Omni 288S

User's Manual

ZyXEL

MODEMS OF THE MILLENNIUM

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 option, 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 remanufactured functionally equivalent product of equal value, and will be solely at the option 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 option 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 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.

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Liability Notice

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Acknowledgements

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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 residential installation. 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. However, there is no guarantee that interference will not occur in a particular installation.

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.

FCC Requirements

This equipment complies with Part 68 of the FCC Rules. On the base unit of this equipment is a label that contains, among other information, the FCC Registration Number and the Ringer Equivalence Number (REN) for this equipment.

IF REQUESTED, THIS INFORMATION MUST BE GIVEN TO THE TELEPHONE COMPANY.

The REN is useful to determine the quantity of the devices you may connect to your telephone line and still have all of those devices ring when your telephone number is called. In most, but not all areas, the sum of the RENs of all devices connected to one line should not exceed five (5.0). To be certain of the number of devices you may connect to your line, as determined by the total RENs, you should contact your local telephone company to determine the maximum REN for your calling area.

If your equipment causes harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance. But if

advance notice isn't practical, you will be notified as soon as possible. You will be informed of your right to file a complaint with the FCC.

Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper functioning of your equipment. If they do, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

If you experience trouble with this telephone equipment, please contact the Address and Phone number listed in the warranty card for information on obtaining service or repairs.

The telephone company may ask that you disconnect this equipment from the network until the problem has been corrected or until you are sure the equipment is not malfunctioning.

The user is not authorized to repair or modify the equipment beyond uploading firmware into the flash EPROM.

This equipment may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

Information for Canadian Users

The Industry Canada (IC, formerly DOC) label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. IC does not guarantee that the equipment will operate to a user's satisfaction.

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

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

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

Caution: **Users should not attempt to make such connections themselves, but should contact the appropriate electrical inspection authority, or electrician, as appropriate**.

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to the telephone loop used by the device without overloading. The termination on a loop may consist of any combination of devices, subject only to the requirement that the total of the Load Numbers of all the devices not exceed 100. The load number for the Omni 288S is 10.

This apparatus does not exceed the class B limits for radio noise emissions from digital apparatus set out in the radio interference regulations of Industry Canada.

Telephone Company Requirements

It is not necessary to notify your telephone company before installing the modem, but your telephone company may request the following information:

- Telephone number to which the modem is connected.
- Manufacturer and Model Number.

  ZyXEL Communications Corporation

  Omni 288S

- FCC Part 68 Approval Number and REN#.

  1ROTAI-22730-PT-E

  REN# 0.3B

You will find also this information on a sticker on the bottom of the modems case.

The modem is connected to a public switched line using a USOC (Universal Service Order Code) RJ11C modular jack.

Table of Contents

Chapter 1 - Introduction

Congratulations on the purchase of your Omni 288S modem - one of ZyXEL's premier high-performance products.   The Omni 288S is world renown for its ability to maintain ultra high speeds and clear, quality connections while communicating around the globe.

How to Use this Manual

The chapters and appendices in this complete User'sManual provide instructions and operation tips to get your modem functioning quickly and effectively. The following is a summary of what information you will find in each chapter of this Manual:

Chapter 2: Installation

Instructions for the installation of your Omni 288S.

Chapter 3: Basic Modem Operation

Overview of basic modem related functions and helpful hints to get you started.

Chapter 4: Advanced Data Communications

Detailed information on protocols and standards supported by the Omni 288S.

Chapter 5: Synchronous Mode Operation

Information on Asynchronous and Synchronous communications.

Chapter 6: Leased Line Operation

Describes the Omni 288S and leased line operations.

Chapter 7: Cellular Mode Operation

Instructions on how to utilize the cellular features of the Omni 288S.

Chapter 8: Special Functions

Instructions on how to use the special features of the Omni 288S.

Chapter 9: Fax Operation

Instructions on how to use the fax features of the Omni 288S.

Chap 10: Voice Mode Operation

How to take advantage of the voice features of the Omni 288S.

Chap 11: AT Command Set Summaries

Summary of Basic and Extended AT Commands supported by the Omni 288S.

Chap 12: Status Registers & Result Codes

Viewing and setting S-Registers and Result Codes.

Chap 13: Diagnostics & Troubleshooting

Tips for resolving modem problems and for using the Omni 288S's diagnostic capabilities.

Appendix A: Upgrading Your Modem

Describes the process for upgrading the Omni 288S with flash EPROM.

Appendix B: Contact ZyXEL

How to contact ZyXEL for product support and configuration questions.

Appendix C: Connector Pinouts

Lists the pinouts of the various connectors on the Omni 288S.

If you do not find information on a specific topic, or if you would like more information about a topic covered in your Omni 288S User's Manual, please call ZyXEL Technical Support at **714-693-0808.**   Other means of contacting ZyXEL are listed in **Appendix B.**

Unpacking Your Modem

Enclosed Equipment

Before you proceed further, please check all items you received with your modem againgt this list to make sure nothing is missing. The complete package should include:

- one (1) Omni 288S universal modem
- one (1) AC power adapter (external model)
- one (1) RJ11 modular telephone cable
- one (1) Omni 288S User's Manual
- one (1) ZyXEL modem driver diskette with Windows 95 INF file
- one (1) Data/Fax software for DOS and Windows environments
- one (1) warranty/registration card

Contact your dealer or the store where you bought the modem if anything is missing. Check the modem for shipping damages. If you find any damage, contact the shipping agency immediately.

Retain shipping and cushioning materials for future storage or shipping needs.

Please direct any additional questions about damaged or missing materials to your dealer or distributor, or to the factory address listed in **Appendix B**. warranty card.

Required Equipment

In addition to the ZyXEL Omni 288S modem you just purchased, you must have the following equipment to operate your modem:

- Computer terminal

- Available PC serial port with a high-speed 16550 UART

- Standard "straight-through" RS-232 cable (pins 1-8, 20, 22)

- Available telephone jack

- Available AC wall outlet

- Telephone line from your telephone company (dial-up or leased line)

- Data, fax, and voice communication software

Optional Equipment

The following items are optional for installing your Omni 288S:

- Telephone for manually dialing and answering calls

- Microphone for recording voice messages

- Speakers for listening to recorded messages

Becoming a Registered Owner

Complete the pre-addressed Warranty Registration Card and place it in the mail. Registered owners will receive future product information and update announcements. Warranty registration is not necessary for product repair/or replacement - please also save your **dated invoice** as proof of purchase.

Omni 288S Modem Features

No other 28.8Kbps modem gives you so much for so little. Your Omni 288S is equipped with an array of standard and ZyXEL-famous Intelligent features designed to make your data communications faster, easier, and more convenient.

Standard features

- Ultra-high speed modem - supports V.34 for 28,800bps and backwards compatible

- Operates in all environments: Windows 95, DOS, Windows, Macintosh, OS/2, UNIX, Novell, Amiga, and IBM AS400/RS6000

- V.42 and MNP 4/3 error correction

- V.42bis and MNP 5 data compression

- DTE serial interface with speeds up to 460.8Kbps

- 13 LED lights

- Extended AT command set with V.25bis

- ZyCellular Protocol for demanding cellular operations - data and fax transmission over cellular networks

Intelligent Features

- Automatic data, fax and voice call detection allows you to use a single telephone line to handle all three types of calls

- Asynchronous and synchronous modes for reliable serial data communication

- Fast retrain with automatic fall-forward and fall-back - the Omni 288S will automatically fall back to lower speeds when communicating with slower modems and when encountering unstable or variable line conditions..

- Call-back security and password protection restricts access to authorized callers only.

- Caller ID identifies incoming calls before you answer (you must subscribe to this service through your telephone company in order for your Omni 288S to identify callers)

- Distinctive ring detects data, fax and voice calls (this feature requires communication software that supports distinctive ring, such as ZFAX)

- Remote configuration capability

- EDR (extended Distinctive Ring)

- Flash EPROM memory lets you easily upload new firmware, providing you with easy access to new features.

- ZyXEL exclusive Kernel Recovery Mode for no hassle recovery from failed flash uploads - no factory repairs.

Fax Compatibility

- EIA Class 1, 2, and 2.0 Fax commands

- ITU-T V.17 G3: up to 14,400bps

- ITU-T V.29 G3: up to 9,600bps

- ITU-T V.27ter G3: up to 4,800bps

- ZyXEL Fax AT commands

Voice Features

- TAPI support links the power of telephones and communication networks with your computer

- Microphone jack is provided to increase the quality of voice recordings

- Speaker jack lets you plug in an external speaker for clearer output of recorded messages.

- 2, 3, 3-bit new and 4-bit ADPCM for high quality voice digitization with speech compression at 19.2Kbps, 28.8Kbps, 30.7Kbps, and 38.4Kbps

- Simultaneous DTMF, dial-tone, answer tone and fax/data calling tone detection

- Voice AT+V (IS-101) command set

Technical Specifications

- Operating mode: auto-dial/answer

- Flow control: software XON/XOFF or hardware CTS/RTS

- Data/Voice toggle switch

- Configuration settings: software programmable with nonvolatile memory for phone number/profile storage

- Diagnostics: self test, analog loopback (with self test), digital loopback, and remote digital loopback (with self test)

- Dialing type: tone/pulse dialing

- Line interface: RJ-11 2-wire dial-up or leased line

- Call progress monitoring: dial tone, busy, and ring back detection

- Audio Monitor: programmable volume control

Chapter 2 - Installation

This chapter covers the steps required to install your modem, install and configure the Windows 95 driver, as well as optional steps you may wish to take in the setup of your Omni 288S. More detailed instructions for various types of computers, such as IBM PCs and compatibles, Macs, and UNIX workstations, can be found in Chapter 3 of this Manual.

Required Steps for Omni 288S Installation

1. Turn off your computer.

2. Make sure the modem's power switch is in the OFF position.

3. Connect the power adapter. Plug one end of the power adapter to the round POWER JACK on the back of the modem. Plug the other end to an AC wall outlet. You can leave the power adapter plugged in when you are not using the modem. To prevent power surges from damaging your modem and computer, it is recommended that you connect the power adapter to a surge protector.

| Power Switch | To Power Supply | To Serial Port | To Line (wall jack) | To Phone |
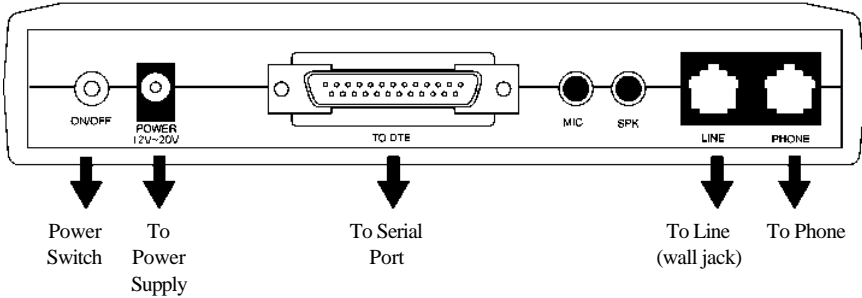
Caution: *Use only the power adapter supplied with your modem. Never use a power adapter designed for a different product.*

4. Connect the serial cable. Plug one end of the serial cable into the SERIAL connector on the back of the modem. Plug the other end of the serial cable to the back of your computer. Your Omni 288S comes with a high-speed serial interface capable of reaching DTE speeds of 460.8Kbps. Be sure that your PC serial port has a high-speed 16550 compatible Universal Asynchronous Receiver Transmitter (UART).

   Note: *Many older computers use a slow 16450 UART. This UART was not designed for high-speed communications and will significantly impede the performance of the Omni 288SS. To check whether your computer has a 16550 compatible UART, use a utility such as Microsoft Diagnostics (MSD) to verify the*

> *type of UART installed in your computer. If your computer has a 16450 UART, either replace it with a 16550 UART or add a serial card with a 16550 UART to your system.*

5. Connect the telephone cord. Plug one end of the supplied telephone (RJ-11) cord into the LINE jack on the back of the modem. Plug the other end into a telephone wall jack, just as you would a standard telephone.

6. Turn the computer back on.

7. Turn the Omni 288S back on by raising the power switch. The PWR LED should come on and the modem performs a self-test procedure.
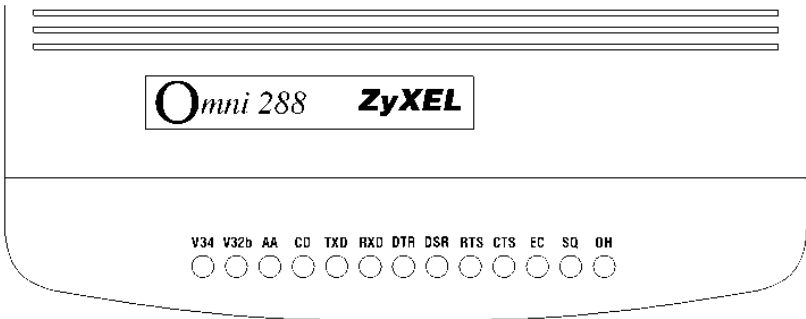
> *Note: If the modem's SQ LED is flashing, it has failed the self-test. Consult Chapter 13 of this Manual for troubleshooting information.*

Optional Steps for Omni 288S Installation

The Omni 288S is equipped with a telephone jack and speaker and microphone jacks on the back panel. The following sections briefly describe how to take advantage of these features.

Telephone Jack

Connect a telephone to the PHONE jack on the back panel of the modem to manually dial and answer calls when the modem is not exchanging data.

Microphone

To connect an external microphone, connect it to the modem's MIC jack on the back of the modem. The microphone jack can accommodate input from a standard 600 Ohm microphone.

Speaker

To connect an external speaker, connect it to the modem's SPK jack found on the back of the modem. The modem's speaker jack accommodates a single 8 Ohm

speaker. To connect two speakers, obtain a dual-plug adapter that allows the modem speaker jack to drive both speakers. This adapter can be found at most electronics stores.

Driver and Software Installation

This section contains step by step procedures for installing the Windows 95 and NT drivers, and configuring Dial-up Networking for the Omni 288S.

Windows 95 Driver Installation

Open the Control Panel by double clicking the "Control Panel" icon in your "My Computer" folder.

Double click "Modems." Then click the "Add" button. The following dialog box will appear.
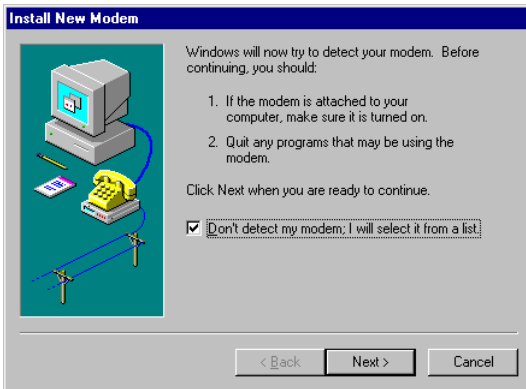
Select "Don't detect my modem; I will select from a list.." Then click "Next."
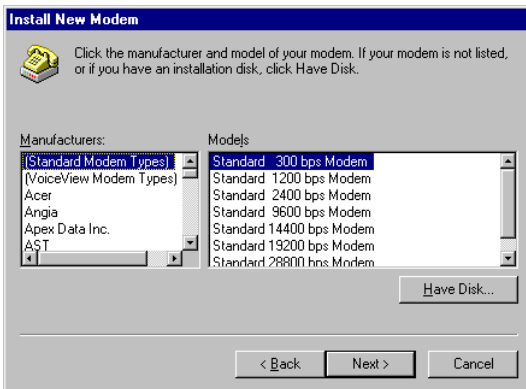
Click the "Have Disk" button.
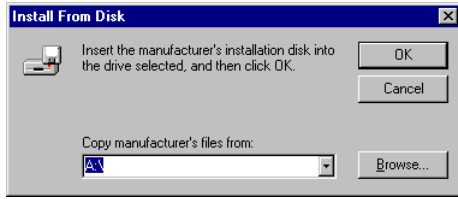
Insert the ZyXEL Windows 95 driver disk into your floppy drive and click OK. If you have downloaded an updated INF file from ZyXEL's FTP, Website, or BBS, use "Browse" to find the location of the updated .INF file, click "Open." Then click "OK."
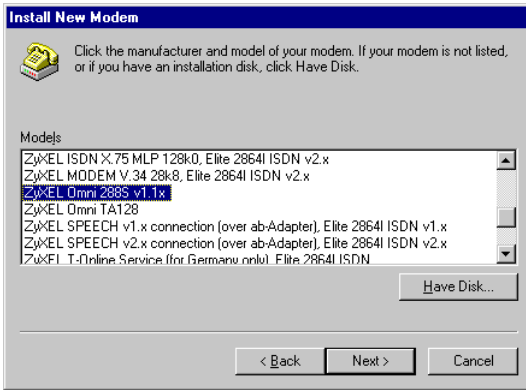
Select Omni288S from the list. Then click "Next."
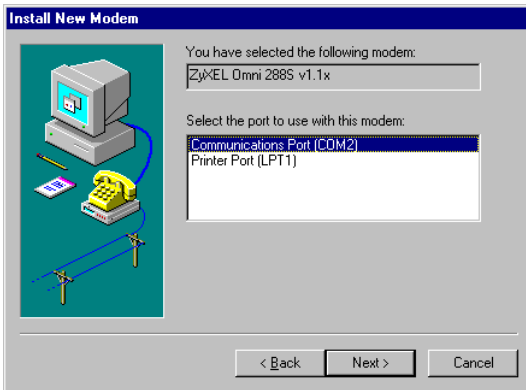
Select the COM port your modem is connected to and click "Next." A final dialog will appear. Click "Finish." You should see a window similar to the one below.
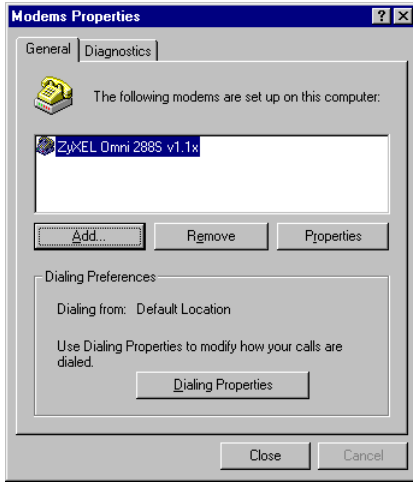
Click "Close." This completes the installation of your Omni 288S modem driver. You may now use programs such as "Dial-Up Networking" with your ZyXEL modem.

Windows 95 Dial-up Networking

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

Double click on the "My Computer" icon and then double click on the "Dial-up Networking" icon. From within the Dial-up Networking folder, double click on the "Make New Connection" icon.
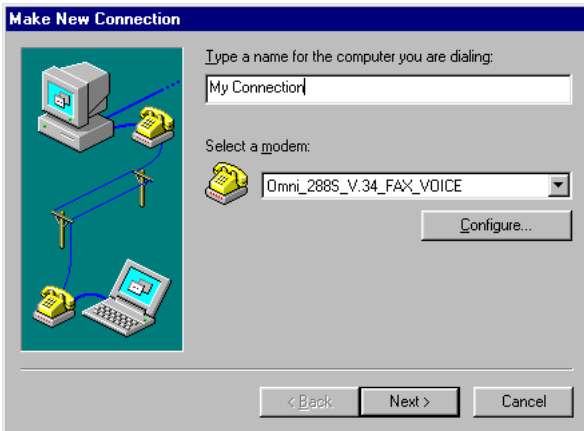
Choose a name for your connection and select your modem type from the drop down window. Then click on the "Next" button.
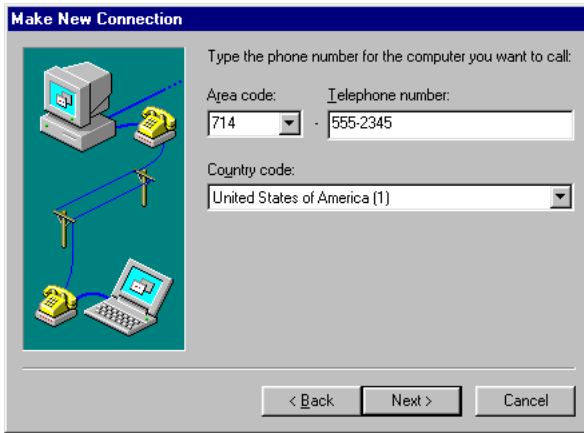
Enter the phone number to your ISP or whatever host you are calling into. Click on the "Next" button.
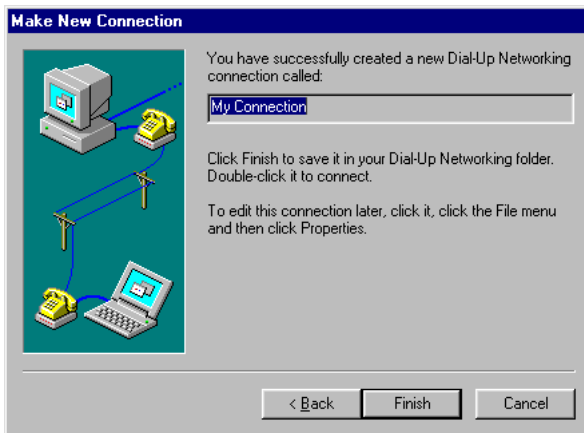
Click on the Finish button. A new icon is created in the Dial-up Networking folder.

Right click on this icon. Then select "Properties" from the menu.
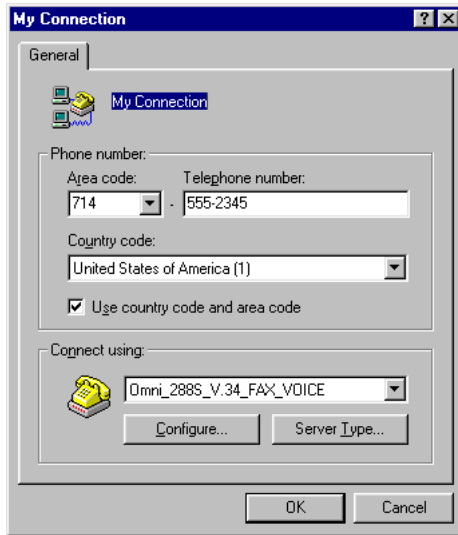
Make sure your Omni modem appears in the "Connect Using." Then click on the "Server Type" button.

These options are mostly host or server specific.

■ If you are using PPP, use the default settings shown above.

■ If you are logging on to an Internet connection, then select "TCP/IP."

■ 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."

Once complete click on "TCP/IP Settings."
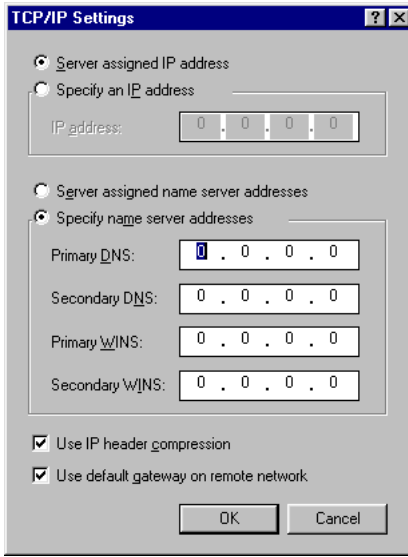
If your host requires you to specify an IP address (Static IP), then click on the "Specify and IP address" radio button and enter your IP address. If your host assigns an IP when you log in (Dynamic IP), then leave the "Server assigned IP address" checked. Most servers assign an IP to you when you log in.

Click the "Specify name server address" radio button and enter your primary and secondary DNS (Domain Name Server) IP.

In most cases, you should leave "Use IP header compression" and "Use default remote gateway" checked. When all of the selections have been made, click the "OK" buttons on all three opened dialog boxes.

This completes the remote connection definition. Locate the new connection icon in your "Dial-up Networking" folder, and double click on it.
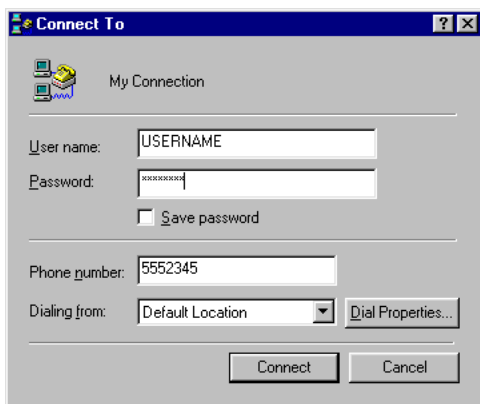
If the User name and Password are incorrect or missing, type them in. Click on the Connect button and your Omni 288S will dial the number and establish a connection to your Internet Service Provider.

> *Note:* *The default protocol for Dial-up Networking is Point-to-Point Protocol (PPP). If your ISP requires you to use Serial Line Interface Protocol (SLIP), you may need to create a special logon script file. Because the procedures for logging on with SLIP accounts vary greatly from ISP to ISP, you should consult the technical support department of your service provider for this information.*

Setup for DOS Fax/Modem Software

After installing the Omni 288S, use the following procedures to verify your modem connections.

1. Install and load your communications software. If you need assistance, refer to the manual that came with the software.

2. If your communications software requires you to select a modem, and the ZyXEL Omni 288S is not one of the choices, you can either check our web site for the driver or select the ZyXEL U-1496 modem. In many cases, the commands for these modems are identical.

3. Select the following communication settings:

Setting	Value
Baud rate	57,600bps
Data bits	8
Parity	None
Stop bits	1
Flow control	Hardware
Initialization string	AT&F
Port	COMn*

Note: *When specifying a port assignment, the 'n' indicates the computer serial port to which your modem is attached. For example, if your modem is connected to serial port 2, you would select COM2.*

4. Place your communications software in terminal or direct connect mode (your communications software manual will explain how).

5. Look at the modem's front panel and verify the DTR LED is ON. If this LED is OFF, your communications software is not addressing your modem at the correct COM port. Make sure your software is set up for the same COM port to which your modem is connected.

6. Type AT and press the Enter key. You should see the AT characters you typed, followed by an OK result code. If you do not see an OK result code, turn the modem off and on, then repeat this step. If you still cannot see the characters, refer to Chapter 13 for troubleshooting suggestions.

7. Type ATDT number and press Enter, where number is your modem's telephone number. You should see a BUSY result code. If you do not see a BUSY result code, refer to Chapter 13 for troubleshooting suggestions.

If you are not able to successfully complete this test and have already followed the appropriate troubleshooting procedures Chapter 13, please call ZyXEL Tech Support at **714-693-0808**.

