*		Analog port selection during call answering.	S84.5
	&L0	Set priority to analog port, Phone 1.	
	&L1	Set priority to analog port, Phone 2.	
&M*n*		Bundle selection (See also S100).	S14b6-7
	&M0 *	Asynchronous mode with data buffering.	
	&M1	Asynchronous command, synchronous data.	
	&M2	Direct asynchronous mode, no data buffering.	
	&M3	Synchronous mode.	
&O*n*		Set default call type for conventional dialing commands.	S83.4-5
	&O0	ATDs, ATDPs, and ATDTs default to make calls for analog adapter, Phone 2.	
	&O2	ATDs, ATDPs, and ATDTs default to make ISDN data calls.	
	&O3	ATDs, ATDPs, and ATDTs default to make calls for the analog adapter, Phone 1	
&S*n*		Data Set Ready (DSR) function selection.	S21.3
	&S0 *	DSR overridden, DSR always ON.	
	&S1	DSR according to CCITT (ITU-TSS). (See also S41.5, S44.4)	
&T*n*		TA testing.	
	&T9	Initiate ISDN Loopback test.	
	&T10	Initiate ISDN Loopback with self test.	
	&T11	Initiate ISDN Loopback from B1 through switch to B2.	
&V*n*		View profile settings.	

Command	Options	Function & Description	Ref.
	&V0	View current active settings.	
	&V1-4	View the (n-1)th user profile settings.	
	&V5	View factory default settings.	
	&V6	View analog adapter, Phone 1 setting	
	&V7	View analog adapter, Phone 2 setting	
&W*n*	n=0-3	Write current settings to user profile n in non-volatile RAM. (See also S35.6)	
&Z?		Display all the phone numbers stored in non-volatile RAM.	
&Z*n=s*	n=0-39	Write phone number/s to NVRAM at location n (n=0-39) use AT*Dn or ATS29=n to set the default dial pointer.	
&ZI*n=s*	n=0-7 s=phone number	MSN setting. Assign the phone number (including subaddress, if any) for various B channel protocols. In answer mode, these numbers will be compared with the received called_party_number and called_party_subaddress information. The call will be accepted using the specific protocol if the assigned number of this protocol matches with the called_party_number.	
	n=0	Assign MSN 's', for X.75.	
	n=1	Assign MSN 's', for V.110.	
	n=2	Assign MSN 's', for V.120.	
	n=3	Assign MSN 's', for PPP, MPPP.	
	n=4	Assign MSN 's' for ISDN data, protocol auto-detection.	
	n=6	Assign the phone number 's' for analog adapter, Phone 1.	

Command	Options	Function & Description	Ref.
	n=7	Assign the phone number ‘s’ for the analog adapter, phone 2.	
&ZI?		Display the phone number (including subaddress , if any) for various B channel protocols.	
&ZO?		Display the &ZOn setting.	
&ZO*n*=*x*		Write own phone number (including sub-address, if any). The number specified will be used as the calling party number whiling dialing. Value for “n” I = ISDN data A= analog adapter, Phone 1 B= analog adapter, Phone 2	

Extended "AT*" Command Set

Command	Options	Function & Description	Ref.
*D*n*	n=0-39	Set default dial pointer at telephone directory location n.	S29
	*D0 *	(See also S35.4 and S38.0)	
*G*n*		Security function selection.	S36.5-7
	*G0 *	Disable security function.	
	*G1	Enable type 1 security, with password check (ZyXEL to ZyXEL only).	
	*G2	Enable type 1 security, with password check and call back (ZyXEL to ZyXEL only).	
	*G3	Enable type 2 security, with password check.	
	*G4	Enable type 2 security, with password check and call back.	
	*G5	Enable type 2 security, with password check and call back, remote site enters the call back number.	

Command	Options	Function & Description	Ref.
*GC*n*	n=0-1	Call-back function selection.	
	*GC0 *	Disable call-back function	
	*GC1	Enable call-back function	
*HC*n*	n=0-4	Assign call-back phone number, “s” to storage location, “n”	
*H*n*	n=0-39	Modify user password table at location n.	
*HS		Modify supervisory password (Default: “ZyXEL”)	
*I*n*	n=0-1	Command set selection.	S17b6-7
	*I0 *	AT command set.	
	*I1	V.25bis command set.	
*M*n*	n=0-1	Leased line auto-handshake mode selection.	S17b6-7
	*M0 *	Leased line auto-handshake on Originate mode.	
	*M1	Leased line auto-handshake on Answer mode.	
*T		Recall the last CND (Caller ID) information.	
*V		View the Password table	
*VC		View the Call-back Number table	

17 Status Registers and Result Codes

S-registers (Status Registers) contain values that determine and reflect how your Terminal Adapter (TA) operates and executes commands. You can read the values and change them, either using terminal commands or the TA's panel controls with the same results.