Chapter 3 - Basic Modem Operation

This chapter covers the basic commands and techniques involved in modem operation. In many cases, this is the only information you will need in order to get your Omni 288S up and running with communication software, and to start making connections with your Omni 288S.

Understanding AT Commands

The Omni 288S communicates asynchronously with computers using AT commands. AT commands are used to configure and control the Omni 288S. Commands are usually sent to the modem by way of communication software, but can also be entered manually by the user with the computer keyboard.

Command statements must be written in a specific form in order for the Omni 288S to recognize them. A command statement always begins with the letters **AT** or **at**. It is then followed by one or more commands and the <Enter> key.

AT commands can only be issued when the Omni 288S is in "command mode" or "off-line."

Once the Omni 288S has established a connection with another modem it is said to be "on-line" or in "data mode." In this mode, the characters sent to the Omni by your computer are transmitted to the remote modem rather than being interpreted by the Omni as commands.

Using the Windows 95 Hyper Terminal Program

In order to issue an AT command statement, you first need to run a communication program such as the Microsoft Windows "Hyper Terminal" program. This program provides a simple method to manually enter AT commands so you can do such things as "customize" the settings of your Omni 288S, or store phone numbers you commonly will connect to.

Once the Omni is connected to your computer's serial port and telephone line, Open the Windows 95 "Accessories" program group, and open the Hyper Terminal Program.

The program will prompt you for a name and Icon to use for your new connection. Type the name **Test Connection** and press <Enter>.

Next, you will be prompted for country information, area code and phone number, and the device used to make the connection. For this test purpose, do not enter a phone number; simply choose the COM port your Omni is connected to from the "Connect Using" list. Click "OK" when finished.

The next window sets the COM port settings. The settings used for The Omni 288S should be as follows.

Bits per second:	57600
Data bits:	8
Parity:	None
Stop bits:	1
Flow Control:	Hardware

Click "OK" when finished. After you have done this, save your new connection by selecting "Save" from the "File" menu and click "OK." A new connection icon will be added to your Hyper Terminal folder.

You are now ready to start entering AT commands.

In the terminal window, type:

```
AT<Enter>
```

Omni 288S responds

```
OK
```

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

To test the telephone line connection issue the manual answer command.

Type:

```
ATA<Enter>
```

The Omni 288S will pick up the phone line, and try to communicate. Normally, this command is only used to answer an incoming call made from another modem. Thus the high pitched noise you will hear from the speaker. To abort the operation, press any key, or select "Disconnect" from the "Call" menu.

Dialing and Answering Techniques

Depending on what communications software you use to make modem connections, you may not have as much control of how the modem dials the telephone number. This section shows some useful examples of the AT commands used for dialing and answering operations. The command characters specific to each function are shown in bold type.

Dialing using the ATD Command

Touch Tone Dialing:	ATD**T** 555 1212
Pulse Dialing:	ATD**P** 555 1212
Tone and Pulse Dialing:	ATD**P** 555 1212 W**T** 24
Dialing Through a PBX:	ATDT 9 **W** 555 1212

> *Note:* *The 'W' in the dial string will cause the modem to wait for a second dial tone before it continues to dial.*

Pausing During Dialing: ATDT 9**,,**555 1212

> *Note:* *The pause time for each comma is defined by S Register S8. Default is 2 seconds per comma.*

Dialing Without Waiting for Dial Tone: AT**X0**D, 555 1212

Originating a call using an Answer Tone: ATDT 555 1212,,,,,,**R**

Redialing the Last Number Called: ATD**L**

Waiting for Five Seconds of Silence: ATDT 800 555 1212 @

123456,1 714 555 1212

Transferring a Call (using flash hook):   ATDT**!** 2468

Auto-Answer and Hook Controls

Enabling Auto-Answer: AT**S0=n**

> *Note:* *In this example, n is a number from 1 to 255 that corresponds to the number of rings after which your modem answers an incoming call.*

Disabling Auto-Answer: AT**S0=0**

Manually Answering a Call: AT**A**

Take modem off-hook: AT**H1**

Hang up modem (on-hook):   AT**H0**

Manually Disconnecting a Call: +++AT**H**

Making Your First Connection

For this example, we will use the connection you created in the Hyper Terminal program to dial the ZyXEL BBS. If you are using a different terminal program, run the program according to the instructions provided with it.

Start the terminal program by double-clicking the **Test Connection** icon. When the terminal window appears, enter the dial command with ZyXEL's BBS as the phone number.

Type:

    ATDT17146930762<enter> (Omit the '1714' if you are in this area code)

The modem will go off-hook, dial the number, and after a few seconds of negotiation tones, you should be connected to our BBS.

You will receive a login message asking for your name. For the purposes of this example you need not continue. Just click the "disconnect" icon on the toolbar.

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&D2 and AT&N0 can be combined into one line AT&D3&N0.

■ The Omni 288S processes commands from left to right. The AT command that appears to the right might over-write the command to the left if they are trying to accomplish tasks or set modes that cannot coexist.

■ If you see duplicated characters for each one you type, your Omni 288S and software both have their "echo" feature turned. The Omni 288S command echo state is switched off using ATE0 and on using ATE1 (default). To eliminate the double characters, turn off the software's command echo rather than using the ATE0 command. If you see no characters in your terminal window when you type, the modem's echo setting is probably set to off. In this case, issue the ATE1 command.

■ When a command is successfully issued and accepted, a modem responds with what is called a "Result Code." The Omni 288S supports both "verbose" result codes (i.e. "OK"), and "numerical" result codes (i.e. "0"). You can use the ATV command to set it one way or the other as follows.

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

■ There are a few basic commands that do not require the "AT" command prefix. These are as follows.

Command	Description
A/	Repeats the last issued AT command once
A>	Repeats the last issued AT command once, or re-dials the last dialed number up to 9 times until a key is pressed or a connection is made.
<any key>	Terminates the current connection attempt, if pressed while modem is handshaking.
+++	Escape code sequence. Entered while the modem is in Data Mode. Returns modem to Command Mode.

■ The Omni 288S supports several groups of AT commands:

AT Command Set/Type	Example
Basic AT (Hayes compatible)	ATB0
Basic AT$ (on line help)	AT$
Extended AT& commands	AT&N0
Extended AT* commands	AT*I1

AT Command Set/Type	Example
Fax and Voice AT+ commands	AT+FCLASS=2
S-Register command	ATS0=1
S-Register bit-mapped command (set S-Register bit 1 equal to 1)	ATS13.1=1
S-Register inquiry command	ATS0? Or ATS13.1?

You may browse the lists of available commands for each command set by using the on-line help commands: AT$, AT*$, AT&$, and ATS$. Further detail on AT commands will be covered in the chapters that pertain to their uses.

Modem Result Codes

When you execute or try to execute an AT command, your modem sends a result code to let you know whether the command was executed. An OK result code means the AT command you sent was executed. If you receive an ERROR code, it means the command was invalid.

The Omni 288S also provides result codes that show:

■ Whether or not a Dial Tone was detected when the modem originated a call.

■ If a busy signal was detected when the modem originated a call.

■ If a remote telephone ring was detected when dialing.

■ The speed, protocol, and error control / data compression method used.

■ If your modem has detected an incoming ring.

Result codes can originate from any of eight result code sets. The **ATX***n* command lets you choose which set of result codes your modem uses. By default, your modem uses result codes equivalent to the **ATX5** command.

The result code options will be covered more thoroughly in later chapters.

Viewing S Register Values

Status registers (or "S-registers") contain values that determine the modem's operating characteristics. Whenever you send an AT command to your modem, you are actually changing the value of an S-register.

You can use the **S***r***?** command to view the value of S-register '*r*'. For example, to view the value of S-register S0, which controls auto-answering, type ATS0? and press Enter. The modem responds with a three-digit character showing the value of this register, followed by OK. A value of 002, for example, means your modem will auto-answer incoming calls after the second ring.

Some S-registers are bit mapped. For these registers, you can use the **S***r.b***?** command to read their values.

For example, to read the value of S-register S35, bit 7, type **ATS35.7?** and press Enter. The modem responds with an appropriate value, followed by OK.

Changing S Register Values

You can use the **ATS0=*n*** command to change the value of an S-register.

For example, to have your modem auto-answer an incoming call after two rings, set S-register 0 to 2. Be sure the *n* value is between 1 and 255. If *n* is set to 0, your modem will not answer incoming calls.

Non-Volatile Memory

The Omni 288S has an amount of memory set aside for storing user information such as frequently used phone numbers and default command settings. This latter is particularly useful when you use your modem to call a variety of different locations that require different settings. For this reason, the Omni 288S provides a number of user "Profiles" that can be accessed through simple AT commands. This section covers the topics of storing phone numbers, and saving default settings in the power-on profile.

Storing Phone Numbers

The AT command to store a phone number is in the format **AT&Z*s*=*n***.

The '*s*' is a number from 0 to 49 that represents the location in memory that the phone number is to be stored, and the '*n*' is the phone number itself.

Example: To store the number '1-714-555-1212' in memory location '2', type:

```
AT&Z2=17145551212<Enter>
```

You can store up to 50 telephone numbers.

Dialing Stored Phone Numbers

The AT command syntax used to dial a store number is **ATDS=*n***.

The '*n*' is the memory location of the stored number you want to dial.

> *Note:* *As a general rule, when a letter in an AT command definition is shown in italic type, the letter is not to be entered as part of the command, but rather is representative of a number or string expected as input. For example: The letter 'S' in the ATDS=n command is actually typed, unlike the 's' in the AT&Zs=n command which represents a number.*

Saving Settings and User Profiles

There are some cases where you may wish to save the settings you have made as the default settings that are recalled when the Omni 288S is powered up. The **AT&WZ** command selects the current settings as the power-on profile.

There are four profiles that can be changed by the user, and one factory default profile. The following table lists the syntax for the command involved in storing, recalling, and viewing the profile settings.

AT&V*n*	Views the settings in profile (*n-1*); *n*=0 to 5; *n*=0 views current settings
AT&W*n*	Stores the current settings in user profile *'n'*; *n*=0 to 3
ATZ*n*	Resets the current settings with the settings in profile '*n*', *n*=0 to 4

Profiles 0 to 3:   User profiles

Profile 4:   Factory default profile

Helpful Hints for PC Computers

Most PCs are equipped with more than one serial port. Standard cables are readily available from many suppliers. Usually, serial ports are manufactured in two forms, either with a 25-pin male jack or a 9-pin male jack. For high speed serial connections at 230.4Kbps or 460.8Kbps, use a low-capacitance cable. Also, keep the cable as short as possible.

The serial port is driven by interrupts. Every interrupt needs a certain amount of overhead processing time. Too many interrupts reduce the computer's efficiency. The UART 16450 is very commonly used in serial port devices. For every character (byte) received, it generates an interrupt. If your hardware allows it and if your software supports it, replace the 16450 UART with a 16550 model. This newer chip has an internal buffer and generates an interrupt for up to every 16 characters (several trigger levels are available). With this UART installed, you may drive your serial port at 57600 bps and above.

While data is written from the transfer-buffer to your hard-disk, characters may be lost at the serial port. This is due to the fact that disk-access interrupts have a higher priority than serial port interrupts. If you are running at a high serial speed, e.g. 230.4Kbps or 460.8Kbps, on your PC, be sure to enable the disk cache by including SMARTDRV execution in your AUTOEXEC batch file.

Default Modem Settings for PC's

The Omni 288S factory settings are configured for operation with PC type computers and comm software. In most cases, no additional settings will be required. The following are some of the default settings that are used for operation with PC computers and software.

AT Command	Description
E1	Echoes command characters
&C1	Carrier detect follows remote carrier
&D2	Modem disconnects on DTR on-to-off transition
&K4	Use both V.42 and MNP 4 error correction, and use both V.42bis and MNP 5 data compression
&N0	Modem negotiates highest possible connection speed

ZyXEL Serial/Parallel I/O Card

For high-speed PC to modem communication, ZyXEL produces the special I/O adapter card. This card includes a serial port and a parallel port, each with special features, particularly when working with a ZyXEL modem, for example:

The serial port is 16550-compatible for most comm software's usage. It has a speed of up to 460.8Kbps and data loss errors will not occur when working with a ZyXEL modem's serial port. This solves high-speed communication problems in Windows and other multi-tasking systems. The serial port has a 32-byte transmission and a 32-byte receival FIFO to increase any comm program's efficiency.

Helpful Hints for Mac Computers

Special AT Command Settings for Mac

For operation with Mac computers, you may use the factory default settings with one exception. You must set the modem to ignore the DTR signal as follows.

Type:

    AT&D0<enter> *(set modem to ignore DTR)*

    AT&WZ<enter>*(saves the settings to power-up profile)*

Mac Serial Port

When you connect your Omni 288S modem to a Macintosh computer, make sure the cable is a hardware handshaking cable. These cables are readily available. The models Lisa, Macintosh 128 and Macintosh 512 don't have hardware handshaking. The serial port on these (very outdated) models is provided as a 9-pin connector similar to that of a PC. The serial port on all other Macintosh models is a Mini-8.

Mac Software Tips

All terminal programs which make use of the hardware handshaking feature can be used on the Apple Macintosh. Such programs are readily available as PD, shareware or commercial software. One of the most powerful shareware programs available is ZTerm.

Fewer programs are available to make use of the ZyXEL's fax features. A commercial software which has found wide acceptance is FaxSTF. It is installed like a printer driver, thus allowing you to send faxes from almost any program which runs on your Macintosh. At the same time it allows automatic fax receiving. This program includes a powerful line manager software which makes sure that the fax software does not interfere with other programs using the serial ports. If the modem is turned off when you start your Macintosh with the line manager activated, the computer may seem to freeze for a few minutes. During this time the line manager software tries to locate and to set up the modem. Turn on your modem before you start your Macintosh to avoid this delay.

MaxFax is another fax software for Macintosh computers. On top of the fax handling, it allows you to make use of the Omni's voice features.

Drivers are available which allow use of the serial ports at speeds up to 230.4 Kbps. These drivers are currently available for Power Macs and AV Macs only.

Helpful Hints for UNIX-Based Computers

Serial Cable

Please consult the documentation that came with your workstation to find the part number of or information on how to make a serial cable for your workstation. The cable should be a hardware-handshaking cable. Please refer to Appendix A for a complete list of signals provided by the modem its serial port.

Basic Modem Settings for UNIX

Unix environments usually don't like modem responses or echoing of commands. Therefore you should set **ATE0Q1**.

Depending on your of Unix, the cable and software used, you may have to disable carrier detection using **AT&C0**.

Unix Software Tips

In order to use your ZyXEL modem from a terminal screen or an X-Windows application, you need a program such as minicom or seyon, respectively.

If you wish to make use of the ZyXEL modem' special features such as voice, special gettys such as mgetty or vgetty are needed. These programs are avaiable from several ftp-sites. Some archives also contain source files.

You should suppress the modem's result codes (**ATQ1**) because some applications may be confused by them.

Chapter 4 - Advanced Data Communications

This chapter is included as a general reference to the connectors, interfaces, protocols, and standards used by the Omni 288S, including definitions of many of the communications-related terms used in this manual.

Front Panel LEDs

The Omni 288 has 13 front panel LEDs. Some LEDs have individual meanings, while others work in combination to apprise you of your modem's operating status. For example, the AA LED is ON when auto-answering is enabled, while the V34 and V32b LEDs together show the connection mode and speed.
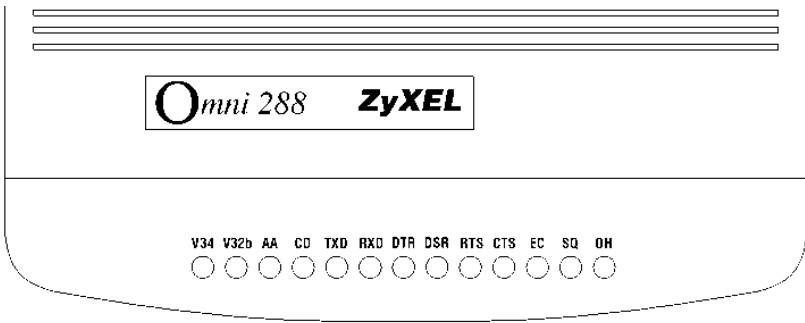
Refer to the following tables for details on the LED status indicators and their meanings.

LED	State	Indicates Status
AA	ON	Modem will automatically answer incoming calls.
	OFF	Modem will not auto-answer incoming calls.
CD	ON	Modem has detected a valid carrier signal, or &C0 is set.
	OFF	No carrier detected.
TXD	ON	Computer is transmitting data to the modem.
RXD	ON	Computer is receiving data from the modem.
DTR	ON	Computer is ready for data communications.
DSR	ON	Modem is ready for data communications.
RTS	ON	Computer requests to send data.
CTS	ON	Modem is ready to accept data for transmission.
EC	ON	Modem is using V.42 or MNP 4 error correction, or V.42bis or MNP 5 data compression.
	Blinking	Data is being re-transmitted.
SQ	ON	Good signal quality
	Flashing	Marginal signal quality or error condition at power-up.
OH	ON	Modem is accessing telephone line.
	OFF	Model is off-line or not accessing the telephone line.

| LED | | |
V34	V32B	Indicates Status
OFF	OFF	Modem is in V.22bis, V.22, or mode slower than 9600bps.
OFF	ON	Modem is in V.32bis or V.32 mode.
ON	OFF	Modem is in V.34 mode.
ON	ON	Modem is in a ZyXEL proprietary mode (ZyX 19.2, ZyX 16.8, or ZyCellular).

DTE Interface

DTE and DCE are terms used in data communication. DTE stands for Data Terminal Equipment and DCE stands for Data Communication Equipment. The computer or terminal is the DTE and the modem is the DCE. The DTE interface used by the Omni 288S is an RS-232 with throughput speeds up to 460.8 Kbps.

Synchronous and Asynchronous Communications

There are two kinds of serial data communication. One is called synchronous, and the other is called asynchronous. In synchronous communication, data is transmitted and received bit by bit and is timed by an accompanying clock signal. In asynchronous communication, data is sent character by character (or octet by octet), and the idle time between characters is variable. Since no clock signal is sent, character timing is recovered from the data itself.

A PC's COM1 and COM2 are asynchronous serial ports. Most PCs' and UNIX systems' serial data communications are asynchronous. The serial data communication on an IBM mainframe or mini is synchronous.

UART

A UART (Universal Asynchronous Receiver Transmitter) is the device used in a DTE or DCE for asynchronous data reception and transmission. The standard UART device used in PCs is of the NS16450 type. For high-speed serial data transfers (38400 bps and up), the PC may not serve the UART fast enough and data may be lost. In this case, a UART with data buffer is needed, such as the NS16550A type device.

Serial Port

A serial port is the serial data connector together with its internal circuit on the DTE or DCE with electrical and mechanical characteristics according to RS-232C. Since some signals travel from the DTE port to DCE port, and some signals travel in the opposite direction, the signal pin is a transmitter on one port and a receiver on the other. The DTE serial port is different from the DCE serial port in terms of signals on the connector pins. There are also mechanical differences in terms of male (with pins) or female (with holes) connectors.

RS-232C or EIA-232D/E

RS-232C is the Recommended Standard (RS) of the Electronic Industries Association (EIA), defining the serial communication interface between a DTE and a DCE. The 232 is basically a serial number for the defined standard. Sometimes it is necessary to redefine a standard, or to revise it. The most commonly used revision of the RS232 standard is the "C" revision. For the "D" revision, the prefix was changed to EIA. Except for a few signals which were added but not commonly used, there is no practical difference between the "C" and "D" revisions. There is now a new revision with the "E" suffix. The RS-232C standard is equivalent to the ITU-T V.24 and V.28 standard.

Serial RS-232C Cable

A serial RS-232C cable is used to connect a DTE port to a DCE port. Do not use a null-modem cable (which may be used to connect two DTEs directly with each other through their serial ports). A normal RS-232C connector has 25 pins, and a normal RS-232C cable has 25 wires. Many signals in the RS-232C are not used in common applications, and a 9-wire RS232C cable is sufficient in most applications. The PCAT's serial port has only 9 connector pins, thus eliminating unnecessary pins. For high-speed DTE-DCE communication, use a low-capacitance cable (as short as possible).

Communication Protocols and Speeds

The ITU-T or ITU-TSS (International Telecommunications Union - Telecommunications Standardization Sector) is the international standard-making body for telecommunications. Their primary function is to draft recommendations. The recommendations they make for modem applications have a "V" prefix and are called V-series recommendations. The most commonly used ITU-T modem standards for 2-wire dial-up lines are summarized in the chart below.

Standard	Speed (bps)
V.34	28,800 ~ 2 400
V.32bis	14,400 / 12,000 / 7,200
V.32	9,600 / 4,800
V.22bis*	2,400 / 1,200
V.22	1,200
V.21	300
V.23	1,200 / 75

* bis is the old French word for second

In the USA, Bell Systems used to create de facto standards such as Bell 212A for 1200 bps modems and Bell 103 for 300 bps modems. Everyone follows the ITU-T standards now for newer and higher-speed modems. The Omni 288S supports all the above mentioned modem standards and are compatible with existing modems.

Universal Protocol Compatibility

Universal compatibility covers a broad range of ITU-T and BELL standards, and provides data compression.

Various operation modes that can be achieved are as follows:

Standard	BPS rate (+/-0,01%)	Baud rate (+/-0,01%)	Modulation	Carrier Freq [Hz]
V.34	28 800 - 2 400	multiple	multiple	multiple
ZyXEL	19 200	2 743		
ZyXEL	16 800	2 400		
V.33*	14 400	2 400	128-TCM	1800
V.33*	12 000	2 400	64-TCM	1800
V.32bis	14 400	2 400	128-TCM	1800
V.32bis	12 000	2 400	64-TCM	1800
V.32bis	7 200	2 400	16-TCM	1800
V.32	9 600	2 400	32-TCM	1800
V.32 uncoded	9 600	2 400	16-QAM	1800
V.32	4 800	2 400	4-DPSK	1800
V.29*	9 600	2 400	16-QAM	1700
V.29*	7 200	2 400	8-QAM	1700
V.29*	4 800	2 400	4-DPSK	1700
V.27bis*	4 800	1 600	8-PSK	1800
V.27bis*	2 400	1 200	4-DPSK	1800
V.26bis*	2 400	1 200	4-DPSK	1800
V.23	1200 / 75	1200 / 75	FSK	
V.23	600 / 75	600 / 75	FSK	
V.22bis†	2 400	600	16-QAM	1200 Orig. 2400 Ans.
V.22†	1 200	600	4-DPSK	1200 Orig. 2400 Ans.
V.21	300	300	FSK	
BELL 103	300	300	FSK	
G3 FAX	Implemented according to T.30, V.17,V.29 and V.27ter.			
Cellular Modes	ZyXEL proprietary cellular modes; 14400 bps to 4800 bps.			

Choosing the Modem Link Options

The Link options or protocol negotiation settings are controlled by the **&N** command. The default setting is **&N0**. The modem will execute an auto-handshake sequence to determine the protocol being used by the remote modem, and connect at the highest allowable speed.

The link options can also be set to force negotiation to any one of the protocol options listed in the above table using **&N1** to **&N73**. If the modem cannot successfully negotiate the protocol that was set, connection will be refused, and the modem will release the line. For specific settings, please refer to Chapter 11.

Certain modes, such as the ZyXEL proprietary modes, Fax mode, and Cellular modes can be added or omitted from the auto-negotiation process using the S-registers settings listed below.

Mode	Disable	Enable
ZyXEL 19200	S43.1=1	S43.1=0 *
ZyXEL16800	S43.0=1	S43.0=0 *
G3 Fax	S38.4=1	S38.4=0 *
Cellular	S43.3=1 *	S43.3=0

* Denotes default setting.

Setting the DTE to DCE Rate

The Omni 288S DTE to DCE rate can be determined in three ways:

1. By default the DTE to DCE rate is equal to the DTE speed set by **S20** (default S20=1 for 115200 bps). This mode is set with **&B1.**

2. To set the DTE to DCE rate to follow the connect speed, set **&B0.**

3. To force the modem to use a fixed baud rate when answering, set S18 to the corresponding value.

S18=	Speed	S18=	Speed
0 *	Disable fixed rate	15	300 bps
1	115200 bps	16	307200 bps
2	76800 bps	17	153600 bps
3	57600 bps	18	102400 bps
4	38400 bps	20	61440 bps
5	19200 bps	21	51200 bps
6	16800 bps	22	624000 bps
7	14400 bps	24	124800 bps
8	12000 bps	25	62400 bps
9	9600 bps	26	41600 bps
10	7200 bps	27	31200 bps
11	4800 bps	28	24960 bps
12	2400 bps	29	20800 bps
13	1200 bps	32	230400 bps
14	460800 bps	46	921600 bps

* Denotes default setting

Error Control

Error control keeps the modem data link error-free by detecting and re-transmitting erroneous data. ZyXEL modems support both MNP and V.42 error control protocols. The MNP protocol was an industry de facto standard developed and licensed by Microcom, Inc. ZyXEL modems support level 4 and 3

error control protocols, commonly denoted as MNP4 and MNP3. V.42 is a standard developed by ITU-T. V.42 supports both LAPM (Link Access Procedure for Modem) and MNP4. A V.42 handshake will try an LAPM connection first, and if not successful, it will try MNP4.

The error control (MNP4, LAPM) methods in modem to modem connections are based on techniques utilized by both modems. They are explained below.

CRC (Cyclical Redundancy Check) Error Detection

At the end of every data block, a 16-bit number CRC, which is calculated through a polynomial function, is sent. The receiving modem receives the block, calculates its own CRC through the same polynomial function, then compares the numbers. If it matches the received CRC, everything is all right. If not, an error(s) has occurred somewhere in the block. The modem checks every block received for error(s).

Automatic Re-transmission Request (ARQ) Error Correction

Once a data block is received error-free, the receiving modem will acknowledge this block immediately. The sending modem receives the acknowledgment and will check if any block(s) is(are) not acknowledged. Let us assume 18 blocks were transferred and the first 14 blocks were acknowledged. If no acknowledgment for block 15 is received in a given time, this block must have been damaged. Acknowledgments of blocks 16 through 18 are ignored. Blocks starting from 15 are resent.

ARQ Error Correction with Selective Reject

ZyXEL modems support V.42 error control with selective reject. Using this feature, the modem only re-sends the erroneous data block(s), not all the data blocks starting from the one in error (just block 15 in the above example). This saves retransmission time and greatly improves efficiency in high error rate situations.

Data Compression

The Omni 288S supports both V.42bis and MNP5 data compression protocols. Data compression works by representing the original data information in less bits and transmitting the reduced data bits through the data link. The receiver recovers the original information by reversing the representing process. The process of representing original data in less bits is called redundancy removal.

Data compression needs an error-free data link to work correctly. MNP5 is used with MNP4 error control and V.42bis is used with V.42 error control.

MNP5 data compression utilizes the run-length encoding and adaptive frequency encoding techniques. V.42bis uses a string coding algorithm.

The compression efficiency of V.42bis is generally higher than that of MNP5. In some cases it can be 50% to 100% higher and in other cases it is just slightly higher. In general, it is about 50% more efficient.

Run Length Encoding

Run-length encoding is applied in an attempt to avoid sending long sequences of repeated characters (data). When three or more repeated characters appear in succession, only the first three tokens (representing the compressed format of that character) and a repetition count will be sent.

Adaptive Frequency Encoding

Adaptive frequency encoding is applied after removing repeated characters (data). In adaptive frequency encoding, a token is substituted in the data stream for the actually occurring character in an attempt to send fewer than 8 bits for each character. The token is generated from a dynamic tabulation of character appearance frequency. The total number of available tokens is 256, of which only the first 32 tokens are smaller than 8 bits, so random data will gain no advantage from this technique.

String Coding

Instead of sending each data character individually, a token for a character string is sent. The modem adaptively builds a dictionary of string tokens according to data that appears. Omni modems support a dictionary size up to 2K string tokens. The input data characters are combined and checked for a matching string in the dictionary. The token is sent for the longest matched string. Compressibility is high if there are some regularities of character pattern in the data.

The error control and data compression option can be enabled either from the or the terminal. **&K4** is the default. For some applications, like BBSs, where transmission of already compressed files is usual, the MNP5 data compression process actually produces more redundant data and slows down transmission. Setting S38b5 will disable MNP5 protocol negotiation regardless of the error control setting.

Hardware or Software Flow Control

Flow control determines how data will be transferred between your computer and modem. Your modem supports two flow control methods. But regardless of which flow control method you use, make sure your communications software is configured to use the same flow control method that your modem is using. Otherwise, you may experience erratic data transfer where portions of received data are lost, or you will receive frequent errors during data transfers.

The flow control option is set by **AT&H***n* as follows:

&H0   disables flow control

&H3   sets CTS/RTS flow control

&H4   sets XON/XOFF flow control

Hardware CTS/RTS

This is a bi-directional flow control where CTS and RTS are RS232 signals which must be available on your computer. When the modem's transmission buffer is almost full, the modem will drop CTS to signal the DTE that it cannot accept any more data. Turn ON the CTS to notify the DTE that it can keep sending data to the modem. On the computer software side, when the receiving buffer of the software is almost full, it will drop RTS to signal the modem to stop sending data to the DTE. Turn ON the RTS and the modem will start sending data again to the DTE. In asynchronous full-duplex applications, the Omni 288S always responds to the RTS signal as a flow control signal. The Omni 288S defaults automatically to this hardware flow control setting and it is a better choice.

Software XON/XOFF

This is a bi-directional flow control. XON and XOFF character defaults are decimals 17 and 19. These can be changed by modifying the S-Registers 31 and 32. Both the modem and the DTE will treat XOFF as a signal to stop transmitting data, and will treat XON as a signal to restart sending data. Modems will not send these characters received from the local DTE to the remote modem.

Chapter 5 - Synchronous Mode Operation

This chapter introduces you to the use of the Omni 288S for synchronous operation. The modem can be used as a synchronous modem when it is connected to a synchronous computer or terminal. It is of course necessary to make sure that the remote modem and system are also set to synchronous. Synchronous operation applies to all of the non-FSK modes the modem is supplied with. Before synchronous transfers are started, some initial settings should be made.

V.25bis Command Set

To enable V.25bis commands use the **AT*I1** command.

For synchronous applications, the modem is permanently set in normal situations for use with one application. Save the desired settings in the power-on profile, and the modem will be initialized to synchronous mode (**&M3**) with V.25bis command enabled (***I1**) when turned it is turned on.

A special command RST is provided to get the modem back to asynchronous AT command mode from V.25bis mode. You can enter this RST command in either synchronous or asynchronous V.25bis mode.

Syntax	Command with Parameters*	Description
CRN	CRN <dialstring>**	Call request with number provided.
CRS	CRS n	Call request with number from memory, 0 # n # 49; n is the memory location.
PRN	PRN n; <number>	Saves <number> to address n (0 # n #49).
RLN	RLN***	Requests list of all stored numbers.
DIC	DIC	Ignores incoming call.
CIC	CIC	Accepts incoming call.
CFI	CFI XX	Call failure indication: ET Engaged Tone. NS Number is not stored. RT RING Tone. AB Abort Call. NT Answer Tone is not detected.
INC	INC	Incoming call.
VAL	VAL	Valid.
INV	INV	Invalid.
LSN	LSN n; <number>	List of stored numbers. (Response to RLN)
RST	RST	Changes to the asynchronous AT command mode.

Clock Options

Synchronous data must be transmitted and received with a common timing clock. This timing clock is used to transmit data from the DTE to the modem which modulates the data according to this clock. The receiving modem recovers the clock and data from the carrier and sends the data to the receiving DTE along with the clock. There are three types of transmission synchronous clock sources to choose from:

1. The **internal clock** is the one that suits most applications and is the default; in this case, the clock signal is generated by the sending modem.

2. The **slave clock** is used when in remote digital loopback mode.

3. The **external clock** is a signal generated by the sending DTE.

INTERNAL	AT&X0	The modem provides the clock and sends it to the DTE. Adaptive rate can be used. (Default)
EXTERNAL	AT&X1	The DTE provides the clock and sends it to the modem. Must use auto-retrain, cannot use adaptive rate.
SLAVE	AT&X2	Recovered receiver clock serves as transmission clock.

RTS Options

There are two RTS options. The choice depends on application and host/terminal requirements. In asynchronous mode RTS is used as a hardware flow control signal.

IGNORED	AT&R1	RTS is ignored; always assumed to be ON. (Default)
CTS TRACKS RTS	AT&R0	Delay before CTS responds to RTS's change. The delay is set in the S26 register.

Command State Options

For synchronous data communication, there are two options you can choose from to define how the modem will operate in the command state.

SYNC DATA	AT&M1	The modem accepts asynchronous command in command state, but exchanges data synchronously in data state.
SYNC	AT&M3	The modem accepts synchronous command (V.25bis) and exchanges data synchronously with a remote modem.

You can always use the panel operation to control and configure the modem and use the manual dial and answer to operate the modem.

Dialing from Synchronous Mode

1. **Dial from the terminal using asynchronous commands.** Set **&M1** and use asynchronous AT commands to dial the number. Once the modem is connected, the modem will enter synchronous operation.

2. **Dial through the computer using V.25bis commands.** Some communication software packages on synchronous computers can dial using V.25bis synchronous commands. In this case, set **&M3** and ***I1** and the modem will accept V.25bis commands and make a synchronous connection.

3. **Using DTR to dial a stored number in synchronous mode.** Store the telephone number from the front panel STORE NUMBER menu or by the asynchronous command **&Zn=.** Use the DEFAULT DIAL parameter menu or ***Dn** command to select the default dial pointer. Set **&D1** and either **&M1** or **&M3,** then raise DTR from your terminal or communication software. The modem will dial the default stored number. After the modem is connected, the modem will enter synchronous operation.

   With **S35b4** set, pressing the DATA/VOICE switch will also cause dialing of the default number.

4. **Manual dial.** Set the modem to synchronous mode (**&M1** or **&M3**), then dial a number from a telephone set. When you hear the answer tone, type **ATD** (if &M1 is set). The modem will go into synchronous operation after connection.

Answering from Synchronous Mode

Auto-Answer

Set the modem to synchronous mode. Set the S-register **S0** to equal the number of rings before auto-answer occurs. Set it from the terminal (if **&M1** is set) using the asynchronous AT command, or select the STATUS REGISTER menu to change the **S0** value.

Manual Answer

Type **ATA** from the terminal (if **&M1** is set).

Chapter 6 - Leased Line Operation

A leased line is a permanent telephone line connection between two fixed points. It can be dedicated copper wires or a leased telephone circuit from the telephone company. 4-wire leased lines use one pair of wires to transmit data and a second pair to receive. 2-wire leased lines transmit and receive on the same pair of wires. The Omni 288S supports **only** 2-wire leased lines.

Connecting to a 2-Wire Leased Line

The Omni 288S is equipped with a phone jack for dial-up line connections. Connections can also be made to a 2-wire leased line using the same jack.

Line Type Setting

AT-Command	Description
AT&L1	The modem is connected to a 2-wire leased line; the line plug should be plugged into the jack assigned LEASED LINE on the rear panel.

For the normal dial-up line only models, only 2-wire leased lines can be used and the same phone jack is used for both dial-up and leased-line connections. The dial backup feature is not available in this case.

Power Level Setting

The Omni 288S's leased-line mode transmission power level can be adjusted from **0 dBm** to **-27 dBm** in **1 dBm** increments. If a dial-up model is used for 2-wire leased-line connection, the transmission power is limited to **-3 dBm.**

AT-Command	Description
AT*P0 AT*P15	The default is -9 dBm. The adjustable range is from 0 to -15 dBm, effective in leased-line operation only. If bit 3 of S35 is set, this range will change to -12 to -27 dBm.

Leased Line Handshaking

In a typical dial-up connection, the originating modem dials the number and waits for the answering modem's carrier signal. The answering modem can be commanded to either answer the call immediately, or after a specified number of rings.

In a leased-line connection, the communication circuit between two modems is always present. Dialing and waiting for rings does not occur in this situation. If these two modems want to establish a data link, one must be designated as the

originator and the other as the answerer. You can set this manually or automatically.

Manual Connect

Set the modem to leased-line mode. Type the asynchronous command **ATD** to the originating modem and **ATA** to the answering. Use **AT*Mn** or set **S14b0** to select originate or answer mode.

Auto Handshake

If you want handshaking to occur automatically upon power-up, you have to save the leased-line configuration to the power-on profile. How to designate a profile to be a power-on profile is described in Chapter 3. Please remember to set the handshake mode before you save the configuration. Be sure that one modem is set to originate mode and the other to answer mode.

AT-Command	Description
AT*M0	When operating over a leased line, modem will handshake in originate mode. (Default)
AT*M1	When operating over a leased line, modem will handshake in answer mode.

Terminating a Leased Line Connection

Pressing the **DATA/VOICE** switch on the Omni 288S will switch the modem on/off the connected leased line.

Chapter 7 - Cellular Mode Operation

The Omni 288S is equipped with a special cellular communication mode which enables the modem to perform reliable high speed data transmissions over cellular phone links. Although all ZyXEL modems can provide the cellular mode, the ZyXEL U-1496P portable modem is specially designed for mobile use. We have nick-named the ZyXEL cellular mode as **ZyCellular.** This chapter not only explains the ZyCellular mode, but also gives background information on cellular data communications.

Cellular Phone Systems

We are referring here exclusively to the analog cellular phone system. It is called **AMPS (Advanced Mobile Phone Service)** in North America. The cellular phone system got its name by dividing its covered area into many small cells. Each cell has a cell site radio station maintaining a radio link with every cellular phone that is in use in the cell. If a cellular phone moves out of one cell's boundary and goes into another cell, it will be instructed to switch its radio link to the new cell using a new frequency channel. This is called cell hand-off.

By limiting the radio transmission power in each cell's radio communication, it will not interfere with a distant cell's radio communication using the same frequency. Frequency reuse is the principle of cellular phone systems to increase the number of radio channels available.

Cellular Impairments

A common problem in cellular communication is cell hand-off. In the process of cell hand-off, the radio link, hence the modem carrier, will be interrupted for 0.2 second to 1.2 seconds. A normal modem will respond with retrain which takes about 10 seconds or may even hang up.

A cellular phone may be instructed to change its power depending on its distance from the cell site station. The radio link will be interrupted for about 0.2 second. An effect similar to cell hand-off will .

A particularly difficult cellular impairment for data communication is called multi-path fading. A cellular phone receives the cell site station's radio signal through many indirectly reflected paths. Due to the phase difference of the arriving signals caused by the signals taking different paths, the combined signal, depending on location, may be strong, weak or totally faded. A moving cellular phone will experience a periodical signal weakness. This is called multi-path fading. Fading will cause data errors because the carrier is lost due to fading.

The analog cellular phone system was designed for voice communications. It employs companding (concatenated from compressing and expanding; it makes small signals better at the sacrifice of large signals) and pre-emphasis which are

good for voice, but not suitable for a modem signal. Modem signals, if too strong, may saturate the cellular link and cause distortion. Modem signal power that is too weak will result in lower signal-to-noise ratio at the receiving end. There is an optimum power in cellular data communications, but it is different in each case.

Cellular Modems and ZyCellular Technology

A truly cellular modem must handle the cellular impairments and maintain a reliable data link with reasonable data throughput through a cellular channel. Some modems claiming to be "cellular" lack most of these capabilities.

A link-layer-only protocol does not do anything to enhance modem data pump performance or physical communication robustness. It does not help much to handle cellular impairments.

ZyXEL developed special technologies for cellular data communications to provide reliable, high throughput data links over a cellular channel. We call these technologies ZyCellular. ZyCellular technologies specifically improve the modem data pump's performance with respect to cellular impairments.

ZyCellular Modes

In addition to normal modem, fax, and voice operation modes, the following cellular modes are available in the Omni 288S:

Mode	Speed
Multi-Auto	V.34/ZyX modes/V.32bis/V.32/V.22bis/G3 FAX/Cellular
CELL 14400	14400/12000/9600/7200/4800
CELL 12000	12000/9600/7200/4800
CELL 9600	9600/7200/4800
CELL 7200	7200/4800
CELL 4800T	4800

CELL 14400 will connect with another modem using cellular mode at a speed of up to 14400 bps. It will also connect with another V.32bis/V.32 modem. The actual speed depends on the line condition. The modem will automatically fall-back or fall-forward within its speed range.

CELL 12000, CELL 9600, and **CELL 7200** limit the maximum speed to 12000 bps, 9600 bps, and 7200 bps, respectively.

CELL 4800T uses a trellis coded modulation at 4800 bps speed. It has a better performance than the uncoded V.32 4800 bps mode.

The modem will automatically and dynamically select and adjust to the best speed and mode in which to operate. Selecting one of the above cellular modes only limits the maximum speed at which the modem will operate.

The **MULTI-AUTO** mode will automatically adapt to the other modem's capability, and will request and connect the appropriate mode. If both sides have cellular mode capability and at least one side is using a cellular phone, using MULTI-AUTO to make or answer a data call will result in a cellular mode connection. MULTI-AUTO is the default mode.

Cellular Mode Usage

Usage of the cellular mode is recommended when using a cellular link for modem connections. It can also be used other bad line conditions such as a line with frequent large impulse noise. ZyCellular mode is more noise resistant, impairment resistant, and error resistant.

It is simple to use the ZyCellular mode. Everything is determined automatically by the modem. The user only needs to set S-register S49 bit 7 and leave the modem on MULTI-AUTO. The modem takes care of everything else.

S49b7 tells the modem where it is installed. If **S49.7=0,** the modem is installed in an office connected to a normal telephone line; if **S49.7=1,** it means the modem is a mobile unit connected to a cellular phone. When a ZyCellular modem calls or answers another modem, it will indicate its cellular capability and whether it is using a cellular phone. If both sides have the ZyCellular capability and at least one side is using a cellular phone, the connection will automatically be a cellular mode connection such as it would be if it were using CELL 14400 mode. If one side is a normal non-cellular modem, the connection will automatically be a normal modem mode.

If manual power setting is desired, set **S43.2=1** to disable power adjustment and use S49 bits 0-3 to set power -9 to -24 dBm.

If a cellular mode connection is desired, set **S43.3=0** to enable the cellular mode connection. The default for this option is to be disabled **(S43.3=1).**

You can also send and receive faxes on cellular links by setting **S49.7=1** on the ZyCellular modem that is using a cellular phone. Now your modem can send and receive faxes to and from fax machines and other fax modems.

Cellular Modem Installation Examples

The most difficult part of cellular modem installation is connecting the modem to the cellular phone. There is no standard on the interface and connector type that a cellular phone should use or provide. Every cellular phone maker has its own interface design. There isn't a standard way to connect a modem to a different brand of cellular phone. Some vendors have made a specific adapter for each model of cellular phone that will convert a specific cellular phone's interface to a standard telephone company's 2-wire phone interface. A cellular modem can connect to a cellular phone such an adapter.

If you are using a cellular phone data interface adapter, the following figures illustrate three installation examples. The figures are illustrated with a U-1496P model. You can use the Omni 288S, in the same way.

The following is an example of a mobile phone that has a handset cradle and a separate transceiver and handset.
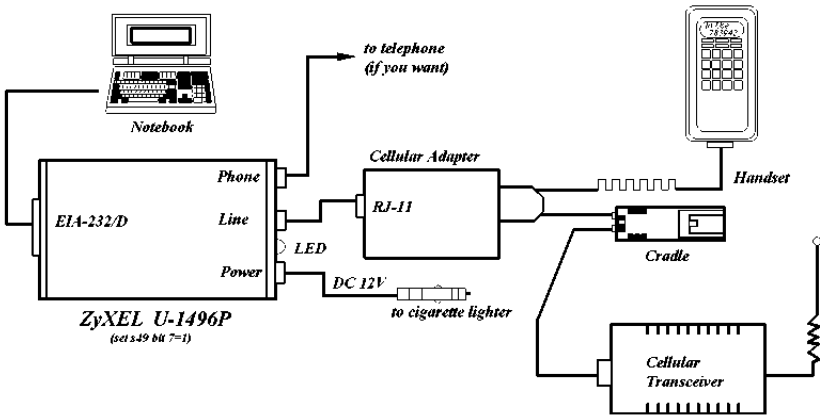
The following is an example of a mobile phone that has a separate transceiver and handset.
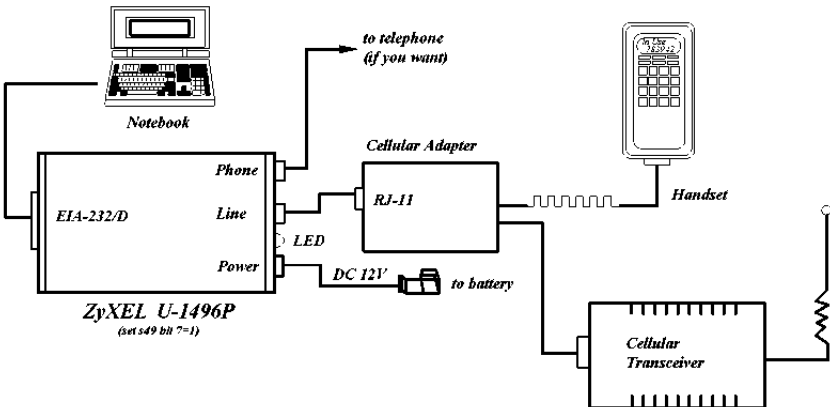
The following is an example of a one-piece hand-held mobile phone.

Notebook

to telephone
(if you want)

Cellular Adapter

Phone

EIA-232/D   Line   RJ-11   Portable
                                            Phone
            LED

Power

ZyXEL U-1496P   DC 12V   to battery
(set s49 bit 7=1)
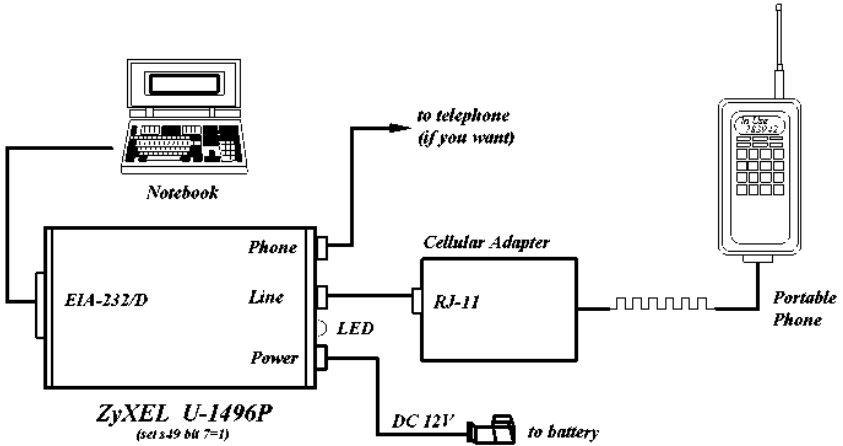
Some newer cellular models, particularly the hand-held ones, have an audio jack that can connect the cellular phone's audio input/output to an outside headphone-microphone set. A simple adapter cable can be used to connect the RJ11 modem's 2-wire interface to this cellular phone's audio jack. In this case, you need to manually dial or answer a call using the cellular phone to establish a phone connection and then manually make the modem go on-line using the ATD or ATA command.

Office Installation

Naturally, you can install the Omni 288S in an office environment, as with all the other ZyXEL models.
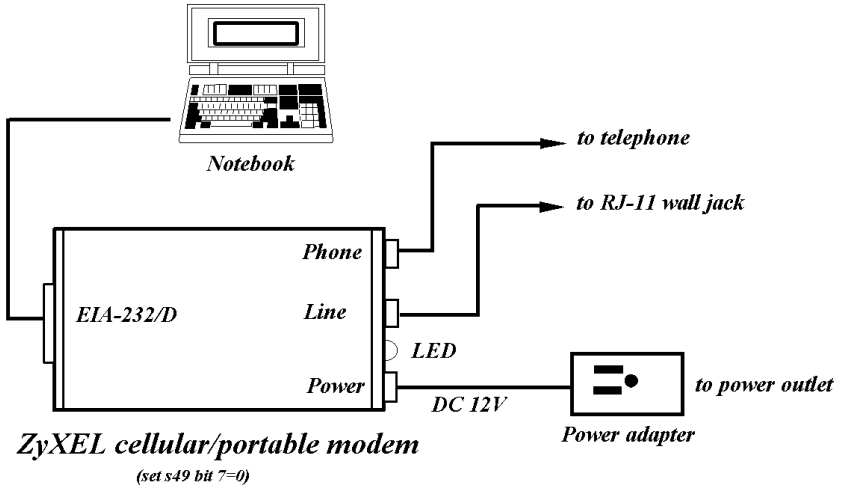
Chapter 8 - Special Functions

This chapter describes the special features of the Omni 288S, and offers instructions on how each is used.

Security Functions

The Omni 288S provides a security function that prevents unauthorized users from making connections. Two types of **security functions** are provided.

■ Type 1 security is used when the remote modem is also a ZyXEL modem.

■ Type 2 security is used when the remote modem is any other brand.

The **type 1** connection, the dial-in (remote) modem will send in its supervisor password for checking at the initial connection , and the local modem will check this password against its pre-stored acceptable password list.

The **type 2** connection, the remote terminal will be prompted to enter the password at the initial connection and the local modem will do the password checking.

Levels of Security

Two levels of security are provided:

■ With **level 1 security,** the local modem will maintain the connection if the password is OK, otherwise the line disconnected.

■ With **level 2 security,** dial back the phone number corresponding to the dial-in password. The line simply disconnected if the password does not match.

User Passwords

50 user passwords may be defined. The corresponding 50 dial-back numbers are the the modem's 50 stored phone numbers. Any character (ASCII 0-127) can be used in the password, the maximum password length is 8 characters.

The security functions are only accessible through AT commands in terminal mode. Any access attempt will result in the modem's prompting to enter the supervisor password the attempt will be rejected if the entered password is not correct. The default supervisor password is ZyXEL when the modem is shipped from the factory. This supervisor password is also the password sent for automatic password checking in a type 1 connection. To modify the supervisor password, use **AT*HS.**

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

```
Password: (Enter supervisor password)
```

```
********

Password: (Enter new supervisor password)

********

Verify: (Enter the new supervisor password again)

********

OK
```

The command **AT*Hn** will modify the nth user password. You will be prompted to enter the supervisor password first and then be prompted to enter the nth user password.

The command **AT*V** will list the 50 user passwords and the supervisor password on the screen for viewing. Again, you will be prompted to enter the supervisor password first.

The following commands will enable different types and levels of security:

Command	Function
*G0	Disable security function.
*G1	Enable type 1 and level 1 security, with password check.
*G2	Enable type 1 and level 2 security, with password check and callback.
*G3	Enable type 2 and level 1 security, with password check.
*G4	Enable type 2 and level 2 security, with password check and callback.
*G5	Enable type 2 and level 2 security, with password check and callback, remote site enters the callback number.

> *Note: Before the security type or level changed, the modem requires the supervisor password.*

For type 2 security, the remote site will be prompted to enter the user password. A maximum of 3 tries in 40 seconds is allowed. If a correct password is not entered within this time limit the line will be disconnected. If the remote site is to enter the callback number it will be prompted to do so.

Remote Configuration

Remote configuration on the Omni 288S is provided as a profile by profile batch mode. When on-line, the remote modem's current configuration or one of its profiles can be read into one of the local modem's user profiles. This profile is modified locally and the line can be disconnected during this time.

Local profile modification is done by loading this profile as the active settings and then modifying and saving the active settings back to the profile. Then the connection is reestablished and the profile transmitted to the remote modem.

Reading a remote profile b into a local profile a is acheived by the command:

AT*Rab

a=0-3	Local user profile number
b=0-3	Remote user profile number
b=4	Remote active configuration
b=5	Remote factory default

Return the modems to on-line status again. The local modem can upload (write) its profile to the remote modem's profile and have the remote modem reset from the new profile. This is done with the command:

AT*Wab

a=0-3	Local user profile number
a=4	Local active configuration
a=5	Local factory default
b=0-3	Remote user profile number

The remote profile read and write commands - ***Rab** and ***Wab** - only work in the on-line condition. The connection speed and mode do not matter. The remote modem must be set to accept remote configuration by executing the **AT*F1** command. The **AT*F0** command will set the modem up to deny remote configuration requests. Because the modem uses the remote digital loopback mode to request remote configuration information, the remote digital loopback request must also be granted (**AT&T4**) on the remote modem to accept the remote configuration request.