Every user profile corresponds to a separate set of S-register values, but when we mention S-registers, we are referring to the ones that correspond to the active profile. If you want to read or change the values in a profile that is currently inactive, you will first have to recall that profile to make it active.

At the time this manual was written, the omni was equipped with 124 S-registers, from S0 to S124. S0 to S11 are standard AT S-registers, and S12 to S124 are mostly bit-map configured. Changes in the bit-map configuration can have the same effect as issuing AT Commands. However, it is recommended to use equivalent AT Commands.

Viewing and Setting S-Registers

There are several AT Commands that are used to view the values stored in the S-registers.

Viewing S-registers

To display the value stored in S-register ‘r’ with AT Commands, use:

```
ATSr?
```

To view all of the S-resister settings use the &Vn command:

```
AT&Vn
```

- **n=0** - View S-register settings for current active profile.

- **n=1-4** - View settings for user profile number (n-1).
- **n=5** - View the factory default settings.
- **n=6** - View the analog adapter's setting, Phone 1 (non-data).
- **n=7** - View the analog adapter's setting, Phone 2 (omni.net).

The S-register values may be displayed in either Decimal or Hexadecimal format when using the preceding commands. Bit 3 of S-register 84 sets which numbering system is used for display.

- ATS84.3=0 - for decimal format.
- ATS84.3=0 - for Hex format.

To display the value of bit b of S-register r, type:

```
ATSr.b?
```

Setting S-registers

In order to change the value in S-register 'r' to value 'n' use:

```
ATSr=n (range 0-255)
```

In order to change the value in a specific bit (b) of S-register r, use:

```
ATSr.b=n (range 0-1)
```

In both commands, n is a decimal number in the given range. While the first command modifies all bits in the S-register simultaneously, the second command lets you change bit b without affecting other bits in this S-register. When using **ATSr=n**, you need to do a conversion to or from the binary number to find out which bits you manipulate.

For example, if you want to set S38 bit 3 to 1 for a specific application, you may either use **ATS38.3=1** (simple) or use the following (difficult):

note: The values used in the example below differ from the actual values in the S-register and are used for demonstration purposes only.

Read the value from S38 using ATS38?

Convert it to binary, using the following weight table:

Bit	Binary value	Decimal value	Hexadecimal value
0	00000001	1	$01
1	00000010	2	$02
2	00000100	4	$04
3	00001000	8	$08
4	00010000	16	$10
5	00100000	32	$20
6	01000000	64	$40
7	10000000	128	$80

To set bit 3 to 1 (binary), do a logic OR operation with the value.

Operation	Example-1			Example-2		
	Binary	Dec.	Hex	Binary	Dec.	Hex.
	10001000	136	$88	01000000	64	$40
OR	00001000	8	$08	00001000	8	$08
	10001000	136	$88	01001000	72	$48

To set bit 3 to 0 (binary), you must invert the value using a logic NOT operation and then do an logic AND operation.

NOT	00001000	8	$08	00001000	8	$08
	11110111	247	$F7	11110111	247	$F7
AND	10001000	136	$88	01000000	64	$40
	10000000	128	$80	01000000	64	$40

Finally, using the ***result*** decimal value, issue an **ATS38=n** to set the register.

S-Register Descriptions

The descriptions for each S-register. In most bit-mapped S-registers, the default bit value is 0 (which is the normal situation) and only the non-default situation is described. Some reserved bits are for factory use and the user should not change them.

Values followed by an asterisk * are the factory default settings.

Basic S-Registers "ATSn=x"

Command	Function & Description	Ref.
S0=	Set the number of rings on which the TA will answer. A 0 value disables auto-answer.	+000
S1=	Counts and stores number of rings from an incoming call.	+000
S2=	Define escape code character, default <+> (43 dec.).	+043
S3=	Define ASCII Carriage Return.	+013
S4=	Define ASCII Line Feed.	+010
S5=	Define ASCII Backspace.	+008
S7=	Set duration, in number of seconds, TA waits for a carrier.	+060
S8=	Set duration, in seconds, for pause (,) option in Dial command and pause between command re-executions for Repeat (>)command.	+002

Extended S-Registers "ATSn=x"

Command	bit	dec	hex	Function and description	Ref.
S15=	bit	dec	hex	Bit-mapped register.	+130
	0,1	0	0	Even parity.	
		1	1	Odd parity.	
		2	2 *	No parity.	
	2	0	0 *	1 stop bit.	
		4	4	2 stop bits.	
	4,3	0	0 *	10 bit character length.	*C0
		8	8	11 bit.	*C1
		16	10	9 bit.	*C2
		24	18	8 bit.	*C3
	7-5	0	0	Profile 0 as active settings after power ON.	Z0
		32	20	Profile 1 as active settings after power ON.	Z1