Batch mode remote configuration is a convenient feature allowing you to pre-configure a remote modem in one of the local modem's user profiles and send it to the remote modem in one action. It is particularly useful when there are many remote modems and a set of standard configurations is available so you can store them into user profiles. You just need to configure the remote modem into one of the standard configurations by activating the remote configuration once.

Caller Number Delivery (Caller ID)

Caller Number Delivery (CND), commonly called **Caller ID,** is a new kind of phone service that may be offered by your local phone company. Check your phone company for availability. You must subscribe to it and usually pay an additional monthly service charge this service.

With CND service, the phone company's central office will send the coded caller information to the called station. This information is sent once between the first and second. The Omni 288S modem can decode this caller information and present it to the connected computer/terminal during the second ring period as part of the call progress ring message. The modem will also report the Caller ID information if asked by the command **AT*T.**

There are two kinds of caller information message formats sent by the phone company.

- One is the single message format which includes date, time, and caller ID

- The other is the multiple message format which also includes the caller name as registered with the phone company.

The command **ATS40.2=*n*** is used to enable (**n=1**) or disable (**n=0**) the Caller ID detection function. The default is disabled. Enable it only when you have this service and want to enable its detection.

> *Note:* *The Caller ID message may cause some communication software that is not expecting it to become confused. If you plan to use the Caller ID feature, be sure you are using software that supports it (such as ZFAX).*

In single message format, the modem will send a ring message to the terminal as follows:

```
RING

TIME: <MM-DD hh:mm>

CALLER NUMBER: <CALLER_ID> or CALLER
NAME:<CALLER_NM>

RING
```

MM is the two-digit month message, DD is the two-digit date message, hh is the hour and mm is the minute of the time, and CALLER_ID is the phone number of the caller or CALLER_NM his/her name.

The following is an example of a caller ID message as it might appear on your screen:

```
RING

TIME: 04-28 12:30
```

```
CALLER NUMBER: 7135551414 or   CALLER NAME: Jack
Smith

RING
```

In the multiple message format, if the caller's number and name are available, the ring message will display both:

```
RING

TIME: MM-DD hh:mm

CALLER NUMBER: <Caller_ID>

CALLER NAME: <Caller_Name>

RING
```

Here is an example:

```
RING

TIME: 04-28 12:30

CALLER NUMBER: 7135551414

CALLER NAME: Jack Smith

RING
```

If the caller number and name are not available, the ring message will appear as follows:

```
RING

TIME: 04-28 12:30

REASON FOR NO NUMBER: OUT_OF_AREA

REASON FOR NO NAME: PRIVACY

RING
```

The last CND message that the modem received can be displayed by using the AT*T command.

Setting **S48.0=1** will cause the modem to report CND information in its ASCII coded hexadecimal raw data format. The DTE software is responsible for explaining the data.

Notes: Please refer to the Bellcore Technical Advisory document AT-NWT-000030 for the exact data format. The above Caller ID scheme applies to the North America area. Different countries may employ different Caller ID schemes, check if the scheme used in your country is supported before using the Caller ID

feature. For most other Caller ID schemes, only the Caller telephone number is provided.

Distinctive Ring

Distinctive Ring is a phone service that may be offered by your phone company. Check your phone company for availability. With this service, you can have several phone numbers assigned to the same phone line. The phone company will send a different type of ring signal for each phone number being called. The subscriber can distinguish which number is called by which type of ring is received.

A simple use of this feature is that you can have three numbers on the same line and you can list the three numbers for voice, data, and fax, respectively. You can then have your fax machine answer only the ring corresponding to the fax number and have your modem answer only the ring corresponding to the data number. The voice call will not be answered by either fax machine or data modem and it will only be answered when someone picks up the phone. Or you can have the answering machine answer only the voice ring. A more complicated use is that you can have one number for multiple uses, such as one number for both data and fax.

A ring signal is a composition of repeated on and off states. Different types of rings usually correspond to different compositions of the "ON" part (cadence) of the ring. The Omni 288S modem can distinguish up to four types of ring signals and can be commanded to answer or not answer any one of these four types of ring signals. Following is a list of these four types of ring signals. These are the ring types used in the USA. The difference among the ring types is the two-second ON part of the ring signal. It comprises a long, double short, or triple short ring.

S-register **S40 bits 3-6** are used for distinctive ring control. Each bit controls the answering of a particular ring type. Setting a bit to "1" (on) enables answering, setting it to "0" (off) rejects the ring. Note that the ring may still be heard even if it is not counted as an accepted ring by the modem.

The control relationships between bits 3-6 in register S40 and the different ring types are:

Type	Bit (on)	Ring Sequence
1	3	1.2s or 2s on; 4s off
2	4	0.8s on, 0.4s off, 0.8s on; 4s off
3	5	0.4s on, 0.2s off, 0.4s on, 0.2s off, 0.8s on; 4s off
4	6	0.3s on, 0.2s off, 1s on, 0.2s off, 0.3s on; 4s off

Note: *If all of these bits are "0" (off), any ring with a duration longer than 100 ms will be accepted. Use this default if you do not have distinctive ring service.*

If more than one type of Distinctive Ring is turned on, RING n will be reported for an incoming ring signal where n is the ring type number.

> *Note:* *Countries other than the U.S. may have different specifications for different ring types. The manufacturer may append other sets of ring type specifications to suit each country's needs.*

Extended Distinctive Ring (EDR)

Extended Distinctive Ring (EDR) is a special feature designed for single telephone line home use to receive fax or data calls without interfering with regular voice calls. Most users, when they install a fax/modem at home, won't subscribe to an extra telephone line for occasional fax or data calls; however, fax/data calls do come in from time to time.

If a user lets the fax/data software application answer, voice calls will be missed. On the other hand, if a human being or an answering machine answers, fax or data calls may either be missed or the person who answers the call has to go through some procedures to get this call connected to the proper application. Either way is not desirable.

Once enabled with the proper settings, EDR can:

1. Detect the data/fax CNG tone without physically answering the call. After a CNG tone is detected, the modem will report RING or RING n to the application software. The software can cause the modem to answer the call.

2. Detect several DTMF tones without physically answering the call. The DTMF tones, once detected by the modem, will be reported as RING or RING n to the software application.

With these two functions, the Omni 288S can be installed with an answering machine or voice telephone set at home. In most cases, the modem should not be set to answer regular rings, nor to report them. Thus, the software will not instruct the modem to answer the call when phone rings. When a call comes in, the answering machine will answer the phone and play a voice message. At this moment, the modem, having detected the ring signal is gone, will start to listen to the line for CNG tone or DTMF tones.

If the remote caller is an unattended fax machine, it will send a CNG tone for a period of time. The modem will detect the CNG tone and report RING to the software immediately. The software application can then issue commands to answer the call and receive the fax. If the remote caller is using a fax phone which does not send out a CNG tone and is waiting for a fax answer tone in order to press the START button, the caller can press a designated DTMF tone, which will activate the modem to report and subsequently be ordered to answer the fax call.

Setting Up EDR

The new EDR can be used at home where multiple phones are installed in parallel. Once this function is enabled, the modem will go into EDR mode after the ring disappears, and it will be able to detect the data/fax CNG tone and DTMF tones, and report them as different types of rings. The EDR settings are defined in S-register S51.

S51 Bit-mapped register: (default: 0)

Bits	Bin.	Dec.	Description
(7,6)	00	0	Disable data CNG tone detection (default)
	01	64	Report RING for data CNG tone
	10	128	Report RING 1 for data CNG tone
	11	192	Report RING 3 for data CNG tone
(5,4)	00	0	Disable Fax-CNG tone detection (default)
	01	16	Report RING for fax CNG tone
	10	32	Report RING 1 for fax CNG tone
	110	48	Report RING 2 for fax CNG tone
(3,2)	00	0	Disable DTMF tone detection (default)
	01	4	Report RING for a DTMF tone
	10	8	Report RING <DTMF> for a DTMF tone
	11	12	Reserved
(1,0)	00	0	Disable EDR (default)
	01	1	Report RING twice
	10	2	Report RING four times
	11	3	Report RING six times

EDR detection (either CNG or DTMF tones) will be disabled once it . However, a customer's program might not answer because the setting of the software may require multiple rings to answer. S51 bits 0-1 control the number of rings that the modem will report once the CNG or DTMF tone is detected.

The timing relationship between the Caller ID (if enabled), EDR, and ring detection is as follows:

```
ring1       ring2       ring3
***--------***--------***----------------------------
              3sec   3s    3s   3s    S7 timeout
   +------+---+------+---+------+---+-------------+----
    CID/EDR RD    EDR    RD    EDR   RD       EDR         RD
```

CID=Caller ID task   **RD**=Ring Detection task   **EDR**=EDR task
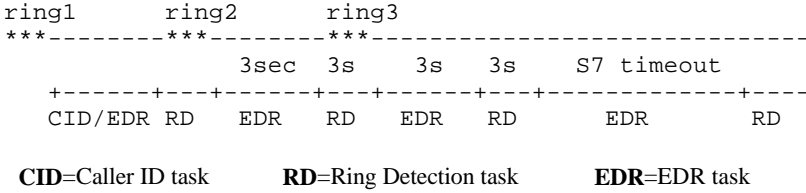
> *Note: During the EDR period, any AT command will disable the EDR function.*

EDR Application Example

If we use ZFAX as our fax receiving application and we don't want it to answer the call unless it is a fax call, the way to set it up would be:

1.   Set ZFAX to answer on 2 rings.

2.   Set **S51.0=1** to enable EDR and report RING twice. The modem will not report a normal RING and ZFAX will not answer a call unless EDR RING is reported.

3.   Set **S51.4=1** to enable fax CNG tone detection. It is reported as RING.

4.   Set **S51.2=1** to enable DTMF tone detection. It is reported as RING. If the remote fax machine does not generate the CNG tone, ask a fax caller through your answering machine message to press "*" (or any other DTMF key) if he or she wants to send a fax.

Save the settings in a profile and reset the modem with **AT&WZ**.

Chapter 9 - Fax Operation

The Omni 288S can be used as a fax machine, and this chapter explains how. In the sections below, we will describe how the modem works as a fax machine, the ITU-T T.30 fax protocol, the Class 1, 2, and 2.0 fax commands and ZyXEL extended fax AT commands. Also covered are the status report result codes, the flow control protocol associated with ZyXEL fax AT commands, and some specific fax applications. The instructions for using the included modem/fax/voice utility program are included on the software disk. Some distributors and dealers also include other software with the Omni 288S. For help with such software, refer to the documentation that came with it.

Fax Basics

Fax is the abbreviation for facsimile. There are four major parts in a facsimile machine: the scanner, encoding and decoding device, modem, and printer. Before a page can be sent, it is first scanned. The bit-mapped data is encoded with data compression and is then transmitted across the phone line by an internal modem module. The remote facsimile receives the data with its internal modem, decodes it back to bit-mapped image data, and prints it on paper.

Fax Branding: The Telephone Consumer Protection Act of 1991 makes it unlawful for any person to use a computer or other electronic device to send any message via a telephone or fax machine unless such message clearly contains in a margin at the top or bottom of each transmitted page or on the first page of the transmission, the date and time it is sent and an identification of the business or other entity, or individual sending the message and the telephone number of the sending machine or such business, or entity, or individual. In order to program this information into the fax function of your modem, please refer to the documentation of the fax software you will be using.

Modem as Fax Machine

Modems can also be designed to include a fax transmitting and receiving function similar to a fax card. Since the modem's interface with the computer is the standard serial RS-232 interface, this interface is used for both modem and fax operations. Fax image coding and decoding must be done in the computer. Modem/Fax, also called fax/modem, can be either an external stand-alone unit or a plug-in card. External stand-alone units can be connected to any computer with a standard RS-232 serial port.

The Omni 288S supports Group 3 send and receive facsimile functions. For normal fax operation, you must connect the modem to a computer, usually a PC. The computer serves as the input/output device for the fax function. The RS-232 serial connection or the ZyXEL serial port interface connects the Omni 288S to the computer. The Omni 288S uses the same interface for both data and fax applications. In fax operations, the modem performs protocol handshaking and

image data transfer. The computer handles image data creation, capturing, conversion, compression, decompression, retrieving, and storing.

ITU-T T.30 Fax Protocol

The ITU-T T.30 fax protocol is known as the G3 fax handshake signals and procedures. The modem takes full control of this protocol - initiating and terminating fax calls, managing the communication session, and transporting the image data. Therefore, the modem relieves the computer fax software of the T.30 protocol handling.

The Omni 288S allows for fax speeds up to 14400 bps when transmitting to a fax machine which complies with the G3 fax standard. Speeds will fall back to 12000, 9600, or 7200 bps in poor line conditions. When connecting to a non-G3 fax device, the Omni 288S allows for fax speeds up to 9600 bps and will automatically fall back to 7200, 4800, and 2400 bps if the line quality is poor.

Fax Command sets

The Omni 288S supports four command sets for fax operation:

- Class 1 command set

- TIA PN-2388 Class 2 command set

- TIA 592 Class 2.0 command set

- ZyXEL Extended Fax AT command set

Defining the Fax Command Sets

The EIA Class 1 and Class 2 fax commands are a set of AT fax commands defined by EIA/TIA (Telecommunications Industry Association) for controlling fax/modems from a computer through the serial RS-232 interface. All fax/modems and fax software supporting this standard will be compatible with each other.

Class 1 commands control how the modem does on-line negotiation while Class 2 commands allow the modem to do many negotiations at once. The Class 1 protocol uses the modem to transmit fax data only. The complete organizational overhead for this protocol is handled by the connected computer. The Class 1 command set is also called the TIA-578 standard.

Several revisions of the class 2 standard exist. Implementations conforming to different revisions may not work together. A formally approved version is the Class 2.0 command set, also called the TIA-592 standard.

Class 1 Command Set

Command	Value	Description
+FCLASS=n		Service class selection
	n=0	Set to Data mode
	n=1	Set to Class 1 mode
	n=2	Set to Class 2 mode
	n=2.0	Set to Class 2.0 mode
	n=6	Set to ZFAX mode
	n=8	Set to Voice mode

> *Note:* *If S57.4=0 (default), the response to the +FCLASS=? command will not report Class 1 capability. This is due to the fact that some fax software packages may get confused by this response.*

Command	Value	Description
+FTS=n	0-255	Stop transmission and pause, in 10 ms units.
+FRS=n	0-255	Wait for silence, in 10 ms units.
+FTM=<MOD>		Transmit data with <MOD> carrier.
+FRM=<MOD>		Receive data with <MOD> carrier.
+FTH=<MOD>		Transmit HDLC data with <MOD> carrier.
+FRH=<MOD>		Receive HDLC data with <MOD> carrier.

The <MOD> parameter for the preceding commands take the following values:

Value	Modulation	Speed	Requirements
3	V.21 ch. 2	300	required for FTH & FRH
+FTH and +FRH support value 3 (V.21 ch. 2 / 300 bps) only.			
24	V.27ter	2400	required for FTM & FRM
48	V.27ter	4800	required for FTM & FRM
72	V.29	7200	required for FTM & FRM
73	V.17	7200	required for FTM & FRM
74	V.17 w/st	7200	required for FTM & FRM
96	V.29	9600	required for FTM & FRM
97	V.17	9600	required for FTM & FRM
98	V.17 w/st	9600	required for FTM & FRM
121	V.17	12000	required for FTM & FRM
122	V.17 w/st	12000	required for FTM & FRM
145	V.17	14400	required for FTM & FRM
146	V.17 w/st	14400	required for FTM & FRM

* w/st means with V.17 short training

Class 2 Command Set

The following Class 2 commands are supported and implemented per TIA PN2388 (8/20/90).

Command Syntax	Description
+<command>=<value>	Execute a command or set a parameter.
+<command>=?	Read permissible settings.
+<command>?	Read current setting.

Supported Commands (per TIA PN2388 8/20/90)

Command	Value	Description
+FAA=*n*		Auto-answer mode parameter:
	n=0	Answer as set by +FCLASS.
	n=1	DCE answers and auto-determines type.
+FBADLIN= *<value>*	0-255	Bad line threshold (number of consecutive bad lines for a bad page parameter): Determine if Copy Quality OK on the T.30 flow chart . <value>=0 to 255; a value of 0 implies that error checking is disabled.
+FBADMUL= *<value>*	0-255	Error threshold multiplier: Determine if "Copy Quality OK" on the T.30 flow chart . <value>=0 to 255; a value of 0 implies that error checking is disabled.
+FBOR=*n*		Phase C data bit order:
	n=0	Select direct bit order.
	n=1	Select reversed bit order in receiving mode for phase C data.
+FBUF?		Buffer size; read only parameter: Allow DTE to determine the characteristics of the DCE's buffer size.
+FCIG=*"string"*		Local fax station ID string, for polling Rx.
+FCLASS=*n*		Service class selection: Refer to +FCLASS Class 1 command in previous section.
+FCON		DCE responds fax connection .
+FCQ=*n*		Copy quality check capability parameter
	n=0	No copy quality check capability.
	n=1	Only check 1D phase C data.
	n=2	Check both 1D and 2D phase C data.
+FCR=*n*		"Capability to receive" parameter
	n=0	DCE will not receive message data or poll a remote device.
	n=1	DCE receives message data or polls a remote device.

Command	Value	Description
+FCTCRTY= *<value>*	0-255	ECM retry count; in Error Mode only: The sender will try to send a partial page 4 times. <value>=0 to 255; units of 4 retries. If the Continue To Correct (CTC) count is 0, it will not make any further attempts.
+FDCC=*vr,br,wd,ln,* *df,ec,bf,st*		DCE capabilities parameters.
	vr=0	Vertical resolution: Normal; 98 lpi.
	vr=1	Vertical resolution: Fine; 196 lpi.
	br=0	Bit rate: 2400 bit/s; V.27ter.
	br=1	Bit rate: 4800 bit/s; V.27ter.
	br=2	Bit rate: 7200 bit/s; V.29 or V.17.
	br=3	Bit rate: 9600 bit/s; V.29 or V.17.
	br=4	Bit rate: 12000 bit/s; V.17.
	br=5	Bit rate: 14400 bit/s; V.17.
	wd=0	Page width: 1728 pixels in 215mm.
	wd=1	Page width: 2048 pixels in 255mm.
	wd=2	Page width: 2432 pixels in 303mm.
	ln=0	Page length: A4; 297mm.
	ln=1	Page length: B4; 364mm.
	ln=2	Page length: unlimited length.
	df=0	Data compression format: 1-D; modified Huffman.
	df=1	Data compression format: 2-D; modified Read.
	ec=0	Error correction disabled.
	ec=1	Enable error correction mode.
	bf=0	Disable binary file transfer.
	st=0	Minimum scan time/line: 0 ms.
	st=1	Minimum scan time/line: 5 ms.
	st=2	Minimum scan time/line:10 ms (normal); 5 ms (fine).
	st=3	Minimum scan time/line:10 ms.
	st=4	Minimum scan time/line:20 ms (normal); 10ms (fine).
	st=5	Minimum scan time/line:20 ms.
	st=6	Minimum scan time/line:40 ms (normal); 20ms (fine).
	st=7	Minimum scan time/line:40 ms.
+FDCS=*vr,br,wd,ln,* *df,ec,bf,st*		Current session parameter; refer to +FDCC command.
+FDIS=*vr,br,wd,ln,* *df,ec,bf,st*		Current session negotiation parameter; refer to +FDCC command.

Command	Value	Description
+FDR		Receive phase C data command; initiates document reception.
+FDT=*df,vr,wd, ln*		Transmit phase C data command: release the DCE to proceed with negotiation.
+FECM=*n*		Error mode control:
	n=0	Error mode is disabled.
	n=2	Error correcting mode is enabled, handled by the DCE alone, including buffering of partial pages.
+FET=*n*		End of page or document command:
	n=0	More pages; same document.
	n=1	End of document; another document follows.
	n=2	No more pages or documents.
	n=4	Procedure interrupt; another page follows.
	n=5	Procedure interrupt; end of document, another document follows.
	n=6	Procedure interrupt; end of document.
+FK		Regular fax abort command.
+FLID=*"string"*		Local ID string parameter.
+FLO=*n*		Flow control options:
	n=0	No flow control.
	n=1	Set XON/XOFF software flow control.
	n=2	Set CTS/RTS hardware flow control.
+FLPL=*n*		Document for polling command:
	n=0	The DTE has no document available for polling.
	n=1	Indicate a document available for polling.
+FMDL?		Request DCE model .
+FMFR?		Request DCE manufacturer .
+FMINSP=*n*		Minimum phase C speed parameter:
	n=0	2400 bps.
	n=1	4800 bps.
	n=2	7200 bps.
	n=3	9600 bps.
	n=4	12000 bps.
	n=5	14400 bps.
+FPHCTO= *<value>*	0-255	DTE Phase C response timeout: Determine how long the DCE will wait for a command after reaching the end of data when transmitting in Phase C. <value>=0 to 255; 100 ms units.
+FPTS=*n*		Page transfer status

Command	Value	Description
	n=1	Received page good.
	n=2	Page bad; retrain requested.
	n=3	Page good; retrain requested.
	n=4	Page bad; procedure interrupt requested.
	n=5	Page good; procedure interrupt requested.
+FREL=*n*		Phase C received EOL alignment:
	n=0	The EOL patterns are bit aligned as received.
	n=1	The last received bits of EOL patterns are byte aligned by the DCE, with necessary zero fill bits inserted. Refer to TIA PN-2388 for details.
+FREV?		Request the DCE revision identification.
+FSPL=*n*		"Enable polling" command:
	n=0	Disable polling.
	n=1	Enable polling.

All other +F commands are not supported, but the modem will respond OK. In many cases this means "don't care." See PN 2388 for command details.

Class 2 Command Responses

Response	Value	Function and Description
+FCFR		Confirmation .
+FCIG:"string"		Report remote ID response CIG.
+FCON		Facsimile connection response.
+FCSI:"string"		Report remote ID response CSI.
+FDCS:vr,br,wd,ln, df,ec,bf,st		Report session parameters response; refer to +FDCC=.... command.
+FDIS:vr,br,wd,ln, df,ec,bf,st		Report session negotiation parameters response; refer to +FDCC=.... command.
+FDTC:vr,br,wd,ln, df,ec,bf,st		Report remote capabilities response; refer to +FDCC=.... command.
+FET:n		Post page message response; refer to the +FET=n command.
+FHNG:n		Call termination status response.
	n=00	Normal and proper end of connection.
	n=10	Transmit error on phase A hang up code.
	n=20	Transmit error on phase B hang up code.
	n=40	Transmit error on phase C hang up code.
	n=50	Transmit error on phase D hang up code.
	n=70	Receive error on phase B hang up code.
	n=90	Receive error on phase C hang up code.
	n=100	Receive error on phase D hang up code.
+FNSC:"HEX string"		Report the non-standard facilities command frame.

Response	Value	Function and Description
+FNSF:"HEX string"		Report the non-standard facilities frame response.
+FNSS:"HEX string"		Report the non-standard setup frame response.
+FPOLL		Remote polling indication.
+FPTS:n		Receive page transfer status response; refer to +FPTS=n command.
+FTSI:"string"		Report remote ID response TSI.
+FVOICE		Transition to Voice response.

Class 2 Flow Control

Flow control is necessary to match the DTE-DCE data rate to the line signaling rate while transmitting or receiving Group 3 (T.4) data. In Class 2 fax mode, both hardware (RTS/CTS) and software (XON/XOFF) flow control are enabled.

Class 2.0 Command Set

Command Syntax	Description
+<command>=<value>	Execute a command or set a parameter.
+<command>=?	Read permissible settings.
+<command>?	Read the current setting.

Supported Commands

Command	Value	Description
+FAA=*n*		Auto-answer mode parameter:
	n=0	DCE answers as set by +FCLASS.
	n=1	DCE answers and auto-determines call type.
+FBO=*n*		Phase C data bit order:
	n=0	Select direct bit order.
	n=1	Select reversed bit order in receiving mode for phase C data.
+FBS?		Buffer size parameter read only.
+FCC=*vr,br,wd,ln,* *df,ec,bf,st*		DCE capability parameter. Refer to +FDCC command in Class 2 for parameter settings.
+FCLASS=*n*		Service class selection. Refer to +FCLASS Class 1 command in previous section.
+FCO		DCE response fax connection made.
+FCQ=*<rq>,<tq>*		Copy quality check capability parameter
	rq=0	DCE Receive Copy Quality Checking disabled.
	rq=1	DCE Receive Copy Quality Checking enabled.
	rq=2	DCE Receive Copy Quality Correction enabled.
	tq=0	DCE Transmit Copy Quality Checking

Command	Value	Description
		disabled.
	tq=1	DCE Transmit Copy Quality Checking enabled.
	tq=2	DCE Transmit Copy Quality Correction enabled.
+FCR=*n*		"Capability to receive" parameter
	n=0	DCE will not receive message or poll a remote device.
	n=1	DCE receives message data or polls a remote device
+FCT=*n*	0-255	DTE phase C time-out parameter. n=0-255, 1 units.
+FDR		Receive phase C data command initiates document reception
+FDT		Transmit phase C data command: releases the DCE to proceed with negotiation
+FEA=*n*		Phase C received EOL alignment parameter
	n=0	Determine that T.4 EOL patterns are bit aligned (as received).
	n=1	Determine that the last received bits of T.4 EOL patterns are byte aligned by the DCE, with necessary zero fill bits inserted.
+FIE=*n*		Procedure interrupt parameter
	n=0	Procedure interrupt requests from the remote station are ignored, and not reported to the DTE.
	n=1	Procedure interrupt requests from the remote station are accepted, negotiated and reported using the +FVO response.
+FIP		Initialize facsimile parameters to factory default.
+FIS=*vr,br,wd,ln, df,ec,bf,st*		Current session parameter. refer to +FDCC Class 2 command in previous section parameter settings.
+FKS		Session termination command.
+FLI=*"string"*		Local ID string parameter.
+FLO=*n*		Flow control options:
	n=0	No flow control.
	n=1	Set XON/XOFF software flow control.
	n=2	Set CTS/RTS hardware flow control.
+FLP=*n*		Document for polling command:
	n=0	The DTE has no document for polling.
	n=1	Indicated document available for polling.

Command	Value	Description
+FMI?		Request DCE manufacturer identification.
+FMM?		Request DCE model identification.
+FMR?		Request DCE revision identification.
+FMS=*n*		Minimum phase C speed parameter. refer to +FMINSP Class 2 command in previos section for parameter settings.
+FNR=*rpr, tpr, idr, nsr*		Negotiation message reporting control parameters:
	rpr=0	Receiver parameters are not reported. +FIS: and +FTC: response reports are suppressed.
	rpr=1	Receiver parameters are reported. +FIS: and +FTC: response reports are generated.
	tpr=0	Transmitter Parameters are not reported. +FCS: response reports are suppressed. (+FCS parameter is still loaded)
	tpr=1	Transmitter Parameters are reported. +FCS: response reports are generated.
	idr=0	ID Strings are not reported. +FTI: +FCI: and +FPI: response reports are suppressed.
	idr=1	ID Strings are reported. +FNF:, +FNS: and +FNC: response reports are generated.
	nsr=0	Non-standard frames are not reported. +FTI: +FCI: and +FPI: response reports are suppressed.
	nsr=1	Non-standard frames are reported. +FTI:, +FCI: and +FPI: response reports are generated.
+FNS=*"string"*		Non-standard byte string parameter. "string": string of hexadecimal coded octets.
+FPI=*"string"*		Local fax station ID string, for polling Rx.
+FPP=*n*		Packet protocol control parameter:
	n=0	Disable the DCE-DTE packet protocol.
	n=1	Enable the DCE-DTE packet protocol. All multi-character messages from the DCE are sent to the DTE using a simple packet protocol data link.
+FPR=*n*		Serial port rate control parameter:
	n=0	Automatic DTE rate detection by the DCE.
	n>0	Serial rate is fixed at the value multiplied by 2400 bps. For example, when n=8, the DTE rate is equal to 19200 bps (8x2400).
+FPS=*n*		Page transfer status: refer to the +FPTS Class 2 command in previous sections for settings.

Command	Value	Description
+FRQ=*pgl, cbl*		Quality thresholds parameters:
	pgl= 0-64 (HEX value)	Specify the percentage of good lines (e.g. with negotiated number of pixels) required for a page considered acceptable. The percentage of good lines would be computed by the equation: $100 \times (\text{<lc>} - \text{<bl>}) / \text{<lc>}$ lc: total line count as reported in the +FPS: response. bl: bad line count as reported in the +FPS: response. If the resulting value is less than the value in <pgl>, the page is unacceptable.
	cbl= 0-FF (HEX value)	Specify the maximum tolerable number of consecutive bad lines. If this value is exceeded for a given page, the DCE shall consider the page unacceptable.
+FRY=*n*	0-255	ECM retry value n=0-255, units of 4 retries.
+FSP=*n*		Enable polling command:
	n=0	Disable polling.
	n=1	Enable polling.

Class 2.0 Command Responses

Response	Value	Function and Description
+FCI:"CSI ID string"		Report remote ID response, Called Station ID
+FCO		Fax connection established response.
+FCS: vr, br, wd, ln, df, ec, bf, st		negotiated session parameters (DCS frame information) response. Refer to +FIS= comnd.
+FET:<ppm>		Post page message response:
	ppm=0	Another page next, same document.
	ppm=1	Another document next.
	ppm=2	No more pages of documents.
	ppm=3	Another page next, same document, procedure interrupt requested.
	ppm=4	Another document next, procedure interrupt requested.
	ppm=5	No more documents or pages, procedure interrupt requested.
+FHS:<hsc>		termination status:
	hsc= 0-0F	Call placement and termination. Refer to TIA-592 for details.
	hsc= 10-1F	Transmit phase A and miscellaneous errors. Refer to TIA-592 for details.

Response	Value	Function and Description
	hsc= 20-3F	Transmit phase B hang up codes. Refer to TIA-592 for details.
	hsc= 40-4F	Transmit phase C hang up codes. Refer to TIA-592 for details.
	hsc= 50-6F	Transmit phase D hang up codes. Refer to TIA-592 for details.
	hsc= 70-8F	Receive phase B hang up codes. Refer to TIA- 592 for details.
	hsc= 90-9F	Receive phase C hang up codes. Refer to TIA- 592 for details.
	hsc= A0-BF	Receive phase D hang up codes. Refer to TIA- 592 for details.
+FIS:vr, br, wd, ln df, ec, bf, st		emote fax station capabilities (DIS frame information) response refer to +FIS=... command for a description of sub-parameters.
+FNC: "NSC FIF string"		Report NSC (non-standard Commands) frame
+FNF: "NSF FIF string"		Report NSF (non-standard Facilities) frame.
+FNS: "NSS FIF string"		Report NSS (non-standard Setup) frame.
+FPI: "CIG ID string"		Report remote ID response-Polling Station ID (CIG).
+FPO		Remote polling indication.
+FPS:ppr, lc, blc, cblc, lbc		.30 phase C page reception response:
	ppr=1	Received page good.
	ppr=2	Page bad; retrain requested.
	ppr=3	Page good; retrain requested.
	ppr=4	Page good; remote request for procedure interrupt accepted.
	ppr=5	Page bad; retrain requested; remote request for procedure interrupt accepted.
		The receiving DCE may count <lc>, <blc>, <cblc> and <lbc> due to DCE buffer overflow and report them: lc: line count blc: bad line count cblc: maximum consecutive bad line count lbc: lost byte count
+FTC: vr, br, wd, ln, df, ec, bf, st		emote fax station capabilities (DCT frame information) response refer to +FIS=... command for the description of sub-

Response	Value	Function and Description
		parameters.
+FTI: "TSI ID string"		Remote ID response-Transmit Station ID (TSI).
+FVO		Report transition to voice.

Extended Fax AT Command Set

Extended Fax AT Commands are unique to ZyXEL modems. The computer controls the modem through a set of extended fax AT commands and the modem responds with a set of status report result codes. During data state, compressed fax image data is flowing between the modem and computer. The default serial connection speed is 38400 bps, and it is higher than the fax link rate. CTS/RTS hardware flow control is used to regulate the data flow.

The Omni 288S accepts the extended fax AT commands to set the modem mode and fax parameters. Besides the extended fax AT commands, the modem accepts all the other AT commands described in this chapter. For instance, you can use ATD to make a fax call, or ATA to answer an incoming fax call. When using the extended Fax AT commands, you need to send the command ATFCLASS=6 first. Following are the fax related AT commands:

Mode Setting

Command	Function
#F	Set the modem into V17G3 FAX mode same function as the extended AT command AT&N32.
#B0	Set fax receiving mode. The connection parameters and received fax data are sent to DTE continuously following the connect message. (Default)
#B1	Set fax receiving mode. The messages are separated from the received fax data. The modem sends CONNECT FAX and ZyXEL first, then it waits for the DC2 character (hex18) to send the fax data. When the modem receives a DC2 from the DTE, it starts to send the fax connection parameters/SnnnnVnTnRnLnCnP<string><CR><LF> then the received fax data. In this mode, the modem will wait for DC2 at the beginning of every page. The DTE software should detect the page separator RTC and then sends the DC2 to receive the next page of fax data. This mode is used with a BBS receiving faxes.
#B2	This mode is for the polling feature of the modem. In this mode, the modem will send a polling signal to the remote fax device to ask to receive a fax from the remote fax device. The received fax data will be sent to the DTE continuously following the message.

Command	Function
#B3	Displays the ring cadence.

Parameter Setting

Command	Function
#V0	Set to normal vertical resolution.
#V1	Set to high vertical resolution.
#T0	Set to one dimensional coding scheme.
#T1	Set to two dimensional coding scheme.
#R0	Set recording width: 1728 picture elements along a scan line length of 215 mm.
#R1	Set recording width: 2048 picture elements along a scan line length of 255 mm.
#R2	Set recording width: 2432 picture elements along a scan line length of 303 mm.
#L0	Set maximum recording length: A4 (297 mm).
#L1	Set maximum recording length: B4 (364 mm).
#L2	Set maximum recording length: unlimited.
#C0	Set minimum scan line time capability the receiver: 20 ms at 3.85 line/mm, T(7.7)=T(3.85).
#C1	Set minimum scan line time capability the receiver: 5 ms at 3.85 line/mm, T(7.7)=T(3.85).
#C2	Set minimum scan line time capability the receiver: 10 ms at 3.85 line/mm, T(7.7)=T(3.85).
#C3	Set minimum scan line time capability the receiver: 20 ms at 3.85 line/mm, T(7.7)=1/2 T(3.85).
#C4	Set minimum scan line time capability the receiver: 40 ms at 3.85 line/mm, T(7.7)=T(3.85).
#C5	Set minimum scan line time capability the receiver: 40 ms at 3.85 line/mm, T(7.7)=1/2 T(3.85).
#C6	Set minimum scan line time capability the receiver: 10 ms at 3.85 line/mm, T(7.7)=1/2 T(3.85).
#C7	Set minimum scan line time capability the receiver: 0 ms at 3.85 line/mm, T(7.7)=T(3.85).
#P<*string*>	Set local phone number the phone number following the character 'P' can up to 25 characters. The modem will exchange this phone number with the remote fax machine during initial handshaking.

Status Report Result Codes

When the Omni 288S is set in the fax mode, each ATD or ATA command will make the modem try to establish a fax connection. The Omni 288S will send a status report result code back to the DTE (computer).

NO DIAL TONE	Tried to dial but no dial tone is detected.
NO CARRIER	Handshake fails or no carrier is detected or time-out.
BUSY	Other party's phone line is busy.
NO ANSWER	Quiet answer is not detected before time-out.
CONNECT FAX	See below.

When a fax connection is successfully established, the modem returns this message:

```
CONNECT FAX/SnnnnVnTnRnLnCnP<string>
```

This message includes the connection speed and the fax parameters explained in the table below.

Field	Description
S*nnnn*	Fax connection speed; nnnn is a 4-digit number representing the connection speed. nnnn =1440, 1200, 9600, 7200, etc., 1440 and 1200 stand for 14400 and 12000.
V*n*	Vertical resolution; n = 0 or 1.
T*n*	Coding scheme; n = 0 or 1.
R*n*	Recording width; n = 0, 1, or 2.
L*n*	Recording length; n = 0, 1, or 2.
C*n*	Scan line time; n = 0 to 7.
P*<string>*	Remote fax number.

After each fax disconnection, the following result code is sent back to the DTE:

```
DISCONNECTnP<string>
```

This result code informs DTE of the disconnecting status.

Field	Description
DISCONNECT0	Disconnect with remote confirmation.
DISCONNECT1	Disconnect without remote confirmation.
P<string>	Remote fax number.

The basic AT commands ATV0 and ATQ1 do not affect the above CONNECT and DISCONNECT status report result codes. The modem will always return the same status format as above.

Flow Control

In extended fax AT command mode, the Omni 288S always uses hardware (CTS/RTS) flow control. The flow control signaling used sending a fax is:

- CTS is used by the Omni 288S to flow control the DTE. When the modem turns CTS off, the buffer inside the modem is full and cannot accept any more data. The computer should send data only when CTS is ON.

- RTS is used by the computer to signal the Omni 288S that the fax message is finished. As soon as RTS off is detected, the modem starts the post message handshaking to make sure that the remote facsimile has received the fax message successfully. Then it hangs up the phone and sends a status report to the DTE.

If you want to send a multi-page fax, just add the RTC signal between the fax message of two pages. The modem detects the RTC signal automatically, handshakes the multi-page procedure with the remote facsimile and sends the next page message.

The following flow control signaling is used while receiving a fax:

- CTS is not used when receiving fax.

- RTS is used to inform the Omni 288S that the computer cannot accept data at this moment. The modem will not pass received data to the DTE if RTS is turned off.

When finished receiving the fax message, the Omni 288S will turn off CD then send a status report result code to the DTE.

Fax Reception from a BBS

The Omni 288S can automatically detect data and fax calls and allow BBS software to receive faxes on the same phone line. To allow your BBS to receive incoming faxes, make the following set-up changes in your BBS:

1. Add the string #B1+FCLASS=6 to the init string. Be sure the +FCLASS=6 command is the last command.

2. Change one of the messages in the list to CONNECT FAX.

3. Set the external mail string to ZyXEL and give it an error level.

4. In your BBS batch file, if the error level matches the external mail, execute

   ```
   rcvfax 2 /p:comport [/w:workpath]
   ```

   This setting will enable the BBS to receive a fax and store it automatically.

The following is a sample setting for the FrontDoor system.

- Add these commands to the init string:

```
X7#B1+FCLASS=6
```

■   Change the connection message to:

300	CONNECT	4800	CONNECT 4800
1200	CONNECT 1200	9600	CONNECT 7200
1275	CONNECT FAX	19200	CONNECT 9600
2400	CONNECT 2400	38400	CONNECT 14400

■   Set external mail as:

String	Error Level
1 ZyXEL	100
2	
3	

The following is a sample setting in the BINKLEY.CFG file for a Binkley system.

```
Init AT&FX7S0=1#B1+FCLASS=6
```

```
ExtrnMail ZyXEL errorlevel
```

Chapter 10 - Voice Mode Operation

Voice mode refers to the Omni 288S's ability to digitize incoming voice messages, which the computer stores and forwards. It also means the modem can playback the recorded digitized voice either off-line for local message listening or on-line for a message announcement. For interactive voice applications, DTMF tone detection capability is important so a computer can react according to the remote caller's touch tone input. This Chapter summarizes the use of the Omni 288S's numerous voice features.

Voice Data Compression

The main issue in digitized voice mode is the amount of storage required. A good phone quality voice digitization will produce about 64 Kbits of data for each second of voice recording. At this digitization rate, the hard disk will be filled up quickly by digitized voice data. Speech compression is needed to reduce the rate of digitized data. A relatively simple ADPCM (Adaptive Differential Pulse Code Modulation) algorithm can reduce the speech data rate to half the rate and maintain about the same voice quality. This algorithm can also be used to reduce the speech data rate to 1/3 or 1/4 of the original rate, but with voice quality degradation. Reducing the speech data rate further and maintaining good voice quality requires a sophisticated and complicated signal processing algorithm. It also requires a lot of digital signal processing computation power.

The Omni 288S supports seven voice digitization schemes:

Compression Method	Bits/Sample	Rates (samples/second)
ZyXEL 2 ADPCM	2	7200, 8000, 9600, 11025
ZyXEL 3 ADPCM	3	7200, 8000, 9600, 11025
ZyXEL 3 ADPCM (new)	3	7200, 8000, 9600, 11025
ZyXEL 4 ADPCM	4	7200, 8000, 9600, 11025
DVI ADPCM	4	7200, 8000, 9600, 11025
A-law PCM	8	7200, 8000, 9600, 11025
u-law PCM	8	7200, 8000, 9600, 11025

> *Note:* *The New 3-ADPCM scheme is a 3-bit ADPCM scheme with added sync bits in the voice data. This helps to avoid loss of data synchronization due to data errors or data loss. It is the recommended 3-bit ADPCM scheme. It will automatically recover from data errors when playing without producing noisy voice signals.*

Automatic Detection of Voice, Data, Fax

Since there is no way to standardize the way a human voice should behave in telephone calling and answering, it is nearly impossible to automatically distinguish a voice call from a fax call from a data call. One common way of accomplishing this task is to combine the use of a digitally recorded voice message with DTMF tone detection. The voice message instructs the caller to press one number on the touch-tone keypad if they want to send a fax, or another number if they want to talk. By detecting which DTMF tone was sent, the modem and software can switch to the appropriate mode and handle your call accordingly. If no tone is received by the timeout, the Omni 288S will assume it is a data call and begin its modem handshaking process.

The shortcoming of this process is that some modems will be confused by the initial voice message portion, and will not be able to connect. Even if the data call is successfully connected, the long delay before handshaking may not be acceptable in some applications.

Some software packages use an initial period of silence when answering, and detect if there is voice energy to decide if it is a voice call.

The Omni 288S can recognize a fax or data call more quickly if a calling tone is received. In this case, the voice announcement can be omitted.

Voice Input/Output Devices

Microphone and Speaker Jacks

On the back of the Omni 288S, there are two jacks for external microphone and speaker connections. These jacks are convenient means for voice input/output. The speaker jack is capable of directly driving an 8 ohm speaker. When an external speaker is plugged into the speaker jack, the internal speaker is automatically shut off. The speaker jack only drives one speaker. If you have two speakers with a stereo plug, use a plug adapter that will enable both speakers to be driven by one source out of the speaker jack. If you are connecting the speaker jack output to an amplifier, insert some attenuation in between. The speaker jack output signal may be too strong for the amplifier.

Voice Input/Output Device Selection

To take advantage of the voice functions of the Omni 288S, you can use either the speaker and microphone jacks or the handset of any telephone. The voice input/output device selection is controlled by voice AT commands. Generally, the user makes input/output selection through application software packages according to the program's instructions. The user need not worry about using AT commands to make the selection. Below are some specific directions for cases where manual selection through AT commands are necessary.

Choose your Input/Output Device by typing the appropriate AT commands.

To select the telephone (connected to phone jack) as your I/O device, type:
```
AT+VLS=1<Enter>
```

To select the external microphone as your input device, type:
```
AT+VLS=8<Enter>
```

To select the modem internal speaker as your output device, type:
```
AT+VLS=16<Enter>
```

Note: *The external speaker simply replaces the internal speaker. As an output device. Device selection remains the same.*

Voice Mode Application Examples

Shown below are six examples of some common uses of the Omni 288S voice mode operation, and the AT command sequences used to initiate them. The voice application software you use will normally perform these functions automatically.

Recording a greeting message

Commands	DCE Responses	Description
AT+FCLASS=8	OK	Switch to voice mode.
AT+VSM=?	(reference table)	List the compression schemes
AT+VSM=4	OK	Select 4-bit ADPCM compression method.
AT+VLS=1	VCON	Activate the telephone set on the PHONE jack.
AT+VRX	CONNECT <DATA>	Start recording.
<DLE><!>	<DATA> <DLE><ETX> OK	Stop recording, and return to command state.
AT+VLS=0	OK	Deactivate the telephone on the PHONE Jack.
AT+FCLASS=0	OK	Return to data mode.

Playing a voice file through the internal speaker

Commands	DCE Responses	Description
AT+FCLASS=8	OK	Switch to voice mode.
AT+VSM=?	(reference table)	List the compression schemes
AT+VSM=2	OK	Select 2-bit ADPCM compression method.
AT+VLS=16	VCON	Activate internal speaker.
AT+VTX	<DATA> <DLE><ETX> OK	Start replay, then return to the command state.

Commands	DCE Responses	Description
AT+VLS=0	OK	Deactivate internal speaker.
AT+FCLASS=0	OK	Return to the data mode.

Plaing a voice file through the phone line

Commands	DCE Responses	Description
AT+FCLASS=8	OK	Switches to voice mode.
AT+VSM=?	(reference table)	List the compression schemes
AT+VSM=4	OK	Select 4-bit ADPCM compression method.
AT+VLS=2	VCON	Connect to line.
AT+VTX	CONNECT <DATA> <DLE><ETX>	Start replay.
	OK	Return to command state.
AT+VLS=0	OK	Deactivate line connection.
AT+FCLASS=0	OK	Return to the data mode.

Omni 288S as a Voice answering machine

Commands	DCE Responses	Description
AT+FCLASS=8	OK	Switch to voice mode.
AT+VSM=?	(reference table)	List the compression schemes
AT+VSM=4	OK	Select 4-bit ADPCM for greeting message.
AT+VLS=2	VCON	Connect to line.
AT+VTX	CONNECT <DATA>	Start to play greeting message.
	<DLE><ETX>	Return to command state.
	OK	
AT+VSM=2	OK	Change to 2-bit ADPCM for recording.
AT+VRX	CONNECT <DATA>	Start recording.
	<DLE>b *or* <DLE>q	DCE detects busy tone *or* long period of quiet.
<DLE><!>		Stop recording.
	<DATA> <DLE><ETX>	DCE delivers remaining data.
	OK	Return to command state.
AT+VLS=0	OK	Deactivate line connection.
AT+FCLASS=0	OK	Return to data mode.

Omni 288S as a Fax answering machine

Command	DCE Response	Description

Command	DCE Response	Description
AT+FCLASS=8	OK	Switch to voice mode.
AT+VSM=?	(reference table)	List the compression schemes
AT+VSM=4	OK	Select 4-bit ADPCM for greeting message.
AT+VLS=2	VCON	Connect to line.
AT+VTX	CONNECT	Start to play greeting message.
	<DATA>	
	<DLE>c *or*	T.30 fax calling tone *or*
	<DLE>'n'	DTMF digit 'n' detected.
	<DATA>	
	<DLE><ETX>	
	OK	Return to command state.
AT+FCLASS=2	OK	Switch to fax mode.
ATA	Try to handshake fax mode.	Answer fax call.

Omni 288S as a Data answering machine

Command	DCE Response	Description
AT+FCLASS=8	OK	Switch to voice mode.
AT+VSM=?	(reference table)	List the compression schemes
AT+VSM=4	OK	Select 4-bit ADPCM for greeting message.
AT+VLS=2	VCON	Connect to line.
AT+VTX	CONNECT	Start to play greeting message.
	<DATA>	
	<DLE><ETX>	
	OK	Return to command state.
AT+VSM=2	OK	Change to 2-bit ADPCM for recording.
AT+VRX	CONNECT	Start recording.
	<DATA>	
	<DLE>s	DCE detects silence.
<DLE><!>		Stop recording.
	<DATA>	DCE delivers remaining data.
	<DLE><ETX>	
	OK	Return to command state.
AT+FCLASS=0	OK	Switch to data mode
ATA	Try handshake data mode.	Answer data call.

Note: *If a modem data tone is detected (indicated by a <DLE>e response) , the modem should be switched to data mode.*

Voice States and Operation Modes

The Omni 288's Voice Mode DCE control interface adheres to the TIA TR29.2 committee IS-101 Interim Standard. ZyXEL is continuously enhancing its modems' voice capability and voice feature implementation. Please refer to future manual amendments or firmware release notes for updated details.

In ZyXEL Voice Mode, three states exist that correspond to the flow direction of voice data between the modem (DCE) and the computer (DTE). These are outlined in the table below.

Voice State	Data Flow Direction
Voice Command State	No data transfer other than event reports
Voice Data Reception State	Voice data transfer from DTE to the DCE
Voice Data Transmission State	Voice data transfer from DCE to the DTE

Note: Voice data DTE/DCE transfer is half-duplex.

The DCE may issue event detection reports at any time, regardless of the DCE state. These reports may be tone or cadence events such as calling tone. ZyXEL provides the Service Level C Event Detection Capabilities of IS-101 as follows:

Event Description	DCE Voice State
RING	Command
Ringback	Command
Fax or Data Answer (e.g., 2100 Hz)	Command
BUSY	Receive, and Command
DIALTONE	Receive, and Command
DTMF Received	Receive, Transmit, and Command
Fax Calling Tone	Receive, Transmit, and Command
Presumed Hang-up (SILENCE) Time-out	Receive
Presumed End of Message (QUIET) Time-out	Receive
Mandatory Receive Buffer Overrun	Receive
Mandatory Transmission Buffer Underrun	Transmit

Voice Command State

The DCE is in the Voice Command State and is ready to accept commands when the DCE is operating in voice mode. Additionally, the DCE must not be communicating with a remote station, or with any local devices capable of translating analog signals to voice (e.g., speaker), or voice signals to analog (e.g., microphone).

The DCE considers data transfers from DTE commands and returns responses back to the DTE after processing these commands. While doing so, the DCE also monitors the line which connects the DCE to remote stations or to local devices to detect events. The DCE later reports to the DTE, signals carried over the line, such as tones, as well as PSTN generated control and notification signals, such as ringing.

The Voice Command State provides several DTE options. The modem may wait for an unspecified time after playing a welcome message, or switch to other modes as part of a DTE call discrimination algorithm.

Voice Data States

The DCE is in Voice Data State when the DCE is operating in voice mode and is communicating with a remote station or with one or more local devices which are capable of translating analog signals to voice (e.g., speaker) or voice to analog (e.g., microphone). The DTE transfers data to the DCE for transmission to the remote station. The DCE transfers data to the DTE after reception from the remote station. The DCE monitors data and the control signals to detect events which the DCE later reports to the DTE pertaining to the line connecting the DCE to the remote station, and pertaining to requests from the DTE.

Voice Data State has two sub-states. These are Voice Transmission State and Voice Reception State.

Voice Data Transmission State

The DCE is in Voice Transmission State when the DCE receives digitized data from the DTE, converts the binary data into an analog signal, and transmits the analog signal to the remote station or to one or more local device destinations such as a speaker. While transmitting the data, the DCE:

1. monitors the line which connects the DCE to the remote station or to one or more local devices to detect events which the DCE reports to the DTE and

2. does not expect to receive, digitize, or process any incoming analog signals for transfer to the DTE. Events detected when monitoring are notification signals such as busy.

The Voice Data Transmission State is terminated by either of the following two methods:

1. The DCE receives a <DLE><ETX> shielded code from the DTE.

2. When a DTE/DCE inactivity time-out occurs.

After termination of the Voice Data Transmission State, the DCE will enter the Voice Command State.

Voice Data Reception State

The DCE is in the Voice Reception State when the DCE digitizes the analog signal from the remote station or from local device sources such as a microphone. The analog signal is converted into binary data, which is compressed or otherwise processed. The resulting data is transferred to the DTE. While receiving the data, the DCE:

1. monitors the line we which connects the DCE to the remote station or to one or more local devices t detect events which the DCE reports to the DTE. These events pertain to signals carried over the line such as tones, and to PSTN -generated control and notification signals such as ringing.

2. does not expect to receive digitized data from the DTE, perform conversion, or transmit the analog signal to the remote station or to one or more local devices.

The Voice Reception State is terminated by either of the following two methods:

1. The DCE receives <DLE><!> shielded code from the DTE.

2. The DCE receives characters other than <XON>, <XOFF> or a shielded code from the DTE.

After termination of the Voice Data Reception State, the DCE enters the Voice Command State.

Events and Actions with Shielded Code

Event Detection and Reporting

The voice mode may return many more event detection reports than the familiar RING result code used in data/fax modems. While in voice mode, the DCE can detect DTMF tones. The DCE will report the event to the DTE at the time of detection by inserting a <DLE> shielded code into the data to the DTE. The form of the report is <DLE><code>, where <code> can be one of the possible character values listed in the following table.