Command	bit	dec	hex	Function and description	Ref.
		64	40	Profile 2 as active settings after power ON.	Z2
		96	60	Profile 3 as active settings after power on.	Z3
		128	80 *	Factory default as active settings after power ON.	Z4
S16=		dec	hex	Test status register.	+000
		0	0	No test in progress.	&T0
S18=		dec		Force modem or TA to fix baud rate when idle.	+000
		0 *		Disable fixed baud function	
		n+1		Enable baud rate fixing at idle, n=0-15 baud rate value settings (n) the same as S20 value.	
S20=		dec	hex	DTE speed (bps). Auto detected from AT Command.	+003
		0	0	230400 bps	
		1	1	115200 bps	
		3	3	57600 bps	
		4	4	38400 bps	
		5	5	19200 bps	
		9	9	9600 bps	
		11	B	4800 bps	
		12	C	2400 bps	
		13	D	1200 bps	
		14	E	460800 bps	
		15	F	921600 bps	
S21=	bit	dec	hex	Bit mapped register.	
	1-2	0	0	Speaker always Off.	M0
		2	2	Speaker On until carrier is detected.	M1
		4	4	Speaker always On.	M2
	3	0	0	DSR always On.	&S0

Command	bit	dec	hex	Function and description	Ref.
		8	8	According to CCITT (see also S44.4, S41.5).	&S1
	4	0	0	CD always On.	&C0
		16	10	CD tracks presence of data connection (see also S38.3).	&C1
	6-7	0	0	Assume DTR always On.	&D0
		64	40	108.1, DTR Off-On transition causes dial of the default number.	&D1
		128	80	108.2 Data Terminal Ready, DTR Off causes the TA to hang up and return to command state.	&D2
		192	C0	108.2, DTR off causes the TA to hang up and reset the TA to profile #0 after DTR dropped.	&D3
S23=	bit	dec	hex	Bit mapped register.	+105
	0	0	0	Command echo disabled.	E0
		1	1	Command echo enabled.	E1
	2	0	0	Insertion is not allowed during a phone call.	
		4	4	Insertion is allowed during a phone call.	
	3-5	0	0	ATX0 (See result code table).	
		8	8	ATX1 dec hex AT	
		16	10	ATX2 40 28 X5	
		24	18	ATX3 48 30 X6	
		32	20	ATX4 56 38 X7	
	6	0	0	Display result code in numeric format (see S35.7).	V0
		64	40	Display result code in verbose format.	V1
	7	0	0	TA returns result code.	Q0

Command	bit	dec	hex	Function and description	Ref.
		128	80	TA does not return result code (see S40b1).	Q1
S24=	bit	dec	hex	Bit mapped register.	
	0-1	0-3	0-3	Ring volume control, increments of 1 in decimal.	N0-3
	2	0	0	Ignore S21.1-2 when Phone 1 key pad dialed.	
		4	4	Do not ignore S21-2 when Phone 1 key pad dialed.	
	3	0	0	Ignore S21.1-2 when Phone 2 key pad dialed.	
		8	8	Do not ignore S21-2 when Phone 2 key pad dialed.	
	4-5	16-48		Speaker volume control, in increments of 16 in decimal value.	L0-3
	6	0	0	POTS Port tone volume low.	
		1	1	POTS Port tone volume high.	
S27=	bit	dec	hex	Bit mapped register.	
	3-5	0	0	Flow control disabled.	&H0
		24	18	Hardware (RTS/CTS) flow control.	&H3
		32	20	Software (XON/XOFF) flow control.	&H4
		40	28	Reserved.	&H5
S29=		0-39	0-39	Set default dial phone number pointer, use AT&Zn=s to store phone numbers.	+000 *D
S31=		0-255	0-FF	Holds the ASCII decimal value of the XON.	+017
S32=		0-255	0-FF	Holds the ASCII decimal value of the XOFF.	+019
S35=	bit	dec	hex	Bit mapped register.	