<code>	Event Report Description
<DLE> (0x10)	Two contiguous <DLE><DLE> codes indicate a single <DLE> in the data stream.
<SUB> (0x1A)	<DLE><DLE> in the data stream.
<DC2> (0x12)	Concatenate reception data streams. The DCE sends this code to indicate the start of a new voice data stream with the same parameters as the last stream for the purpose of a timing mark. The DCE resets its compressors before transmitting the data after the <DLE><DC2> codes. This resync generation timer is defined by the command AT+VSY.
<ETX> (0x3)	End Data State. The DCE sends this code to indicate the end of the voice data.
R (0x52)	Ring: The <DLE> shielded version of the RING result code
1 (0x31)	DTMF 1
2 (0x32)	DTMF 2
3 (0x33)	DTMF 3
4 (0x34)	DTMF 4
5 (0x35)	DTMF 5
6 (0x36)	DTMF 6

<code>	Event Report Description
7 (0x37)	DTMF 7
8 (0x38)	DTMF 8
9 (0x39)	DTMF 9
0 (0x30)	DTMF 0
A (0x41)	Extended Keypad DTMF A
B (0x42)	Extended Keypad DTMF B
C (0x43)	Extended Keypad DTMF C
D (0x44)	Extended Keypad DTMF D
* (0x2A)	Extended Keypad DTMF *
# (0x23)	Extended Keypad DTMF #
o (0x6F)	Buffer Overrun.
c (0x63)	T.30 fax calling tone (1100Hz). The time interval between reports is 4.0 seconds.
e (0x65)	Data modem calling tone (1300Hz). The time interval between report is 4.0 seconds.
h (0x68)	Line current break (local phone goes on-hook).
H (0x48)	Line current detected (local phone goes off-hook).
s (0x73)	Silence detected. The DCE has determined that there was no voice energy present at the beginning of the voice receiving session followed by a period of silence greater than the amount of time selected by the +VSD command.
q (0x71)	Quiet detected. The DCE has determined that there was voice energy present at the beginning of the voice receiving session followed by a period of silence greater than the amount of time selected by the +VSD command.
$ (0x24)	Bong Tone (300Hz for 1 second).
l (0x6C)	Loop current interruption. This may be a remote hang-up.
b (0x62)	BUSY. If the DCE continues to detect BUSY, it may report this event repeatedly. The delay between reports is 4.0 seconds.
u (0x75)	Transmission Buffer Underrun. The DCE will report this code if the DCE's buffer becomes empty without first receiving a <DLE><ETX> or a <DLE><CAN> command.
a (0x61)	Data answer tone. The delay between reports is 4.0 seconds.

Action Commands in Voice Data State

The DTE may initiate actions by inserting a <DLE> shielded code into the data to the DCE. The form of the action is <DLE><code>, where <code> is one of the character values listed in the following table:

<code>	Event Report Description
<NUL> (0x0)	Does nothing. The DTE can use the code to refresh the DTE/DCE Inactivity Timer, instead of XON.
<DLE> (0x10)	Two contiguous <DLE><DLE> codes indicate a single <DLE> is in the data stream.
<SUB> (0x1A)	<DLE><DLE> in the data stream.

<code>	Event Report Description
u (0x75)	Turn up the volume or gain by one unit.
d (0x64)	Turn down the volume or gain by one unit.
p (0x70)	Pause Data State: The DCE suspends sending analog data to the currently selected analog destination. While pausing, the DCE will maintain the contents of its internal buffer and the state of its compressors, continue in the Data State, and send silence to the analog destination.
r (0x72)	Resumes Data Transmission State: The DCE resumes sending the contents of the DCE buffer to the currently selected analog destination. Before resuming sending the analog signal to the analog destination, the DCE will not reset the contents of its internal transmission buffer, nor reset the compressors.
<ETX> (0x3)	Ends Data Transmission State: The DTE sends this code to signify the end of the voice data from the DTE and cause the DCE to return to the Voice Command State. The DCE will complete the transmission of the contents of its buffer before switching to the Voice Command State and returning the OK result code
<DC4> (0x14)	Clears the transmission buffer of voice data and ends Data Transmission State: The DTE sends this code to indicate the end of the voice data from the DTE and cause the DCE to return to the Voice Command State. The DCE will clear its internal transmission buffer before switching to the Voice Command State and returning the OK result code.
<CAN> (0x18)	Clears the transmission buffer of voice data: This code commands the DCE to (1) clear its internal transmission buffer; (2) get ready for a new voice data stream with the same parameters as the last stream; and (3) reset its compressors and send silence over to the analog destination while paused.
<FS> (0x1C) or <DC2> (0x12)	Concatenate data streams: The DTE sends this code to indicate the start of a new voice data stream with the same parameters as the last stream without first returning to the Voice Command State. The DCE will transmit the remainder of its internal transmission buffer and reset its compressors before transmitting the data following the <DLE><FS> or <DLE><DC2> codes.
! (0x21)	Ends Data Reception State. The DTE sends this code to indicate the end of voice data reception and the return to Voice Command State. The DCE will discard the contents of its buffer before switching to the Voice Command State and returning the OK result code.

Voice AT Commands

The following is a summary of voice AT commands supported by the Omni 288:

AT Command Syntax

AT is the command line prefix. Voice commands take one of the following forms:

Command-Form Syntax	Command-Form Function
+V<CM>?	Read current setting.
+V<CM>=?	Read permissible settings.
+V<CM>=<string>	Set single-value parameter.
+V<CM>=<value_string>	Set compound parameter.

Voice AT commands begin with 'AT' followed by a '+V' command prefix. <CM> represents the command character/s. The command parameters can are made up of <value> and/or <value_string> parameter types. The <value_string> type consists of multiple values separated by commas or semicolons.

The first two command-forms are for read actions, the last two are for write actions. A command line may contain either or both action types or be of the read or write type only.

Response Syntax

For each command line received, the modem issues a response to each command in the command line followed by a final response.

Each command response is of the form:
    <CR><LF>

    <value>*(or)* <value range> (for ? or =? read commands)

    <CR><LF>

with a final response of:
    <CR><LF>

    OK *(or)* ERROR

    <CR><LF>

The final response is OK if all the commands in the command line have been successfully executed, otherwise it is ERROR.

   Note: <CR><LF> characters will not be shown in further examples.

Flow Control

Flow Control is necessary to match the DTE-DCE data rate to the line signaling rate and to the analog conversion of the voice signals and data. For the Omni 288S, both software XON/XOFF and hardware RTS/CTS flow control are used - the software flow control is the default setting. The DTE turns off the flow control, but some other method may be used to avoid overrun of the buffer.

The DTE can select the flow control method in voice mode by using the +FLO command (defined in Class 2 and 2.0).

Supported Commands in Voice Mode Operation

■ **ATD (with +FCLASS=8)**

This command causes the DCE to dial a phone number. The DCE uses the current destination setting to perform a dial action. If +VLS is equal to zero at the time of the ATD command, the DCE will return an ERROR result code.

The DCE attempts to determine when the remote station has gone off-hook by ringback detection and disappearance (see the +VRA and +VRN commands, respectively). Once the DCE has determined with high confidence that the remote station has gone off hook, the DCE returns the OK result code. For example, the DCE reports this result code when the DCE has determined on answer that the remote station is a data modem. The DCE may also issue this result code when the DCE has assumed that the remote station has gone off-hook by actions associated with the +VRA and the +VRN commands.

The DCE issues the NO ANSWER result code when the DCE has continuously detected ringback for the amount of time specified in S-register S7.

■ **ATH (with + FCLASS=8)**

This command causes the DCE to hang up the phone. In voice mode, this command is equivalent to the +VLS=0 command, and the DCE to the data mode (+FCLASS=0) with auto-baud, regardless of the state of the +VNH command. When the +VNH=0 command is in effect and the DCE is not in voice mode, the ATH command behaves as for the data mode.

This command does not change any of the voice mode parameters such as +VSM, +VSD, etc. When the +VNH=1 or +VNH=2 command is in effect and the DCE is not in voice mode, the DCE issues an OK result code as a result of the ATH command, but the DCE may or may not go on-hook depending on the setting of the +VNH command. As part of the call discrimination algorithm, the DCE may switch to other modes, such as facsimile or data, in order to try handshakes in these modes. Voice mode does not support the ATH1 command.

■ **AT+FCLASS=<mode>**

This command selects a DCE mode. Either data, fax, or voice. The DCE recognizes the value of 8 as the Voice Mode.

<mode>	DCE mode
0	Data Mode
1	Fax Mode, Service Class 1 (TIA/EIA-578)
2	Fax Mode, Service Class 2 (TIA PN-2388)
2.0	Fax Mode, Service Class 2.0 (TIA/EIA-592)
6	Fax Mode, ZyXEL Fax AT Commands

8	Voice Mode (TIA IS-101)

The DCE returns the OK result code if the DCE accepts the command. The DCE returns the ERROR result code if the <mode> subparameter is not permitted.

■   **AT+FCLASS?**

The DCE returns the current mode setting followed by the OK result code.

■   **AT+FCLASS=?**

The DCE returns permitted modes. The response is (with S57.4=1):

```
0,1,2,2.0,6,8,Z

OK
```

■   **AT+VLH=?**

This enables the DTE to inquire the hook status of the connected local phone. The DCE will return 0 for on-hook and 1 for off-hook status.

■   **AT+VNH=<hook>**

The DCE enables or disables automatic hang-up to a varying degree for data and fax modes.

<hook>	Hook Control Description
0	The DCE retains automatic hang-ups as is normal in the other mode such as hanging up the phone when the DCE does not detect a data carrier within a given time interval). (Default)
1	The DCE disables automatic hang-ups usually found in the other Non-Voice Mode.
2	The DCE disables automatic hang-ups in the other Non-Voice Mode. The DCE only performs a "logical" hang-up (returns the OK result code).

■   **AT+VNH?**

The DCE returns the current hang-up setting, followed by the OK result code.

■   **AT+VNH=?**

The DCE returns permitted hang-up modes. The response is :

```
0,1,2

OK
```

■   **AT+FLO=<method>**

The DCE selects the type of flow control provided and used.

<method>   Flow Control Method

<method>	Flow Control Method
0	XON/XOFF and RTS/CTS flow control turned off
1	Use software XON/XOFF flow control in either direction.
2	Use hardware RTS/CTS flow control.

The DCE returns the OK result code if the DCE accepts the command. The DCE returns the ERROR result code if the <method> subparameter is out of range.

■   **AT+FLO?**

The DCE returns the current flow control setting, followed by the OK result code.

■   **AT+FLO=?**

The DCE returns permitted flow control methods. The response is:

```
0,1,2
OK
```

Voice Mode Action Commands

■   **AT+VIP**

The DCE will initialize all voice parameters to the default settings as follows:

Parameter	Related Commands	Default Value
Silence threshold	+VSD	15
Hang-up code	+VNH	0
Compression method	+VSM	2 (2-bit ADPCM)
Beep tone interval	+VTD	50 (unit: 10 ms)
Inactivity timer	+VIT	70 (unit: 0.1 s)
Silence interval	+VSD	70 (unit: 0.1 s)
Ringback timer	+VRA	70 (unit: 0.1 s)
Ringback timer	+VRN	10 (unit: 1 s)
Reception Gain	+VGR	0
Transmission Gain	+VGT	128
Resync timer	+VSY	0 (disabled)
DTMF detection intervaland threshold	+VDD	8 (unit: 5 ms) 5
Flow control method	+FLO	1 (software)

The DCE returns the OK result code if DCE accepts this command or returns the ERROR result code if the DCE is not connected

■   **AT+VRX**

The DCE starts the voice reception process by first returning the CONNECT result code to the DTE. After this is reported, the DCE sends <DLE> shielded voice data to the DTE. There are three ways to leave the Voice State:

1.   The DTE sends a character other than <XON>, <XOFF> or a shielded code.

2. The DTE sends a <DLE><!> shielded code.

3. A DTE/DCE Inactivity Timer time-out.

Upon termination of the voice state, the DCE will append a <DLE><ETX> character pair, followed by the OK result code. The DCE then returns to Voice Command State.

The Inactivity Timer is in effect while the reception operation is in progress. If the DTE wishes to use this timer and stop the DCE from performing unwanted restarts, the DTE must assure that there is data sent from the DTE to the DCE often enough to refresh the timer; the DTE may use the <DLE><NUL> shielded code as a no-operation command to refresh the timer.

■ **AT+VTS=<string>**

This command causes the DCE to issue DTMF single frequency tones, and optionally, double frequency tones. The DCE accepts <DLE><!> to abort playing tones, the OK result code, and to the Voice Command State.

The tone generation string consists of elements in a list with each element separated by a comma. Each element can be:

1. A single ASCII character in the set 0-9, A-D, #, and *. The DCE interprets the single ASCII character as a DTMF digit with a duration given by the +VTD command.

2. A string enclosed in square brackets, "[ ]." The DCE interprets the values in square brackets as a general dual tone and duration selection. The quantity within the square brackets consists of a three element list. The first element is the first frequency, the second element is the second frequency, and the third element is the tone duration in 10 ms intervals.

3. A string enclosed in curly braces, "{ }." The DCE interprets the quantity in the braces as a DTMF tone with a different duration than that given by the +VTD command. The quantity in the curly braces consists of a two element list. The first element is the DTMF tone character and the second element is the tone duration in 10 ms intervals. For every inter-element comma in the list, the DCE pauses for an interval set by the +VTD command.

■ **AT+VTS=?**

This command causes the DCE to report the allowable tone frequency range and duration range. The Omni uses two tones, both in the frequency range of 20 to 4800 Hz, and a duration range from 0 to 10 seconds. The response is as follows:

```
(20-4800),(20-4800),(0-1000), 0-9, A-D, *, #

OK
```

■ **AT+VTX**

This command causes the DCE to start the voice transmission process. The DCE begins the Voice Transmission Mode by returning the CONNECT result code to the DTE. After this report, the DCE accepts <DLE> shielded voice data from the DTE. The DTE shall send the data in the format previously selected by the +VSM command and use the flow control method selected by the +FLO command.

There are two ways to leave the Voice Transmission State:

1.   The DTE sends a <DLE><ETX> shielded code.

2.   A DTE/DCE Inactivity Timer time-out.

Item (1) is the DTE initiated means of terminating the Voice Transmission State, and item (2) is a DCE-initiated means of terminating the Voice Transmission State. Upon termination of the Voice Transmission State, the DCE sends the OK result code and returns to Voice Command State.

Voice Mode Configuration Commands

■   **AT+VGR=<gain>**

This command causes the DCE to set the gain for the received voice samples. The gain is an unsigned octet value. The normal value is 128. A value larger than 128 indicates a larger gain than normal, and a value smaller than 128 indicates a gain smaller than normal. A gain value of 56 corresponds to -18 dB gain, 128 for 0 dB, and 200 for 18 dB, in 0.25 dB steps. A value of zero invokes Automatic Gain Control on the DCE. The gain range is 56 to 200 and the default value is 0.

The DCE returns the result code OK if DCE accepts this command, or it returns the result code ERROR if the <gain> parameter is out of range.

■   **AT+VGR?**

The DCE will return current gain, followed by the OK result code.

■   **AT+VGR=?**

The DCE will return all permitted values for the gain. The response is:

```
56-200

OK
```

■   **AT+VGT=<level>**

This command causes the DCE to set the volume level, either by amplifying or attenuating the signal, for the transmitted voice samples. The transmission gain (or attenuation) is an unsigned octet value. The default value is 128. A value larger than 128 indicates a larger gain than normal, and a value smaller than 128 indicates a gain smaller than normal. The level range is 56 to 200. A gain value of 56 corresponds to -18 dB gain, 128 for 0 dB, and 200 for 18 dB, in 0.25 dB steps.

The DCE returns the result code OK if DCE accepts this command, or it returns the result code ERROR if the <level> parameter is out of range.

- **AT+VGT?**

The DCE returns the current gain, followed by the OK result code.

- **AT+VGT=?**

The DCE returns permitted values for the gain. The response is:

```
56-200

OK
```

- **AT+VIT=<timer>**

This command sets the inactive time-out value for the DTE/DCE Inactivity Timer. The default value is 7 seconds. Acceptable values are 0 to 255 with a unit of 0.1 second. The DTE can disable the Inactivity Timer by setting the value to zero.

The DCE returns the OK result code if DCE accepts this command, or it returns the ERROR result code if <timer> is out of range.

- **AT+VIT?**

The DCE returns the current Inactivity Timer timeout value, followed by the OK result code.

- **AT+VIT=?**

The DCE returns the permitted Inactivity Timer timeout values. The units are in 0.1 seconds. The response is :

```
0-255

OK
```

- **AT+VLS=<device>**

This command causes the DCE to select a voice I/O device. The permitted <device> is as follows:

<device>	Description
0	No voice I/O devices connected. Local phone connects to telco line. The DCE is on-hook.
1	Voice I/O through local phone connected to POTS Port. Local Phone provided with power to detect hook condition. The DCE is on-hook.
2	Voice I/O through Telco Line. The DCE is off-hook.
8	Voice Input through External Microphone. Local phone connects to Telco Line. The DCE is on-hook.
16	Voice output to Internal Speaker. Local Phone connects to Telco Line. The DCE is on-hook.

The DCE returns the VCON result code (returns OK if S48.5=1) if the DCE accepts this command, or it returns the ERROR result code if the <device> value is not permitted.

■ **AT+VLS?**

The DCE will return the current I/O device followed by the OK result code.

■ **AT+VLS=?**

The DCE will return permitted I/O devices. The response is:

```
0,1,2,8,16

OK
```

■ **AT+VSD=<sds>,<sdi>**

This command causes the DCE to set the silence detection sensitivity and the required period of silence before the DCE can report silence detected at the end of a voice reception either with the "Presumed End of Message" (QUIET) or "Presumed Hang-up" (SILENCE) event reports.

> **<sds>:** DCE silence detection threshold level a larger value of this subparameter implies that the DTE wants the DCE to treat noisier condition as silence. The actual value of this subparameter has no physical meaning. The range of the sensitivity <sds> is from 0 to 31. A value of zero disables the silence detection. The default value is 15.

> **<sdi>:** The required period of silence before the DCE can report silence detected either with the "Presumed End of Message" (QUIET) or "Presumed Hang-up" (SILENCE) event report. A value of zero disables the DCE silence detection. The range of the interval <sdi> is from 0 to 255 in units of 0.1 seconds. The default value is 70 (7 seconds).

The DCE returns the OK result code if DCE accepts this command, or it returns the ERROR result code if <sds> or <sdi> is out of range.

■ **AT+VSD?**

This command causes the DCE to report current <sds> and <sdi> settings. The form of the response is:

```
<sds>,<sdi>

OK
```

■ **AT+VSD=?**

This command causes the DCE to report the permitted range of <sds> and <sdi>. The response is:

```
(0-31),(0-255)
```

```
OK
```

■ **AT+VSM=<cml>,<vsr>**

This command causes the DCE to select a compression scheme and sample rate as follows:

<cml>	Compression Scheme	Bits/Sample	<vsr> possible values
2	ZyXEL 2 ADPCM	2	7200, 8000, 9600, 11025
3	ZyXEL 3 ADPCM	3	7200, 8000, 9600, 11025
30	ZyXEL 3 ADPCM (new)	3	7200, 8000, 9600, 11025
4	ZyXEL 4 ADPCM	4	7200, 8000, 9600, 11025
40	DVI ADPCM	4	7200, 8000, 9600, 11025
80	A-law PCM	8	7200, 8000, 9600, 11025
81	u-law PCM	8	7200, 8000, 9600, 11025

The DCE returns the OK result code if DCE accepts this command, or it returns the ERROR result code if any of the values are out of range.

Chapter 11 - AT Command Set Summaries

Basic AT Command Set

Command	Options	Function & Description	Ref.
A/		Re-execute the last command once	
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 modem 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)	
Bn		Handshake option	S28.7
	B0 *	Select CCITT V.22 for 1200 bps	
	B1	Select Bell 212A for 1200 bps communication	
Ds		Dial s (numbers and options) that follow (see also S38.0, S35.4). The options of s are listed as follows:	
	0-9, #, *	Digits for dialing	
	P	Pulse dialing	S23.1
	T	Ton dialing	S23.1
	,	Pause for a time specified in S6. Remaining digits will be dialed as in-band DTMF.	
	;	Return to command state after dialing	
	!	Hook flash	
	@	Wait for a 5 second silence before proceeding	
	R	Reverse handshake (go on-line in Answer mode)	S17.5
	W	Wait for second dial tone. Remaining digits will be dialed as in-band DTMF	
DL		Repeat last ATD command	
DSn	n=0-49	Dial number stored in non-volatile RAM at location 'n'; use "+" to dial two consecutive numbers for bundling or MPPP calls	S44.3
En		Command mode local echo of keyboard commands	S23.0
	E0	Echo off	
	E1 *	Echo on	
Hn		On/off hook control	
	H0 *	Hang up (on-hook) the modem or ISDN, same as 'ATH'	
In		Display inquired information	
	I0	Display numerical product code, same as 'ATI'	
	I1	Display product information and ROM checksum	
	I2	Display modem link status report	
Ln	n=0-7 4 *	Speaker volume control. The higher the value, the higher the volume	S24.5-7
Mn		Speaker control	S21.1-2
	M0	Speaker always OFF	
	M1 *	Speaker ON until call is answered	

Command	Options	Function & Description	Ref.
	M2	Speaker always ON	
	M3	Speaker ON after the last digit is dialed out and OFF when carrier is detected	
N*n*	n=0-7 5 *	Ring volume control.'N0' will disable the audio ring function	S24.1-3
O		Return to on-line state	
O1		Force modem to request a retrain	
Q*n*		Result code displayed	S23.7
	Q0 *	Modem returns result code	
	Q1	Modem does not return result code	
	Q2	Modem returns result code but quiet after answering on a RING (see also S42.2)	S40.1
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'	
T		Ton dial	S23.1
UPX		Download firmware to the Flash EPROM usin 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 modem and set power-on profile.	S15.5-7
	Zn	Reset modem and load user profile n (0-3).	
	Z4	Reset modem and load factory settings.	
$		Basic command summary help	

Description of ATI2 Output:

The Link Status Report output appears as follows:

```
ZyXEL MODEMS LINK STATUS REPORT

Chars Sent          0     Chars Received     0
Octets Sent         0     Octets Received    0
Blocks Sent         0     Blocks Received    0
Blocks Resent       0     Max Outstanding    0
Max Block Size      0     Retrains Requested 0
Link Duration       0     Retrains Granted   0
FRN Requested       0     FRN Granted        0
FCS Errors          0     Round Trip Delay   0
Xmitter Underrun    0     Receiver Overrun   0
Last Speed/Protocol 14400

Disconnect Reason      Local hang up
```

Data Type	Description
Chars	Data received from or sent to DTE (PC). (Formatted as 7,E,1 or 7,O,1 or 8,N,1 etc.)
Octets	Data received from or sent to remote modem in error control mode. (Compressed if data compression was enabled.)
Block	Framed Octets. (Delimited by the unique bit pattern "01111110" known as a flag.)

Output Parameter	Output Value Description	
Chars Sent	Number of characters DTE has sent to modem	
Chars Received	Number of characters modem has sent to DTE	
Octets Sent	Number of data bytes sent to remote modem	
Octets Received	Number of data bytes received from remote modem	
Blocks Sent	Number of data blocks sent to remote modem	
Blocks Received	Number of data blocks received from remote modem	
Blocks Resent	Number of blocks resent due to remote modem request. (If there were many blocks resent, you may have experienced line trouble or protocol incompatibility.)	
Max Outstanding	Maximum blocks received without acknowledgment by remote modem.	
Max Block Size	Maximum octets contain in a block	
Retrains Requested	The number of times local modem requested retrain.	
Link Duration	Total link duration time (in minutes).	
Retrains Granted	The number of times remote modem requested retrain.	
T401 Time-outs	For protocol maintenance, modem probably recovered.	
T402 Time-outs	For protocol maintenance, modem probably recovered.	
FCS Errors	Errors in frame (block) checksum. (If there were many FCS Errors, you may have experienced problems on the line.)	
Round Trip Delay	Time (Units 1/2400 sec.)	
Xmitter Un-derrun	For modem's processor power measurement.	
Receiver Overrun	For modem's processor power measurement.	
Disconnect Reason	Local Hang-up	Remote Hang-up
	Carrier Lost	On-Line (Not disconnected)
	Resent Expiration	Protocol Error
	Break Time-out	DTR Dropped
	Carrier Lost 1 (No handshaking response)	Carrier Lost 2 (Remote hang-up, busy tone)

Extended AT& Command Set

Command	Options	Function & Description	Ref.
&Bn		Data rate, terminal-to-modem. (DTE/DCE)	S28.6
	&B0	DTE rate follows connection rate. (See also S44.6)	
	&B1 *	DTE/DCE rate fixed at DTE setting (See also S18, S20, and S44.6)	
&Cn		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)	
&Dn		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 modem to hang up.	
	&D3	Same as &D2 but DTR OFF causes the modem to hang up and reset from profile 0.	
&F		Load factory settings to RAM as active configuration.	
&Gn		Guard tone options	S28.4-5
	&G0 *	No guard tone (within USA, Canada).	
	&G2	1800 Hz guard tone.	
&Hn		Data flow control, DTE/DCE.	S27.3-5
	&H0	Flow control disabled.	
	&H3 *	Hardware (CTS/RTS) flow control	
	&H4	Software (XON/XOFF) flow control.	
&Jn		Type of Phone line	S28.0
	&J0	Single phone line, RJ11	
	&J1	Multiple phone/modem line, RJ12/RJ13	
&Kn		Modem error control and data compression.	S27.0-2
	&K0	No error control.(Same as AT&K)	
	&K1	MNP4 (See also S41.0).	
	&K2	MNP4+MNP5 (See also S38.5, S41.0).	
	&K3	V.42+MNP4.	
	&K4 *	V.42+V.42bis, compatible with &K2 (See also S38.5).	
&Ln	&L0 *	Dial-up line	S14.2-3
	&L1	2W leased line	
	&L2	4W leased line, if available	
&Mn		Synchronous/asynchronous mode selection	S14.6-7
	&M0 *	Asynchronous mode with data buffering	
	&M1	Asynchronous command, synchronous data	
	&M2	Direct asynchronous mode, no data buffering	
	&M3	Synchronous mode	
&Nn		Modem link mode options (DCE/DCE). (See also S43.7, S48.1)	S19

Command	Options	Function & Description	Ref.
	&N0 *	Multi-Auto, auto negotiate highest possible link rate: V.34, ZyX 19200, ZyX16800, V.32bis, V.32, V.22bis, V.22 and Bell 212A, G3 Fax V.17/V.29/V.27ter and cellular modes. (See also S38.4, S43.0, S43.1, S43.3 and S48.5)	
	&N3	V.32 9600T/9600/7200T/4800	
	&N4	V.32 9600/7200/4800	
	&N5	V.32 4800	
	&N12	V.23 1200/75 (See also S48b3, S52b7)	
	&N13	V.23 600/75 (See also S52b7)	
	&N14	V.22bis 2400/1200	
	&N15	V.22 1200	
	&N16	V.21 300	
	&N17	V.32bis 14400/12000/9600/7200/4800	
	&N18	V.32bis 12000/9600/7200/4800	
	&N19	V.32bis 7200/4800	
	&N24	BELL 212A 1200	
	&N25	BELL 103 300	
	&N32	G3 Fax V.17/V.29/V.27ter 14400/12000/9600/7200/4800/2400 (See also S42.4).	
	&N34	ZyXEL 19200	
	&N35	ZyXEL 16800	
	&N36	ZyXEL 14400	
	&N37	ZyXEL 12000	
	&N38	ZyXEL 9600	
	&N39	ZyXEL 7200	
	&N42	CELL 14400	
	&N43	CELL 12000	
	&N44	CELL 9600	
	&N45	CELL 7200	
	&N46	CELL 4800T	
	&N62	V.34 28800	
	&N63	V.34 26400	
	&N64	V.34 24000	
	&N65	V.34 21600	
	&N66	V.34 19200	
	&N67	V.34 16800	
	&N68	V.34 14400	
	&N69	V.34 12000	
	&N70	V.34 9600	
	&N71	V.34 7200	
	&N72	V.34 4800	
	&N73	V.34 2400	
&Pn		Pulse dial make/break ratio	S23.2
	&P0 *	make / break, 39% / 61%	
	&P1	make / break, 33% / 67%	
&Rn		RTS (Request To Send) function selection	S21.5

Command	Options	Function & Description	Ref.
	&R0	CTS tracks RTS, response delay is set in S26	
	&R1 *	Ignore RTS, assumes RTS always ON	
&Sn		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)	
&Tn		Modem testing.	
	&T0	Terminate test in progress.	
	&T1	Initiate Analog Loop-back (ALB) test.	
	&T3	Initiate Local Digital Loop-back (LDL) test	
	&T4	Grant Remote Digital Loop-back request from remote modem	
	&T5	Deny Remote Digital Loop-back request from remote modem	
	&T6	Initiate Remote Digital Loop-back (RDL) test	
	&T7	Initiate Remote Digital Loop-back with self test (RDL+ST)	
	&T8	Initiate Analog Loop-back with self test. (ALB+ST)	
&Vn		View profile settings.	
	&V0	View current active settings.	
	&Vn	View the (n-1) user profile settings (n=1-4)	
	&V5	View factory default settings.	
&Wn	n=0-3	Write current settings to user profile n in non-volatile RAM. (See also S35.6)	
&Xn		Synchronous mode timing (clock) source selection	S14.4-5
	&X0 *	Modem provides synchronous transmit clock signal (Internal clock to pin 15 of EIA-232D)	
	&X1	Terminal provides synchronous transmit clock signal (External clock from pin 24 of EIA-232D)	
	&X2	Received carrier provides synchronous transmit clock signal (Remote or Slave clock to pin 15 of EIA-232D)	
&Yn		Break handling. Destructive Break clears the buffer. Expedited Break is sent immediately to the remote system. (For internal modem only.)	S28.2-3
	&Y0	Destructive, expedited.	
	&Y1 *	Nondestructive, expedited.	
	&Y2	Nondestructive, unexpedited.	
&Z?		Display all the phone numbers stored in non-volatile RAM.	
&Zn=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.	

Extended AT* Command Set

Command	Options	Function & Description	Ref.
*Cn		Character length, including start, stop and parity bit.	S15.3-4
	*C0 *	10-bit character length.	
	*C1	11-bit character length.	
	*C2	9-bit character length.	
	*C3	8-bit character length.	
*Dn	n=0-49	Set default dial pointer at telephone directory location n.	S29
	*D0 *	(See also S35.4 and S38.0)	
*En		Modem error control negotiation.	S21.0
	*E0 *	if error control negotiation fails, keep the non-error control connection.	
	*E1	If error control negotiation fails, disconnect the call (hang-up).	
*Fn		Remote configuration enable	S36.0
	*F0	Deny remote configuration	
	*F1	Accept remote configuration (Remote Digital Loop-back must be granted, &T4)	
*Gn		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 user enters the call back number	
*Hn	n=0-39	Modify user password table at location n.	
*HS		Modify supervisory password (Default: "ZyXEL")	
*In		Command set selection	S17.6-7
	*I0	AT command set	
	*I1	V.25bis command set	
	*I2	Dumb mode	
*Mn		Leased line auto-handshake mode selection	S14.0
	*M0	Set to Originate mode	
	*M1	Set to Answer mode	
*Pn	n=0-15	Set leased line transmission power level; ranges from 0 dBm to -15 dBm (default: -9 dBm) (see also S35.3)	S17.1-4
	*P9 *		
*Qn		Action taken when line quality changes.	S27.6-7
	*Q0	No action to poor signal quality.	
	*Q1	Retrain action taken if signal quality is poor. (See also S41.2)	
	*Q2 *	Adaptive rate, automatic fall-back or forward.	
	*Q3	Disconnect if signal quality is poor.	
*Rab		Read remote profile "b" to local user profile "a"	S36.1

Command	Options	Function & Description	Ref.
	a=0-3	Local user profile number "a"	S37.4-7
	b=0-3	Remote user profile number "b"	S37.0-3
	b=4	Remote active configuration	
	b=5	Remote factory default configuration	
*T		Recall the last CND (Caller ID) information.	S40.2
*V		View the Password table	
*Wab		Write local configuration profile "a" to remote user profile "b" and reset remote modem from profile "b"	S36.1
	a=0-3	Local user profile number "a"	S37.4-7
	a=4	Local active configuration	
	a=5	Local factory default configuration	
	b=0-3	Remote user profile number "b"	S37.0-3

The AT+F commands are located in the chapter on Fax Operation.

The AT+V commands are located in the chapter on Voice Mode Operation.

Chapter 12 - Status Registers & Result Codes

S-Register Descriptions

In most bit-mapped S-registers, the default bit value is 0. Non-0 default values are followed by an asterisk. In some cases, default values are shown in the refence column preceded by +. Some bits are reserved for factory use and should not be changed.

Basic S-Registers "ATSn=x"

Command	Function & Description	+Ref.
S0=	Set the number of rings on which the modem will answer. 0 value disable auto-answer	+000
S1=	Counts and stores number of rings from an incoming call	+000
S2=	Define escape code character, default '+' (43 dec.). A value of 128-255 disables the escape code	+043
S3=	Define ASCII Carriage Return	+013
S4=	Define ASCII Line Feed	+010
S5=	Define ASCII Backspace. A value of 128-255 disables the Backspace key's delete function	+008
S6=	Set the number of seconds the modem waits before dialing if 'X0' or 'X1' is selected. If a setting of 'X2' to 'X7' is selected, the modem will dial as soon as it detects a dial tone. This register also sets the time-out interval for the "W" dial modifier to wait for the dial tone. (See also S41b4)	+003
S7=	Set duration, in number of seconds modem 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
S9=	Set duration, in tenths of a second of remote carrier signal before recognition (Ignored if in non-FSK or half-duplex operation)	+006
S10=	Set duration, in tenths of a second, modem waits after loss of carrier before hanging up	+007
S11=	Set duration and spacing, in milliseconds, of dialed Touch-Tones	+070

Extended S-Registers "ATSn=x"

Command	bit	dec	hex	Function and description	Ref.
S13=	bit	dec	hex	Bit-mapped register	+000
	1	2	2	Capture modem manufacturer information during V.42 handshake, can be displayed at ATI2 <Last Speed/Protocol> line if available ('Flash' or ' ZyXEL' stands for ZyXEL connection)	
S14=	bit	dec	hex	Bit-mapped register:	+002
	0	0	0	Modem auto-handshake on Originate mode	
		1	1	Modem auto-handshake on Answer mode	
	1	0	0	Grant Remote Digital Loop-back test request	&T4
		2	2	Deny Remote Digital Loop-back test	&T5
	3,2	0	0	Dial-up line (Default)	&L0
		4	4	2-wire leased line	&L1

Command	bit	dec	hex	Function and description	Ref.
		8	8	4-wire leased line - if available	&L2
	5,4	0	0	Internal clock (Default)	&X0
		16	10	External clock	&X1
		32	20	Remote clock	&X2
	7,6	0	0	Asynchronous data with buffering (Default)	&M0
		64	40	Asynchronous command, synchronous data	&M1
		128	80	Direct asynchronous, no data buffering	&M2
		192	C0	Synchronous	&M3
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 character length	*C1
		16	10	9 bit character length	*C2
		24	18	8 bit character length	*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
		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
		1	1	Loop-back test in progress	&T1
		3	3	Local Digital Loop-back test in process	&T3
		6	6	Remote Digital Loop-back test in process	&T6
		7	7	Remote Digital Loop-back with self-test in process	&T7
		8	8	Analog Loop-back with self test in progress	&T8
S17=	bit	dec	hex	Bit-mapped register	+018
	4-1	0-30	0-1E	Set leased line transmit power level from 0 to - 15 dBm. (See also S35b3) (Default *P9)	*Pn
	5	0	0	Normal dial (Default)	D
		32	20	Reverse dial, go on-line in answer mode.	DR
	7,6	0	0	AT Commands set (Default)	*I0
		64	40	V.25bis command set	*I1
		128	80	Dumb mode (no command accepted)	*I2
S18=		dec	hex	Force modem or TA to fix baud rate when idle	+000
		0 *	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	
S19=		dec	hex	Modem connection mode, same	+000/& Nn
		0-73	0-49	setting value as 'AT&Nn' command	

Command	bit	dec	hex	Function and description	Ref.
S20=		dec	hex	DTE speed (bps). Auto detected from AT Command	+003
		0	0	230400 bps	
		1	1	115200 bps (Default)	
		2	2	76800 bps	
		3	3	57600 bps	
		4	4	38400 bps	
		5	5	19200 bps	
		6	6	16800 bps	
		7	7	14400 bps	
		8	8	12000 bps	
		9	9	9600 bps	
		10	A	7200 bps	
		11	B	4800 bps	
		12	C	2400 bps	
		13	D	1200 bps	
		14	E	460800 bps	
		15	F	300 bps	
		16	10	307200 bps	
		17	11	153600 bps	
		18	12	102400 bps	
		20	14	61440 bps	
		21	15	51200 bps	
		22	16	624000 bps	
		24	18	124800 bps	
		25	19	62400 bps	
		26	1A	41600 bps	
		27	1B	31200 bps	
		28	1C	24960 bps	
		29	1D	20800 bps	
		46	2E	921600 bps	
Note: Only the speeds up to S20=14 are supported by auto speed detection.					
S21=	bit	dec	hex	Bit mapped register	
	0	0	0	Maintain non-error control connection when modem error control handshake fails	*E0
		1	1	Drop connection when modem error control handshake fails	*E1
	1-2	0	0	Speaker always OFF	M0
		2	2	Speaker ON until carrier is detected	M1
		4	4	Speaker always ON	M2
		6	6	Speaker ON after last digit is dialed out until carrier detected	M3
	3	0	0	DSR always ON	&S0
		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 carrier (see also S38.3)	&C1

Command	bit	dec	hex	Function and description	Ref.
	5	0	0	CTS Follows RTS in synchronous mode. Response delay set in S26	&R0
		32	20	Ignore RTS (CTS always ON) in synchronous mode. (Default)	&D2
	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 modem to hang up and return to command state	&D2
		192	C0	108.2, DTR OFF causes the modem to hang up and reset the modem 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
	1	0	0	Tone dial. (Default)	T
		2	2	Tone dial.	P
	2	0	0	Pulse dial make/break ratio = 39% / 61%	&P0
		4	4	Pulse dial make/break ratio = 33% / 67% (Default)	&P1
	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	Modem returns result code	Q0
		128	80	Modem does not return result code (see also S40.1)	Q1
S24=	bit	dec	hex	Bit mapped register	
	3-1	0-14	0-E	Ring Volume control, increment of 2 in decimal value	N0-7
	7-5	32-224	20-E0	Speaker volume control, increments of 32 in decimal value	L0-7
	4-6	16-119	10-70	Speaker volume control, increments of 16 in decimal value	L0-7
	2	0	0	Ignore S21.1-2 when Phone 1 key pad dial	
		4	4	Do not ignore S21-2 when Phone 1 key pad dial	
	3	0	0	Ignore S21.1-2 when Phone 2 key pad dial	
		8	8	Do not ignore S21-2 when Phone 2 key pad dial	
	5-4			Speaker volume control, in increments of 16 in decimal value	L0-3

Command	bit	dec	hex	Function and description	Ref.
S25=		0-255	0-FF	Specify the time delay that DTR signal needs to be OFF before it will be recognized, in 10 ms units. If S25=0, the delay time is set to 4 ms	+000
S26=		dec	hex	RTS/CTS delay	+000
		0-255	0-FF	Set the delay, in 10 millisecond units between the RTS and modem's CTS response in synchronous mode (see '&Rn' command)	&Rn
S27=	bit	dec	hex	Bit mapped register	
	0-2			Modem error control	
		0	0	No error control	&K0
		1	1	MNP4 + MNP3 (see also S41.0)	&K1
		2	2	MNP4 + MNP5 (see also S38.5, S41.0)	&K2
		3	3	V.42+MNP4	&K3
		4	4	V.42 + V.42bis (compatible with &K2)	&K4
	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
	6-7			Signal quality	
		0	0	No response to poor signal quality	*Q0
		64	40	Retrain action taken if signal quality *Q1 is poor	
		128	80	Adaptive rate (auto fall-back /forward) when signal quality changes	*Q2 S41.2
		192	C0	Disconnect when signal quality is poor	*Q3
S28=	bit	dec	hex	Bit mapped register	+068
	0	0	0	Reserved	
	4-5	0	0	No guard tone	&G0
		16	10	Reserved	&G1
		32	20	1800 Hz guard tone	&G2
	7	0	0 *	Select V.22 for 1200 bps communication	
		128	80	Select Bell 212A for 1200 bps communication	
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	
	0	1	1	Use CELL 4800T trells coded 4800 for V.32 4800 (available with cellular mode only)	
	1	2	2	Disable aborting from terminal during modem handshaking	
	2	4	4	V.26 alternative A. (see also '&N11')	
	3	8	8	Add 12 dBm attenuation to the leased line	
	4	16	10	When Data/Voice with is pressed, modem will dial the default number.	*Dn S29
	5	32	20	Enable Selective Reject in V.42 (Default)	

Command	bit	dec	hex	Function and description	Ref.
	6	64	30	Enable password protection to profile saving. When 'AT&W0' is issued, and profile 0 in the NVRAM has this bit set, the supervisory password will be requested. This bit in profile 0 also protects the supervisory password from a hardware reset.	*W0
	7	128	80	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
	0	0	0	Deny remote request for configuration (Default)	*F0
		1	1	Grant remote request for configuration	*F1
	1	0	0	Write from local profile to remote profile (Default)	*Wab
		2	2	Read from remote profile to local profile	*Rab
	7-5			Security function control	
		0	0	Disable security function (Default)	*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
S37=	bit	dec	hex	Bit-mapped register for remote configuration using panel menu control	+000
	3-0	0-5	0-5	Remote profile number	*Wab
	7-4	0-80	0-50	Local profile number	*Rab
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
	4	16	10	Auto-mode fax receiving disabled	&N0
	5	32	20	Disable MNP5	&Kn
S39=	bit	dec	hex	Bit mapped register	+000
	2	4	4	Answer in originating mode	ATA
	3	8	8	Class 2 Fax Bitfax compatibility: +FCON at 2400 next phase at 19200	
	4	16	10	Class 2 Fax mode DTE shifting: +FCON at current DTE, shift to 19,200 when entering into the next phase	
S40=	bit	dec	hex	Bit mapped register	+000

Command	bit	dec	hex	Function and description	Ref.
	1	2	2	No result code displayed in answer mode	Q2
S41=	bit	dec	hex	Bit mapped register	+000
	0	1	1	Special MNP compatibility (see also S27.0, S38.5)	&Kn
	2	4	4	Disable retrain abort, up to 5 min. for special satellite line condition	S27.6 *n
	3	8	8	Enable CCITT signals 140 and 141 on EIA-232D interface	
	4	16	10	In X2-X7 setting, modem waits for S6 seconds before dialing and ignores dial tone detection	
	5	32	20	DSR follows DCD and pulses (see also S44.4)	&Sn
	6	64	40	Force S0>=2	S0
	7	128	80	Ignore calling tone, not to be used as fax detection	
S42=	bit	dec	hex	Bit mapped register	+000
	3	8	8	Disable escape sequence code in answer mode	
	4	16	10	Disable V.17, 14,400 Fax in calling mode, no effect to answering mode &N32	
	5	32	20	Disable Data/Voice button	
	6	64	40	Disable 'RINGING' result code	Xn
	7	128	80	DCD forced on but pulse off for 0.5 seconds at carrier loss	&C0
S43=	bit	dec	hex	Bit mapped register	+000
	0	1	1	Disable ZyXEL 16800 in Multi-Auto mode	&N0
	1	2	2	Disable ZyXEL 19200 in Multi-Auto mode	&N0
	2	4	4	Disable cellular mode automatic transmit power adjustment (see also S49b0-3)	&N0
	3	0	0	Enable cellular mode in Multi-Auto mode.	&N0
		8	8	Disable cellular mode in Multi-Auto	&N0
	6	64	40	Enable 1.5 sec, pause between off-hook and modem answering	
	7	128	80	Modem hang-up if the line condition does not permit modem to run highest speed set by '&Nn' command	
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
	5	32	20	Enable V.13 half-duplex simulation in synchronous mode	

Command	bit	dec	hex	Function and description	Ref.
	6	64	40	When selected with '&B0', DTE speed fixed at 38400 when the link speed is above 9600. DTE speed fixed at 9600 if link speed is 7200, DTE speed follows link speed. When selected with &B1, DTE speed fixed at current rate when an ARQ connection is made, when a non-ARQ connection is made, DTE speed follows the link speed. (See also S18)	&Bn
	7	128	80	Enable UK (Australian, Singapore, Indian, etc.,) type short-to-short (discontinuous) ring-back detection.	
S45=		dec 0-255	hex 0-FF	Delay during which the CND silence detection is disabled, in 20 ms units. (See also S46)	+087
S46=		dec	hex	CND silence detection interval	+003
		0-255	0-FF	To process the CND, silence must be detected for the specified interval, in 20 ms units	
S48=	bit	dec	hex	Bit-mapped register	+000
	0	1	1	Cause CND information to be reported in raw format	
	1	2	2	Enable DATA ONLY mode. Auto-detect V.34/ZyX/V.32bis/V.22bis/V.23/V.21 Bell 103 when answering. If the connection try fails, the modem will continuously recycle the handshaking procedure until the S7 register times out.	
	2	4	4	Enable data calling tone (CNG) sending	
	3	8	8	Reverse the V.23 channel speed. Originate mode modem speed (Send/Receive) 1200/75; Answer mode modem speed (Send/Receive) 75/1200	&N12
	4	16	10	(Work with &D1 command) DTR ON will have the modem dial the default number and DTR OFF will have the modem hang-up and reset to profile 0. When the modem is idle (waiting for command), it will not dial any number when DTR changes from ON to OFF	
	5	32	20	Enable IS-101 command set. Set this bit to 0 to make voice command compatible with U-1496	
S49=	bit	dec	hex	Bit-mapped register	+006
	3-0	0-15	0-FF	Set cellular mode transmit power level -9 to -24 dBm. (See also S43b2)	
	7	0	0	For cellular mode only. Modem is installed in office (Default)	
	7	128	80	For cellular mode only. Modem is connected to a mobile phone	
S50=		dec	hex	Inactively timer, in 10 second units	+000

Command	bit	dec	hex	Function and description	Ref.
		0-255	0-FF	The modem counts when there is no data flow in or out of the RS-232 serial port. A connection is disengaged when the counter reaches the preset value. Set value '0' to disable this function.	
S51=	bit	dec	hex	Bit-mapped register	
	1-0	0	0	Disables EDR	
		1	1	Reports RING twice	
		2	2	Reports RING four times	
		3	3	Reports RING six times	
	3-2	0	0	Disables DTMF tone	
		4	4	Reports RING for a DTMF tone	
		8	8	Reports RING 'DTMF' for a DTMF tone	
		12	0C	Reserved	
		1	1	Reports RING twice	
	5-4	0	0	Disables fax-CNG tone detection (Default)	
		16	10	Reports RING for fax CNG tone	
		32	20	Reports RING 1 for fax CNG tone	
		48	30	Reports RING 2 for fax CNG tone	
	7-6	0	0	Disables data CNG tone detection	
		64	40	Reports RING for data CNG tone	
		128	80	Reports RING 1 for data CNG tone	
		192	B2	Reports RING 3 for data CNG tone	
S52=	bit	dec	hex	Bit-mapped register	+000
	4-3	0-24	0-18	Receive level adjustment	
		0	0	-43 dBm (Default)	
		8	8	-33 dBm	
		16	10	-26 dBm	
		24	18	-26 dBm	
	7	0	0	Select 'Mark' as the first signal of the V.23 handshaking sequence (Default)	&N12
		128	80	Select 'Space' as the first signal of the V.23 handshaking sequence	&N12
S56=		dec	hex		+050
		0-255	0-FF	Hook flash detect time, in units of 10ms, country specific	
S57=	bit	dec	hex	Bit-mapped register	
	4	16	10	Enables the reporting of Class 1 capability in the response to +FCLASS=?	
	6	0	0	Disabled busy detection when dialing is proceeding (Default)	
		64	40	Enables busy detection in dialing period	
S62=	bit	dec	hex	Bit mapped register	+000
	0	0	0	Force the modem to use the new values of S18 to fix the baud rate when answering.	
		1	1	Force the modem to use the old values of S18 (compatible with 1496 series modem) to fix the baud rate when answering.	

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.
Note:	'AT' is omitted when an AT command is referred to in the 'Reference' column..

Result Code Options

"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 Elite 2864I 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		%	%	%	%	@	$	#
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 624000		%	%	%	%	@		
32	CONNECT 124800		%	%	%	%	@		
33	CONNECT 62400		%	%	%	%	@		

ATV0	ATV1	X0	X1	X2	X3	X4	X5	X6	X7
34	CONNECT 41600		%	%	%	%	@		
36	CONNECT 24960		%	%	%	%	@		
37	CONNECT 20800		%	%	%	%	@		
39	CONNECT 28800		%	%	%	%	@	$	#
40	CONNECT 26400		%	%	%	%	@	$	#
41	CONNECT 24000		%	%	%	%	@	$	#
42	CONNECT 21600		%	%	%	%	@	$	#

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

**   When more than one type of Distinctive Ring is turned on (S40b3-6) 'RING
      n' will be reported, n=Ring Type # (1-4)

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 38400/V.32bis 14400/V.42bis`
$	<cr><lf>CONNECT DCE_Speed[/Error_Code]<cr><lf> Example: CONNECT 14400/ARQ
#	CONNECT DCE _Speed/Error_Code/Error_Control † Example: CONNECT 14400/ARQ/ MNP5

†   Data compression included. 'SREJ' is appended if a V.42 connection with selective
    reject is established.

Result Code Field Descriptions

Field Name	Possible Values
Error_Code	NONE, ARQ
Error_Control	LAPM, 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

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**)

Numerical V0	Verbose V1	Numerical V0	Verbose V1
50	CONNECT	57	CONNECT 14400
51	CONNECT 1200	58	CONNECT 16800
52	CONNECT 2400	59	CONNECT 19200
53	CONNECT 4800	60	CONNECT 21600
54	CONNECT 7200	61	CONNECT 24000
55	CONNECT 9600	62	CONNECT 26400
56	CONNECT 12000	63	CONNECT 28800

Chapter 13 - Diagnostics & Troubleshooting

Diagnostics

The Omni 288 is equipped with several diagnostic capabilities:

- Power-on Self Test

- Analog Loop-back Test

- Digital Loop-back with Self-Test

- Remote Digital Loop-back Test

- Remote Digital Loop-back with Self-Test

The diagnostic tests listed above apply to several modes of operation: asynchronous or synchronous, error controlled or non-error controlled, data compression enabled or disabled data mode. You can use these capabilities to verify the line condition and the modem's functioning and performance, and to locate the source of a communication problem.

Power-On Self Test

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

The SQ LED flashes if the test fails. The number of flashes indicates the error number according to the table below.

# Flashes	Error Condition / Status
0	Self-test indicator. If no error occurs, this message will last until the end of the test.
1	ROM code checksum error.
2	System RAM fails.
3	EPROM checksum error. The factory default settings will be downloaded to the EPROM and the self test will be re-inititated. This is not a real error.
4	The testing of DSP RAM fails, condition A
5	The testing of DSB RAM fails, condition B
6	Analog circuit calibration error.
7	Analog circuit calibration error.
8	Analog circuit calibration error.
9	Communication between controller and DSP fails, condition A.
10	Communication between controller and DSP fails, condition B.

Resetting The Modem

If you change the modem's setting and cannot get it back, or if you just want to get back to the factory default state, the following reset procedure will reset the modem to the factory state. This procedure also causes the modem to run a self-test. It is a good way to test the modem hardware.

1. Hold the DATA/VOICE key down while powering up the modem. Hold it for less than 10 seconds otherwise the modem will go to firmware update kernel execution.

2. The Omni 288S will run a continuous analog loopback self-test. Printable characters will be shown on the terminal connected to the modem's DTE port.

3. The V34, CD, DSR, CTS, RXD, EC, and SQ LEDs should be ON. If not, there is a hardware problem. Contact the nearest service center for help. If SQ flashes, the number of flashes indicates the error number corresponding to the error message in the table above.

4. The modem will be reset and will run a self-test. Printable characters will be shown on the computer screen. The SQ LED should be continuously ON. If the LED flashes, the number of flashes indicates the error number corresponding to the error message listed in the table above.