Command	bit	dec	hex	Function and description	Ref.
	1	2	2	Disable aborting from terminal during modem handshaking.	
	4	16	10	When Data/Voice with is pressed, TA will dial the default number.	*Dn S29
	7	128	60	Enable extended numerical result codes from 50-71 when an error corrected connection is made. Use with ATV0 (see result code table).	V0 S23.6
S36=	bit	dec	hex	Bit mapped register.	+000
	5-7	*0	0	Disable security function.	*G0
		32	20	Enable type 1 security, with password check (ZyXEL to ZyXEL only).	*G1
		64	40	Enable type 1 security, with password check and call-back (ZyXEL to ZyXEL only).	*G2
		96	60	Enable type 2 security, with password check.	*G3
		128	80	Enable type 2 security, with password check and call-back.	*G4
		160	A0	Enable type 2 security, with password check and call-back. Remote site enters the call-back number.	*G5
S38=	bit	dec	hex	Bit mapped register.	+000
	0	1	1	Repeatedly dialing default number.	*Dn S29
	3	8	8	DCD on/off sequence follows UNIX standard, DCD high before connect message is sent, DCD off after last DCE response is sent.	&C1 S21.4

Command	bit	dec	hex	Function and description	Ref.
S40=	bit	dec	hex	Bit mapped register.	+000
	1	2	2	No result code displayed in answer mode.	Q2
S41=	bit	dec	hex	Bit mapped register.	+000
	3	8	8	Enable CCITT signals 140 and 141 on EIA-232D interface.	
	5	32	20	DSR follows DCD and pulses (see S44b4).	&Sn
	6	64	40	Force S0>=2.	S0
S42=	bit	dec	hex	Bit mapped register.	+000
	3	8	8	Disable escape sequence code in answer mode.	
	5	32	20	Disable Data/Voice button.	
	6	64	40	Disable <RINGING> result code.	Xn
S43=	bit	dec	hex	DTE Port 2 speed (bps) configured by AT command.	+001
		0	0	230400	*A0
		1	1 *	115200	*A1
		2	2	76800	*A2
		3	3	57600	*A3
		4	4	38400	*A4
		5	5	19200	*A5
		6	6	9600	*A6
		7	7	2400	*A7
S44=	bit	dec	hex	Bit mapped register.	+000
	3	8	8	ATDSn initiates auto-dial of the stored numbers consecutively until connection is made.	DSn
	4	16	10	DSR follows DTR (see also S41.5).	&S1

Command	bit	dec	hex	Function and description	Ref.
S50=		0-255		Inactivity timer for RS-232 Port. Each unit = 10 sec. 000 disables.	+000
S56=		0-255	0-FF	Hook flash detect time for Analog Adapter (POTS port); units 10ms.	+050
S61=	bit	dec	hex		
	3	*0	0	MP data sent in rotate mode.	
		1	1	MP data sent in split mode.	
S64=		0-255	0-FF	Security callback timer in unit of 1 second.	+005
S79=	bit	dec	hex	Bit mapped register.	+000
	0	*0	0	Ignore POTS port 1 global incoming call when port 1 is busy.	
		1	1	Discard POTS port 1 global incoming call when port 1 is busy (Sending RELEASE COMPLETE).	
	0	*0	0	Ignore POTS port 2 global incoming call when port 1 is busy.	
		2	2	Discard POTS port 2 global incoming call when port 1 is busy (Sending RELEASE COMPLETE).	
	2	0	0	POTS 1 call-waiting/multiple-answer disabled.	
		*4	4	POTS 1 call-waiting/multiple-answer enabled.	
	3	0	0	POTS 2 call-waiting/multiple-answer disabled.	
		*8	8	POTS 2 call-waiting/multiple-answer enabled.	

Command	bit	dec	hex	Function and description	Ref.
	4	*0	0	POTS port 1 is connected to a telephone.	
		16	10	POTS port 1 is connected to a fax/modem.	
	5	*0	0	POTS port 2 is connected to a telephone.	
		32	20	POTS port 2 is connected to a fax/modem.	
	7	*0	0	Sending RELEASE COMPLETE with cause ‘user busy’ for ATH 1.	
S80=	bit	dec	hex	Bit-mapped register:	+000
	4	0 *	0	Do not send Low Layer Compatibility information for Phone 2.	
		16	10	Send Low Layer Compatibility for Phone 2.	
	6	0 *	0	Do not send Low Layer Compatibility information for ISDN data call.	
		64	40	Send Low Layer Compatibility for ISDN data call.	
	7	0 *	0	Do not send Low Layer Compatibility information for Phone 1.	
		128	80	Send Low Layer Compatibility for Phone 1.	
S82=		dec		ISDN B channel protocol.	Bn
		60		V.120 64000	
		61		V.120 56000	
		62		X.75 64000 Transparent	
		63		X.75 56000 Transparent	
		64		X.75 64000 T.70	
		65		X.75 56000 T.70	