5. This hardware reset procedure will reset the supervisor password back to the default ZyXEL. But if you set **S35.6=1** in profile 0 the supervisor password is protected and not reset.

Loopback Tests

The Analog Loopback Test (with Self -Test), Local Digital Loopback Test, Remote Digital Loopback Test (with Self-Test) can all be initiated with AT commands from the terminal. Use the **AT&T0** command to terminate the test.

Analog Loopback (AT&T1)

This test can check almost every part of the modem and the RS-232 cable except the telephone line outgoing interface. During Analog Loopback testing, data from the terminal or computer is sent through an RS-232 cable into the modem's transmitter and is modulated to an analog signal. Then it is looped back to the receiver, demodulated to digital form and sent through the RS-232 cable back to the terminal or computer's screen. You can tell if anything is wrong by looking at the screen. The screen should show the data you have sent to the modem. This test can only be initiated while the modem is off-line.

Analog Loopback with Self-test (AT&T8)

This test generates data from the modem itself instead of input data from the RS-232 interface. The data will go through the same path as it would with the Analog Loopback Test. In asynchronous mode, the pattern consists of printable ASCII

characters. You can see the result on the screen. In the synchronous mode, the pattern is made up of scrambled binary 1 and the Throughput Meter will change to a Bit Error Rate Meter. The left reader displays accumulated bit errors while the right reader displays accumulated bits sent. The SQ LED will flash.

This test can only be initiated when the modem is off-line. The following Bit Error Rate Meter example shows 11120 Kbits sent, 22 bits in error. When the number exceeds 99999 Kbits, it will reset itself back to zero.

Local Digital Loopback Test (AT&T3)

This test will loopback the digital form data demodulated from the receiver to the input of the transmitter. During testing, all data received from the remote modem will be returned to the remote modem. This test is applicable when the remote modem does not provide V.54 Remote Digital Loopback capability. This test can be initiated by the local modem when the modems are on-line.

Remote Digital Loopback Test (AT&T6)

This test will request the remote modem to do a digital loopback. During testing, the local modem will send a remote digital loopback request to the remote modem according to V.54. If the remote modem supports V.54 and is programmed to grant this kind of request, it will resend all of the received data back to the local modem. The local terminal or computer will receive all of the data it sends out. This test is applicable when the remote modem and local modem both provide V.54 Remote Digital Loopback capability. This test can be initiated by either modem when the modems are on-line.

Remote Digital Loopback with Self-test (AT&T7)

This test generates data from the modem itself instead of input data from the RS-232 interface. The data will go through the same path as it would with the Remote Digital Loopback Test. In asynchronous mode, the pattern consists of printable ASCII characters. You can see the results on the screen. In the synchronous mode, the pattern is made up of scrambled binary 1, and the Throughput Meter of the initiated modem will change to a Bit Error Rate Meter. The left reader displays accumulated bit errors and the right reader displays accumulated bits sent. This test can be initiated by either modem when the modems are on-line.

Indicator Lights

Retransmission Indicator

In the error control mode, an error occurring in the link will cause the data to be re-transmitted. At the same time, the AA LED will flash. This also indicates the quality of the line. On the LED models the EC LED will flash to indicate retransmission.

Dialing Indicator

The V32b LED will flash on and off for 1/2 second each to indicate that the modem is dialing. This flash will continue after dialing until a carrier is detected. Therefore, the V32b LED will also flash in leased-line modem connections when one modem is trying to handshake but the other modem is not turned on.

Handshaking And Retrain Indicator

The V34 LED and V32b LED will alternatively flash on and off for 1/2 second each to indicate that the modem is handshaking or retraining.

Trouble Shooting

The Omni 288S modem is designed to provide years of ultra high speed satisfaction. In the unlikely event you encounter problems using your modem, the tips in this section will help you to identify and resolve them. Most modem problems are a result of incorrect cabling or settings within your communications or fax software. This section provides a list of more common problems that you may encounter, followed by likely solutions.

AT Command Set Problems

■ **Problem**

Your modem does not respond to AT commands.

■ **Solutions**

1. Make sure the DTR LED is ON. If it is OFF, make sure your communications software is using the same COM port as your modem.

2. Check to see that your modem's COM port is not already assigned to another installed serial device, such as a mouse or laser printer.

■ **Problem**

Your modem fails to execute AT commands.

■ **Solutions**

1. Make sure the DTR LED is ON. If it is OFF, make sure your communications software is using the same COM port as your modem.

2. You may have omitted the characters AT from the beginning of the command line. These characters must appear at the beginning of each command line.

3. You may have typed the commands when your modem was in data state instead of the command state. To switch from data state to command state, type the escape sequence code +++. To return to the data state, type ATO and press Enter.

■ **Problem**

You typed an AT command, but did not receive an OK or 0 result code.

■ **Solutions**

1. Your communications software may be using a different COM port than your
    modem. Be sure both the software and your modem are addressing the same
    COM port.

2. The E0 and Q1 commands may be in effect, disabling echo and result codes.
    To verify this in terminal mode, type AT&V0 and press Enter with the
    modem in command state to view the currently active settings. To enable
    echo and result codes, type AT E1 Q0 and press Enter.

3. You may have typed the commands when your modem was in the data state
    instead of the command state. To switch from data state to command state,
    type the escape sequence code +++. To return to data state, type AT0 and
    press Enter.

■ **Problem**

You receive the ERROR result code after typing an AT command.

■ **Solution**

You may have typed a command that is not recognized by your modem or
communications software.

Command Echo Problems

■ **Problem**

You do not see any typed characters on your computer screen.

■ **Solutions**

1. Make sure the DTR LED is ON. If it is OFF, make sure your communications
    software is using the same COM port as your modem.

2. Neither your modem nor your communications software is configured to echo
    characters. Use the E1 command to enable modem echo, or turn on your
    software program's Echo (or duplex) feature .

■ **Problem**

Each character you type appears twice on your computer screen.

■ **Solution**

Both your modem and your communications software are echoing characters to
your screen. Use the E0 command to disable modem echo, or turn off your
software program's echo (or duplex) feature.

Answer Problems

■ **Problem**

Your modem does not auto-answer incoming calls.

■ **Solutions**

1. Make sure the supplied telephone cable is connected to your modem's LINE jack and not the PHONE jack.

2. Your modem may not be set up for auto-answer. With the modem in command state, type ATS0=1 and press Enter to have the modem answer on the first incoming ring. To auto-answer on a different ring, replace 1 with a value up to 255. Do not assign a value of 0, which turns off auto-answer, unless your software can respond to the modem's RING result codes.)

3. Check that the DTR LED is ON, and that the AA LED flickers with each incoming ring. If the LEDs do not respond in this way, refer to your ZyXEL Modem Reference Manual.

■ **Problem**

When you receive a phone call, your modem immediately seizes control of the telephone line.

■ **Solution**

Your modem may be configured for auto-answering. To disable auto-answer, type ATS0=0 and press Enter with the modem in command state.

Dialing Problems

■ **Problem**

Your modem does not dial calls.

■ **Solutions**

■ Make sure the supplied telephone cable is connected to your modem's LINE jack and not the PHONE jack.

■ You are using touch-tone dialing on a line that requires pulse dialing. Change your communications software to use pulse dialing.

Data Transfer Problems

■ **Problem**

You can make a data connection with a remote modem, but encounter frequent errors during data transfers.

■ **Solutions**

1. Your modem and communications software may be configured for different flow control methods. Be sure your modem and software are both using hardware (RTS/CTS) flow control or software (XON/XOFF) flow control.

2. To verify that your modem and communications software are using the same flow control method, type AT&T8 and press the Enter key with your modem in the command state. You should see a smooth "stair-stepping" ASCII test pattern flowing diagonally across your screen.

Connect Problems

■ **Problem**

Your modem disconnects while communicating with a remote system.

■ **Solutions**

1. The remote system may have hung up. Type ATI2 and press Enter to view the link status report, which will include the reason for the disconnect. For information on understanding this report, refer to your ZyXEL Modem Reference Manual.

2. You may have subscribed to Call Waiting and received an incoming call that interrupted your data connection. See your telephone directory for information on disabling Call Waiting.

Appendix A - Upgrading Your Modem

Upgrading by Flash EPROM

1. Obtain the new firmware by downloading from the ZyXEL BBS, WWW or FTP site. (See Appendix B - Contacting ZyXEL).

2. Turn on your computer.

3. Turn on your Omni 288S modem.

4. Start any communications program that supports the XModem protocol.

5. Type **ATUPX<enter>**.

6. Press Enter and wait for the following prompt characters:

   ```
   You have chosen XMODEM (128 bytes data with
   checksum) protocol to update your modem.  Data in
   Flash ROM will be erased!!!
   ```
   ```
   Are you sure (Y/N)?
   ```

7. Press **Y.** The following message then appears:

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

8. Use the XModem protocol to upload the file Omni **vvv** to   your modem. This step updates the modem's flash EPROM with the latest firmware.

9. When the installation is complete, the modem restarts automatically.

Kernel Recovery Mode

Your Omni 288S is equipped with ZyXEL's exclusive **Kernel Recovery Mode.** This unique feature enables quick recovery from failed flash uploads. With other modems, a failed flash upload usually results in the user having to return the modem to the factory for repair.

In the unlikely event that your modem fails to respond to AT commands after upgrading the flash EPROM:

1. Turn off the modem.

2. Press the D/V button while turning on the modem, then release the button after 5 seconds.

3. A Kernel Program responsible for the update process takes control of the modem. It accepts a limited set of AT commands, including the ATUPX command.

Repeat steps 1 through 6 from the directions above to upload a file that contains valid firmware for your modem.

Appendix B - Contacting ZyXEL

ZyXEL takes pride in it products and its customers. We are continually striving to improve our line by engineering them with your current and future needs in mind.

To help us in that effort, we encourage your comments. For your convenience, we have listed below various means by which you can contact ZyXEL directly:

ZyXEL Phone Numbers

Voice Telephone Numbers

You can reach ZyXEL in the U.S. between 8:00 am and 5:00 PM PST at (714) 693-0808

In Taiwan: 011-886-35-774848

Fax Numbers

ZyXEL provides the following 24-hour fax numbers for technical support and other comments.

In the U.S.: (714)693-8811

In Taiwan: 011-886-35-782439

ZyXEL BBS Number

ZyXEL operates a 4-node BBS 24 hours a day. This BBS contains updates to ZyXEL's ZFAX communications software, modem configuration guidelines, software set-up instructions, and the latest firmware. Sysop pricing information and order forms are also available from the BBS.

- To call the ZyXEL analog BBS , configure your modem 8 data bits, no parity bit, and 1 stop bit. Then dial (714) 693-0762.

- To call the ZyXEL ISDN BBS using one B channel, configure your modem and then dial (714)263-0398.

- To call ZyXEL ISDN BBS using both B channels, configure your modem and then call (714)263-0398 + (714) 263-0498.

Online Access

You can also contact ZyXEL via the Internet using E-mail, our Web site, or FTP, and through CompuServe.

Internet

E-mail

Sales inquiries: sales@zyxel.com

Technical support: support@zyxel.com ; in the U.S.

or support@zyxel.hinet.net ; outside the U.S.

World Wide Web

ZyXEL has a home page on the World Wide Web(WWW). If you have a WWW browser, such as Netscape, you can access this page at the following location: http://www.zyxel.com

FTP

Information, such as ZyXEL software and ROM updates for the U.S. can be found at this FTP address: ftp.zyxel.com

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

CompuServe

CIS ID: 71333,2734

Forum: GO ZyXEL

Appendix C - Connector Pinouts

Phone Jack Pinouts

The Omni 288S is equipped with two RJ11 phone jacks:

1. one for the dail-up line connection (LINE)

2. one for an optional connection to a phone set (PHONE)

The signals for these pins are:

1	A
2	RING
3	TIP
4	A1

The signals A and A1 are used with the KTS (Key Telephone Systems).

PC Serial Port Pinouts

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

Macintosh Serial Port Pinouts

The following table shows the wiring of a modem Macintosh hardware handshaking cable:

Mac Din 8	Modem DB 25	Description
1	4 & 20	DTR to RTS and DTR, Hardware Handshaking Out
2	5	CTS to CTS, Hardware Handshaking In
3	2	TX- to TXD, Data sent
4	7	GND, Ground
5	3	RX- to RXD, Data received
6	-	not connected
7	8	GPI to CD, Carrier detected
8	7	GND, Ground, needed for RS-232 connections

Glossary

Analog: Not digital. Analog quantities may have any value.

Analog loopback test: Testing method in which the modem's analog output signal is connected to the analog input.

Answer: In a connection between two modems, one modem works as the recipient (in answer mode) and the second modem as the initiator (originate mode).

AppleTalk: A simple network to connect several computers directly with each other. AppleTalk is also the protocol according to which connected computers exchange data. In Apple Macintosh computers, this network protocol is part of the system software.

ARQ: Automatic Retransmission reQuest - Standardized method in error control protocols.

ASCII: American Standard Code for Information Interchange. This code assigns a 7-bit numerical value to characters, digits and control characters. An ASCII character is a 7-bit character with a decimal value ranging from 0 to 127.

Asynchronous: Data transfer method in which a character's data bits are framed by additional bits (start bit, parity bit and stop bit). There are variable idle times between characters.

AT command: The commands used with an intelligent modem. Every command line is started with the AT prefix (ATtention). To send an AT command to a modem, you must have communications software running.

Auto-answer: Modem's ability to automatically answer a call after a set number of rings.

Baud: Unit of modem transmission speed. Characters pre second. Named after Baudot, a French engineer who developed the Baudot code - the precursor of today's ASCII code.

BBS: Bulletin Board System, or Mailbox. Computer software which can send and receive messages and files via a modem automatically and which can interact with a remote user. This program usually runs unattended on a computer specifically reserved for this task.

bis: Old French word for two.

Bit: Smallest unit of information. A bit can have one of two states: ON (1; set) and OFF (0; not set). By combining a number of bits, a computer can code any information. A byte consists of 8 bits. Therefore a byte can have any one of 28 (256) states.

Bit rate: Count of data bits transmitted per time unit. The framing bits needed for asynchronous transfer are also counted in the calculation of the bit rate. In general, the bit rate is ten times the character rate.

bps: Unit of measurement. Bits per second.

Carrier: The carrier is a modulated tone and is used by the modem to transfer the data.

CCITT: Comité Consultatif International Téléphonique et Télégraphique; former name for the ITU-TSS (ITU-T), the international standard making organization for telecommunications.

CD: *See DCD.*

Glossary

CEPT: Commission Européenne Postale et Telephonique. This organization regulates the data exhange between the European postal services and participates in the drafting of some standards.

Class 2: A standard for fax transfers using a fax modem. Currently several drafts exist which are incompatible with each other. ZyXEL modems support the draft PN-2388 of Aug. 20th 1990, and the final 2.0 standard.

CNG: Call negotiation tone. A calling fax machine sends this tone before connecting to quickly establish a fax connection. A data modem may also have a data calling tone.

Command mode: In command mode, a modem accepts commands from the local DTE. Data transfer is suspended while the modem is in command mode.

Compatibility: If components are compatible, they work with each other.

COM port: Another name for the serial port on a PC.

Compression: *See data compression.*

CRC: Cyclic redundancy check; an error checking protocol.

CTS/RTS: Control signal lines on an RS-232C serial interface. These lines are needed to use hardware flow control.

Cursor: A special marker on a display. It marks the position where input from the ZyXEL LCD model's front panel will be shown on the display.

Data bit: In asynchronous transfers, a character is composed of data bits (the actual information) and framing bits (start bit, stop bit/s, parity bit). The framing bits are needed to recognize whether a character has been successfully transmitted and where a new charater starts.

Data compression: Recoding of information. The same information is represented by less data bits. ZyXEL modems use MNP4 and V.42 compression schemes.

Data packet: Block of data which is framed by error control groups. A block consists of up to 256 8-bit groups. Data packets are used in synchronous transfer.

Data pump: The important module doing modulation and demodulation for a modem. The data pump is decisive for the quality and the speed of a modem's transfer capabilities.

DCD: Data Carrier Detected - a control signal line of the RS-232C interface.

DCE: Data Circuit Terminating Equipment or Communications Equipment - a modem is a DCE.

Demodulation: Transferring analog signals into digital data bits.

Digital: Digital data consists of a series of bits. A bit may have only one of two states. Analog data may have any value.

Digital loopback test: A modem test procedure which transfers the received digital data back to the modulator and transmits them out.

DIP switch: Dual inline package switch. DIP switches are abundant in the world of electronic equipment. They are used to set certain parameters on a printer, modem or

Glossary

other peripheral devices. You will not find any DIP switches in ZyXEL modems. ZyXEL modems let you perform all settings from the front panel or through command sequences.

DLE: The ASCII code that is used in voice data mode to separate data segments from command segments.

DSP: Digital signal processor. ZyXEL modems are equipped with this/these device(s). DSPs generate, process and analyze all signals.

DSR: Data Set Ready - a control signal line of the RS-232C standard.

DTE: Data Terminal Equipment - a computer or a terminal.

DTR: Data Terminal Ready - a control signal line of the RS-232C standard interface. Some computers set this signal when they are turned on, even if they are not able to receive data.

Echo: For a modem user, echo has two meanings: A modem can return all received characters to its local terminal/computer so they can be seen on-screen. The other meaning of the term ``echo'' is that part of the analog signal the modem sent out is bounced back by the telephone network to the modem's receiver, mixing there with the remote modem's signal.

EDR: Extended Distinctive Ring - A feature of ZyXEL modems which helps to distinguish between data, fax and voice calls.

EEPROM: An Electronically Erasable and Programmable Read Only Memory. Such a device is used in ZyXEL modems to store settings and profiles. An EEPROM does not lose data when the modem is turned off.

EIA: Electronic Industry Association (of North America); this organization was the first to draft a standard serial port (RS-232C).

EPROM: Electrically Programmable Read Only Memory. A memory chip which may be programmed electronically, but must be exposed to ultraviolet radiation to be erased.

Error correction: A method to compensate for errors which occurred in the transmission path. Error correction is done by the modems and is transparent to the DTEs. The most familiar correction methods are MNP5 and V.42bis.

Fax: Long distance copy; facsimile - transfer of graphical data between two fax units. The graphical data is compressed during transfer (G3).

FIFO-Buffer: First-in-first-out buffer. A buffer of this type is used in the 16550 type UARTs which allow higher data throughput rates on PCs.

Firmware: The ZyXEL modems' system software is located in flash EPROMs. Depending on the size of the EPROM(s), some features may or may not be available.

Flash: See Hook-Flash.

Flow control: Method to stop and start the data flow to avoid loss of data.

Front panel: The front panel on the ZyXEL modems consists of LED indicators and key switches. Some models also feature a 20 2 liquid crystal display (LCD).

FSK: Frequency Shift Keying - a frequency modulation scheme.

Glossary

G3 fax: Several fax standards exist. Most available fax machines use the group 3 (G3) standard. This standard defines the compression of graphic data and a transmission speed of up to 14400 bps with an automatic fallback to 2400 bps if the telephone line is bad.

Handshake: At the beginning of a connection, the modems must negotiate and initialize the protocols to be used and the speed at which the connection is to be established. This negotiation phase and the following initialization phase is called handshake.

HDLC: High-level Data Link Control - protocol for synchronous transfer.

High-speed modem: A modem that works at bit rates higher than 9600 bps.

Hook-Flash: The hook-flash is a signal used in a dial sequence. This signal may be used for call transfers or to request an outside line on certain PABX.

Hz: Hertz. A unit of measurement for frequency. Cycles per second.

Internet: The worldwide collection of networks and computers, linked together through to create a global community for information exchange.

internet: Any collection of networks and computers, connected through a main network.

Interrupt: In a computer, some tasks must be performed regularly and without delay. This is possible because the CPUs provide special interrupt vectors. These vectors each point to some short program sequence. An interrupt stops the currently running program and the segment to which the vector points is executed.

ITU-TSS: International Telecommunications Union - Telecommunication Standards Sector. New name for the standard making organization CCITT. See CCITT.

ISP: Internet Service Provider. A company that provides subscribers with access to the Internet, usually through telephone lines via modems.

Jumper: A small device to close a contact. If the jumper TS2 is closed on a ZyXEL internal card model, the modem will go into self-test at the next power-on.

LAPM: Link Access Procedure for Modems - a protocol which controls the handshake between two modems.

Layer protocol: A standard of the ISO (International Standards Organization) which defines everything regarding data communications from the hardware to the screen display in seven levels.

LCD: Liquid Crystal Display - a display device similar to those used in pocket calculators. The LCD on the Supreme model is backlit.

LED: Light Emitting Diode - a display element.

LINE: The jack on the rear panel which is connected to the wall phone outlet.

Mailbox: Electronic letter box; BBS.

Mailer: A program which works with a remote BBS and requests and distributes messages automatically.

Memory: A fast storage component of a computer where data can be saved and from where it can be retrieved.

Glossary

MNP: Protocols for error correction and data compression from Microcom, Inc.

Modem: An artificial word concatenated from **mo**dulator and **dem**odulator. A modem translates the digital signals received from its local DTE to analog signals which are transmitted via a telephone line. At the other end, the analog signals are demodulated and sent to the DTE as digital signals again.

Modulation: Translating digital states to analog waveforms.

NuBus: A bus system for plug-in cards for the Apple Macintosh computers.

Off-line: A modem which is not connected to another modem is off-line.

On-line: A modem which is engaged in a connection with another modem is on-line.

Originate: In a modem connection, one modem must work in the originate mode, the other in the answer mode.

Packed data: Data from which redundant information has been removed. Some file extensions denote packed files. Standard extensions are .ZIP, .ARC, .LZH, .TAR, .ZOO and others. If you transfer packed data don't use MNP5 compression.

Parity: A method to check whether a character has been correctly transmitted in asynchronous transfer. Usual settings are even parity and odd parity. In a connection, the modems at both ends must use the same parity settings.

Parity bit: The parity bit is sent as additional information with the data bits in asynchronous transfers. It controls the integrity of the transferred data. If parity is even, the parity bit is set if an uneven number of data bits is sent in the character, resulting in an even number of set bits.

PC: Personal Computer - acronym for computers which are compatible with the IBM PC or AT computers.

PHONE: Jack to which a telephone set may be connected.

Processing unit: A computer's brain. Here all the necessary calculations are performed. The modems of the 2864 series are basically specialized computers.

Protocol, file transfer: Many protocols have been developed to ensure reliable data transfer at maximum speed, among them Xmodem, Ymodem, Zmodem and Kermit. With modern modems, the use of integrated hardware protocols (MNP4 and V.42) is recommended. The G-flavors of the above mentioned Ymodem and Zmodem allow transfers of multiple files with no additional error correction.

Public Domain: A special form of distributing software. Public domain software authors make no claim to commercialize their rights.

QUIET: A state in the voice mode of ZyXEL modems. Quiet is detected after a long pause in voice data.

RAM: Random Access Memory - working memory. The modem uses it among many other uses to store information on sent, but not yet acknowledged data.

Redundancy: Extra data that does not generate additional information.

Glossary

Remote location: The modem at the other end of the line (the one you are calling or that is calling).

Reset: Return a device into a defined base status.

Retrain: The re-initialization process a modem is doing with the remote modem when the receiving condition becomes bad.

ROM: Read Only Memory. The ROM holds the system software and the profiles and settings of the modem (refer to EEPROM).

RS: Abbreviation of recommended standard.

RTS/CTS: *See CTS/RTS*.

RXD: Line for the received data on a serial port following RS-232C.

Security function: Features of the ZyXEL modems which help deny illegitimate contacts to your computer system through telephone lines.

Self-test: Ability of the modem to check its components and operations for faults.

Serial port: Communication path through which data is transferred bitwise. Only one wire each is available for transmitted and received data.

Shareware: A distribution method for software. The author lets the user try out the fully functional software for a certain amount of time at no charge. If the customer wants to keep and use the product after the period, he must pay the requested fees. This method depends heavily on the honesty of the user.

Signal to noise ratio: A measure for the signal quality of a connection.

SILENCE: Status detected in voice mode. If the modem returns a silence message, no voice energy was detected after a connection was established.

Speech digitalization: Changing spoken sound into digital data which can be pro-cessed and saved by a computer.

S-register: Abbreviation of status-register. The currently used parameters are stored in the status registers. S-registers are a part of the modem's internal memory.

SREJ: Selective Reject - extension of the V.42 protocol which allows the more efficient handling of retransmission of erroneous data blocks.

Start bit: In asynchronous transfers, a new character is introduced by the start bit.

Symbol speed: Speed at which a signaling unit is transferred. In modern modem modulation, a signaling unit is no longer a single bit. Thus, the bit speed is different from the symbol speed.

Stop bit: In asynchronous transfers, every character is terminated by one or two stop bits which show where a character ends.

Synchronous : In synchronous transfer, a dedicated control signal line transmits a clock signal which paces the transmitted data. In highspeed connections, the transfer between two modems is always synchronous, even if the DCE to DTE connection is asynchronous.

Glossary

T.30: A standard for fax transfers.

TAE6: A standard for a telephone wall outlet used in some countries, particularly in Germany.

ter: Old French word for three.

Terminal equipment: A computer running terminal software is used as terminal equipment in modem connections.

Terminal program: A program which emulates the operation of a hardware terminal on a computer's screen and keyboard.

Token: A token is a reencoding of information in less bits; basically an abbreviation.

Transfer mode: Data can be transferred either synchronouosly or asynchronously.

Transfer rate: The speed at which the data bits are effectively transferred.

UART: Universal Asynchronous Receiver and Transmitter; a special IC chip which controls the serial port. Different models are available for PCs. Models with an internal buffer usually allow higher transfer rates.

V.: The ITU-TSS V.-standards describe data transfer via telephone lines.

Western jack: Telephone wall outlet connector used in the USA and other countries.

X.: The ITU-TSS X.-standards describe data transfer in public data networks.

XModem: A widely used, though somewhat aged, file transfer protocol. The use of 128 byte data blocks severely limits the achievable throughput.

XON/XOFF: Software flow control. The data flow is stopped by sending ASCII character Control-Q (dec. 17; hex $11) and restarted by Control-S (dec. 19; hex $13).

YModem: A file transfer protocol which uses data blocks of 1 Kbyte and transfers filenames and more than one file in one transfer.

ZModem: A file transfer protocol with variable block size, reinitiation of aborted transfers and transfer of several files in one transfer along with file (and path) names.