Command	bit	dec	hex	Function and description	Ref.
		70		X.75 64000 BTX	
		71		X.75 56000 BTX	
		72		V.110 64000	
		73		V.110 56000	
		74		PPP async to sync 64K	
		75		PPP async to sync 56K	
		76		SLIP to sync HDLC conversion 64K.	
		77		SLIP to sync HDLC conversion 56K.	
S83=	bit	dec	hex	Bit-mapped register:	+000
	0	0	0	Disable loopback 4 test.	CP0
		1	1	Enable loopback 4 test.	CP1
	2	0	0	ISDN without V.42bis.	&K00
		4	4	ISDN with V.42bis if applicable.	&K44
	4-5	0 *	0	ATDs, ATDPs, and ATDTs is mapped to ATDMs.	&O0
		32	20	ATDs, ATDPs, and ATDTs is mapped to ATDIs.	&O2
		48	30	ATDs, ATDPs, and ATDTs is mapped to ATDBs.	&O3
	6	0	0*	DOVBS answer using 56kbps (US only).	
		64	40	DOVBS answer using 64kbps.	
	7	0	0*	ISDN data call using normal Bearer Service.	
		128	80	ISDN data call using Voice Bearer Service.	
S84=	bit	dec	hex		
	0-2			Embedded Protocol Analyzer control.	CCn

Command	bit	dec	hex	Function and description	Ref.
	0	1	1	Capture DTE-DCE interface protocol information.	
	1	2	2	Capture B-channel (X.75 or V.120) frames.	
	2	4	4	Capture D-channel protocol information.	
	3	0	*0	Display S register value in decimal format.	
		8	8	Display S register value in hex format.	
	4	0 *	0	Indicate Caller ID after the 1st RING message.	
		16	10	Disable Caller ID indication.	
	5	0	0	Phone 1 has higher priority for answering an analog call.	&L0
		32	20	Phone 2 has higher priority for answering an analog call.	&L1
S85=	bit	dec	hex	DCA function.	
	0	0	*0	DCA function disabled.	CE0
		1	*1	DCA function enabled.	CE1
	1-6		*0	Add-persist time interval.	KAxn
	7	0	0	S85b1-6 is in Second unit.	KASn
		128	80	S85b1-6 is in Minute unit.	KAMn
S86=		dec	hex	D channel protocol selection (USA) The following number is valid only for American version:	Pn
		0	0	Northern Telecom proprietary ISDN.	
		1	1	National ISDN 1 (1 SPID mode).	
		2	2	National ISDN 1 (2 SPID mode).	
		3	3	Reserved.	

Command	bit	dec	hex	Function and description	Ref.
		4	4	AT&T proprietary point-to-point.	
		5	5	AT&T proprietary point-to-multi-point (1 SPID mode).	
		6	6	AT&T custom point-to-multipoint (2 SPID mode).	
S87=	bit	dec	hex		
	0	*0	0	Enable POTS port 1 to receive global calls.	
		1	1	Disable POTS port 1 to receive global calls.	
	1	*0	0	Enable POTS port 2 to receive global calls.	
		2	2	Disable POTS port 2 to receive global calls.	
	2	*0	0	CHAP/PAP for authentication conversion.	
		4	4	PAP only for authentication conversion.	
	5-6	0 *	0	Bundle connection is disabled.	&Jn
		32	20	Bundle connection is enabled in answer mode only.	
		64	40	Bundle connection is enabled in call mode only.	
		96	60	Bundle connection is enabled in both directions.	
	7	*0	0	DTE port 2 only answers the matched MSN incoming data calls.	
		128	80	DTE port 2 answers incoming calls when DTE port 1 is busy.	
S89=	bit	dec	hex	Bit-mapped register.	
	5	0	0	Disable the metering pulse of analog adapter, Phone 2.	

Command	bit	dec	hex	Function and description	Ref.
		32	32	Enable the metering pulse of analog adapter, Phone 2.	
	6	0	0	Disable the metering pulse of analog adapter, Phone 1.	
		64	40	Enable the metering pulse of analog adapter, Phone 1.	
S100=		dec	hex	B channel bundling protocol selection	
		0 *	0	Multiple Link Protocol (MLP)	
		1	1	cFossil channel bundling, for European Switches only (cFos)	
S102=				Outgoing ISDN data type. Value has the same definition as S82	Bnn
S104+n=		dec	hex	Outgoing Service Indicator (for 1TR6 only), n=0, analog adapter, Phone 2 n=2, ISDN data n=3, analog adapter, Phone 1	
		1	1	Fernsprechen	
		2	2	a/b - Dienste	
		7	7	Daten bertragung 64 Kbps. The defaults are : * s104=1 - for a/b adapter 2 * s105= - reserved * s106=7 - for ISDN data * s107=1 - for a/b adapter 1	
S108+n=		dec	hex	Outgoing Service Additional (for 1TR6 only) Information n=0, analog adapter, Phone 2 n=2, ISDN data n=3, analog adapter, Phone 1	
	SI=1	1	1 *	ISDN-Fernsprechen 3.1 kHz	

Command	bit	dec	hex	Function and description	Ref.
		2	2	Fernsprechen analog	
	SI=2	2	2	Fax Gruppe 3	
		3	3 *	Daten Ober Modem	
		4	4	Btx Ober Modem	
	SI=7	0	0	Daten bertragung 64 Kbps (X.75 SLP)	
		11------		Async. V.110	
		01------		Extensions of async.	
		--0---*		Number of data bits: 8	
		--1---		Number of data bits: 7	
		---0-*		Number of stop bits: 1	
		---1---		Number of stop bits: 2	
		----*0---		No parity	
		----1---		Even parity	
		11---000		1200 bps	
		11---011		2400 bps	
		11---100		4800 bps	
		11---101		9600 bps	
		11---110		14400 bps	
		11---*111		19200 bps	
		01---000		38400 bps	

Command	bit	dec	hex	Function and description	Ref.
		1010----		Sync. V.110	
		10100000		1200 bps	
		10100011		2400 bps	
		10100100		4800 bps	
		10100101		9600 bps	
		10100110		14400 bps	
		10100111		19200 bps	
		10101000		48000 bps	
		10101001		56000 bps	
		10101010		56000 bps for 56kbit-network	
		10101111		In band negotiation	
S108+n=		dec	hex	High Layer Compatibility (Non-1TR6) n=0, analog adapter, Phone 2 n=2, ISDN data n=3, analog adapter, Phone 1	
		0 *	0	No High-Layer-Compatibility information element will be sent	
		1	1	Telephone	
		4	4	Facsimile Group 2/3	
		40	28	Teletex service (Rec.F.220)	
		49	31	Teletex service (Rec.F.200)	

Command	bit	dec	hex	Function and description	Ref.
		50	32	Information Interworking for Video Services (Rec.F.300 T.110)	
		53	35	Telex service (Rec.F.60)	
		56	38	Message Handling Systems (MHS) (Rec.X.400 series)	
		65	41	OSI application (Rec.X.200 series)	
S114=				I-field data length (MSB byte)	
S115=				I -field data length (LSB byte)	
S117=				V.110 user rate	B1n
S118=	bit	dec	hex		
	0	0	0	Enable dial-in call	
		1	1	Disable dial-in call (dial out only)	
	2	0	0	Default B channel line speed is 64Kbps for ISDN data call	&E0
		4	4	Default B channel line speed is 56Kbps for ISDN data call	&E1
	3	*0	0	Disable CHAP option for PPP/MLPPP.	
		8	8	Enable CHAP option for PPP/MLPPP.	
	4	0 *	0	Use 3.1KHz Bearer service whenever possible for analog adapter, Phone 2	
		16	10	Use Speech Bearer service whenever possible for analog adapter, Phone 2	
	5	0 *	0	Use 3.1KHz Bearer service whenever possible for analog adapter, Phone 1	

Command	bit	dec	hex	Function and description	Ref.
		32	20	Use Speech Bearer service whenever possible for analog adapter, Phone 1	
	6	0 *	0	Enable analog adapter to accept global calls	
		64	40	Forbid the POTS port to accept global calls.	
	7	0 *	0	Enable analog incoming calls.	
		128	80	Reject analog incoming calls.	
S119=	bit	dec	hex		
	0	0 *	0	Disable call-back function	*GC
		1	1	Enable call-back function	
	1	0 *	0	Disable point-to-point signaling DDI function	
		2	2	Enable point-to-point signaling DDI function	
	2	0 *	0	Disable point-to-multipoint signaling DDI function	
		4	4	Enable point-to-multipoint signaling DDI function	
	3	0 *	0	Inbound call ignored when no MSN (EAZ) is matched	
		8	8	Inbound call accepted using default protocol when no MSN (EAZ) is matched	
	4	0 *	0	V.110 user rate = 19200 bps if DTE speed greater than 19200 bps	
		16	10	V.110 user rate = 38400 bps if DTE speed greater than 38400 bps	
	5	0 *	0	Enable normal MSN function	&ZIn

Command	bit	dec	hex	Function and description	Ref.
		32	20	Treat the number assigned by &ZI=n... as sub-address, and match with the called_party_subaddress for inbound call routing	
S120=	0	*0	0	Enable POTS port 1 call out.	
		1	1	Disable POTS port 1 call out.	
	1	*0	0	Enable POTS port 2 call out.	
		2	2	Disable POTS port 2 call out.	
	2	*0	0	Enable multi-answering while TA MSN is not assigned.	
		4	4	Handle incoming calls according to AT&Ln setting.	
	3	*0	0	If S120.2=1 is set and the POTS port is busy, calls will be routed to another POTS port.	
		8	8	If S120.2=1 is set and the POTS port is busy, calls will be rejected.	
	4	*0	0	Enable TA to accept global calls for a/b adapter and ISDN data.	
		16	10	Reject unmatched calls for a/b adapter and ISDN data.	
S124=		dec	hex	Empty IP packet interval for PPP	+000
		0-255	0-FF	Units of 1 sec.	
S125=	bit	dec	hex		
	1-6		*0	Sub-persist time interval.	KSxn
	7	0	*0	S125b1-6 is in Second unit.	KSSn
		128	80	S125b1-6 is in Minute unit.	KSMn
S126=		0-255	0-FF	Add-threshold for BOD in Kbps unit	JAn,+48

Command	bit	dec	hex	Function and description	Ref.
S127=		0-255	0-FF	Sub-threshold for BOD in Kbps unit	JSn,+32
S128=	bit	dec	hex	For DTE port 2 only.	
	0	*0	0	Two POTS and one DTE port.	
		1	1	One POTS and two DTE ports	

- **Bit** - S-register bit number, 'b', used in 'ATSr.b=n' and 'ATSr.b=?'
- **dec** - Decimal value, 'x', used in 'ATSn=x'
- **hex** - Equivalent Hexadecimal value.
- **+nnn** - Factory default when listed in 'Reference' column.

"ATXn" Result Code Option Table

The following table shows the different options available when setting the ATXn command. The default value for ‘n’ is 5 when the omni is shipped:

ATV0	ATV1	X0	X1	X2	X3	X4	X5	X6	X7
0	OK	V	V	V	V	V	V	V	V
1	CONNECT	V	V	V	V	V	@	$	#
2	RING	V	V	V	V	V	V	V	V
3	NO CARRIER	V	V	V	V	V	V	V	V
4	ERROR	V	V	V	V	V	V	V	V
5	CONNECT 1200		%	%	%	%	@	$	#
6	NO DIAL TONE			V		V	V	V	V
7	BUSY				V	V	V	V	V
8	NO ANSWER				V	V	V	V	V
9	RINGING*				V	V	V	V	V
10	CONNECT 2400		%	%	%	%	@	$	#
11	CONNECT 4800		%	%	%	%	@	$	#
12	CONNECT 9600		%	%	%	%	@	$	#
14	CONNECT 19200		%	%	%	%	@	$	#
15	CONNECT 7200		%	%	%	%	@	$	#
16	CONNECT 12000		%	%	%	%	@	$	#

ATV0	ATV1	X0	X1	X2	X3	X4	X5	X6	X7
17	CONNECT 14400		%	%	%	%	@	$	#
18	CONNECT 16800		%	%	%	%	@	$	#
19	CONNECT 38400		%	%	%	%	@		
20	CONNECT 57600		%	%	%	%	@		
21	CONNECT 76800		%	%	%	%	@		
22	CONNECT 115200		%	%	%	%	@		
23	CONNECT 230400		%	%	%	%	@		
24	CONNECT 460800		%	%	%	%	@		
25	CONNECT 921600		%	%	%	%	@		
26	CONNECT 307200		%	%	%	%	@		
27	CONNECT 153600		%	%	%	%	@		
28	CONNECT 102400		%	%	%	%	@		
29	CONNECT 61440		%	%	%	%	@		
30	CONNECT 51200		%	%	%	%	@		
31	CONNECT 62400		%	%	%	%	@		
32	CONNECT 124800		%	%	%	%	@		
33	CONNECT 62400		%	%	%	%	@		
34	CONNECT 41600		%	%	%	%	@		
35	CONNECT 31200		%	%	%	%	@	$	#
36	CONNECT 249600		%	%	%	%	@		
37	CONNECT 20800		%	%	%	%	@		
38	CONNECT 33600		%	%	%	%	@	$	#
39	CONNECT 28800		%	%	%	%	@	$	#
40	CONNECT 26400		%	%	%	%	@	$	#
41	CONNECT 24000		%	%	%	%	@	$	#
42	CONNECT 21600		%	%	%	%	@	$	#
43	CONNECT 48000		%	%	%	%	@	$	#
44	CONNECT 56000		%	%	%	%	@	$	#
45	CONNECT 64000		%	%	%	%	@	$	#
46	CONNECT 112000		%	%	%	%	@	$	#
47	CONNECT 128000		%	%	%	%	@	$	#

***** Use S42.6 to disable 'RINGING' result code.

Result Code Chart Symbol Reference

V	Supported
%	Reports the DTE Speed as: <cr><lf>CONNECT DTE_Speed<cr><lf>
@	CONNECT DTE_Speed/Protocol DCE_Speed/Error_Control ** Example: CONNECT 115200/V120 64000/LABD
$	<cr><lf>CONNECT DCE_Speed[/Error_Code]<cr><lf>
	Example: CONNECT 64000/ARQ
#	CONNECT DCE _Speed/Error_Code/Error_Control
	Example: CONNECT 64000/ARQ/V42b

Result Code Field Descriptions

Field Name	Possible Values
Error_Code	NONE, ARQ
Error_Control	LAPB, LAPD, V42 (This field will not show if no error control is negotiated)
Data_Compression	V42b
DCE_Speed	All possible DCE speeds supported
DTE_Speed	All possible DTE speeds supported
Protocol	Only ISDN protocols are listed here
	X.75
	X.75M (X.75 with MLP Bundle)
	X.75C (X.75 with cFos Bundle)
	V110
	V120
	V120M (V.120 with MLP Bundle)
	V120C (V.120 with cFos Bundle)
	SLIP
	PPP
	BTX

Connect Strings for Error Corrected Connections

To enable the following numerical (ATV0) and verbose (ATV1) result codes when an error corrected connection is made, set S35 bit 7 to 1.

```
ATS35.7=1<enter>
```

ATV0	ATV1	ATV0	ATV1
50	CONNECT	61	CONNECT 24000
51	CONNECT 1200	62	CONNECT 26400
52	CONNECT 2400	63	CONNECT 28800
53	CONNECT 4800	64	CONNECT 31200
54	CONNECT 7200	65	CONNECT 33600
55	CONNECT 9600	66	CONNECT 38400
56	CONNECT 12000	67	CONNECT 48000
57	CONNECT 14400	68	CONNECT 56000
58	CONNECT 16800	69	CONNECT 64000
59	CONNECT 19200	70	CONNECT 112000
60	CONNECT 21600	71	CONNECT 128000

18 Phone Jack Pinout Assignments

The omni features one RJ-45 phone jack and two RJ-11 phone jacks. The RJ-45 labeled “ISDN S” jack is for ISDN line connection (S/T interface), and the RJ-11 jack labeled “PHONE” (also known as an analog adapter in European countries) is for an optional connection to analog telephone equipment such as a telephone set, answering machine, fax machine or analog modem.

RJ-45 Connector for the S/T Interface Model

1. Not Connected
2. Not Connected
3. RCV +
4. XMT +
5. XMT -
6. RCV-
7. -48V
8. -48V RTN

RJ-45 Connector for the U Interface Model

1. Not Connected
2. Not Connected
3. Not Connected
4. Ring
5. Tip
6. Not Connected
7. -48V
8. -48V RTN

RJ-11 Analog Adapter Phone 1&2 (non-data)

1. Not Connected
2. Ring
3. Tip

4. Not Connected

19 Serial Port Interface

EIA-232D 25 Pin Serial Port Interface

Pin Number	ITU-TSS Signal Name	EIA Signal Name	Signal/Pin Description	Signal Direction DTE -DCE
1	101	AA	Protective Ground (GND).	⇔
2	103	BA	Transmitted Data(TXD).	⇒
3	104	BB	Received Data(RXD).	⇐
4	105	CA	Request To Send (RTS).	⇒
5	106	CB	Clear To Send (CTS).	⇐
6	107	CC	Data Set Ready (DSR).	⇐
7	102	AB	Signal Ground (GND).	⇔
8	109	CF	Data Carrier Detected (DCD).	⇐
15	114	DB	Transmit Clock Signal (source: DCE).	⇐
17	115	DD	Synchronous Receive Clock.	⇐
18	141		Local Analog Loopback Test.	⇒
20	108/2 108/1	CD	Data Terminal Ready (DTR). Connect DCE to line.	⇒
21	140		Remote Digital Loop	⇒

Pin Number	ITU-TSS Signal Name	EIA Signal Name	Signal/Pin Description	Signal Direction DTE -DCE
			Test.	
22	125	CE	Ring Indicator(RI).	⇐
24	113	DA	Transmit Clock Signal (source: DTE).	⇒
25	142		Test Indicator.	⇐

Async. Hardware Flow Control Cable Connection

Modem (DCE) DB25	Signal	to PC (DTE) DB 9	to DCE (Null) DB25	to MAC Mini 8	to NeXT 68,040 Mini 8
2	TXD	3	3	3	3
3	RXD	2	2	5	5
4	RTS	7	5	1	6
5	CTS	8	4	2	8
6	DSR	6	20		
7	Ground	5	7	4,8	4
8	CD (DCD)	1	20		2
20	DTR	4	6,8	1	1
22	RI	9			

20 Index