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# 2864 Series Modem User's Manual

**Document No.: 8406, Rev. 1.0**

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**ZyXEL COMMUNICATIONS CORPORATION**

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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 REN's 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 replacing the EPROMs containing the firmware or 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.

## 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

Model Name

FCC Part 68 Approval Number

REN#

You will find this information on the sticker label on the bottom case.

The modem is connected to a public switched line using a USOC (Universal Service Order Code) RJ11C modular jack, and to a leased line using a JM8 jack.

## 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.

This digital 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 (formerly Canadian DOC).





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# Chapter 1

## INTRODUCTION

The 2864 series of V.34 modems includes three sub-series of models, namely the Supreme, Elite and Omni series. The Supreme and Elite series models have ISDN capability or can be upgraded to have ISDN capability. The Omni series does not have ISDN capability. The Supreme series provides an LCD display panel while the Elite series has a front panel with LED indicators only. Many features are common to all three series. If not noted otherwise, a feature illustrated with one series model in this manual applies to the other models and series as well.

The Elite 2864 series of high-speed modems features four base 10models. They differ only in the implemented line interface module, everything else is equivalent except for the panel LED indicator designations.

The models are

Model Name	Line Interface Module	Phone Line Used
Elite 2864	Dial-up line DAA	Dial-up analog PSTN line
Elite 2864L	Dial-up and leased line DAA	Dial-up and/or 2/4-wire leased analog line
Elite 2864I	ISDN S-interface	ISDN line, S-interface
Elite 2864IU	ISDN U-interface	ISDN line, U-interface

The Elite 2864 has a 2-wire dial-up line DAA (Direct Access Arrangement) module for connection to a normal PSTN (Public Switched Telephone Network) 2-wire dial-up phone line. The Elite 2864L has a DAA with both a dial-up and leased line interface. A 2 or a 4-wire leased line can also be used besides the normal 2-wire dial-up line. Dial back-up capability is provided while using leased line. The Elite 2864I has an ISDN S-interface module that will connect to an ISDN S-interface line. It will connect to an ISDN call or a modem/fax call from PSTN made to this ISDN line. A U-interface ISDN module is available for the USA market. The Elite 2864IU is the ISDN model with the U-interface module.

By changing the line interface module, one Elite model will essentially become another Elite model. Each Elite model has different markings on its front and rear panels. Thus, in addition to the line interface module the front and rear panel also need to be changed in order to transform one Elite model into a different Elite model. Note that each Elite model has its own telecommunication authority approval

number. When the model is changed, the approval number is also changed. Find the new approval number and check whether it is appropriate for the user to do the model transformation before you start the transformation process.

Like the Elite series, the Supreme series includes different models which differ only in the line interface module. There are three models in the Supreme series - The Supreme 2864L, 2864I, and 2864IU. The Supreme 2864L has a DAA with both a dial-up and leased-line interface; the Supreme 2864I has an ISDN S-interface module; the Supreme 2864IU has an ISDN U-interface module.

The Omni series models have only modem/fax/voice capability. They do not provide ISDN capability nor are they ISDN upgradeable. The Omni 288P is the model with a parallel port DTE interface and the Omni 288S is with a serial port DTE interface. The Supreme and Elite models have both a parallel port and a serial port DTE interface.

## How To Use This Manual

This manual describes the use of all models in the 2864 series and gives instruction for their installation and operation. The 2864I and 2864IU ISDN models come with a separate manual describing their ISDN operation.

The manual is divided into five sections.

**Basic Overview** - The first section is comprised of chapter 1 (INTRODUCTION) through chapter 3 (MODEM INSTALLATION). It gives a basic overview of the 2864 series modems' features, introduces some basics of modem operation for novice users, and explains the installation of the different models of the 2864 series.

**Modem Operation** - The second section introduces you to some skills you will need to make the best use of your modem. In chapter 4 (MODEM OPERATION) you are introduced to the use of the different modem ports and you will find information on how to return the modem to standard settings (reset) and how to upgrade your modem in the future. The panel operation of the Supreme models is described in chapter 5 (2864 QUICK START) and chapter 6 (MODEM PARAMETER SETTINGS). Users of the non-LCD models should consult the equivalent AT command sections listed for each of the panel operations.

**Settings and Commands** - The third section, chapter 7 (PROFILES) through chapter 9 (AT COMMAND SET SUMMARY), provides an overview of the settings and commands which are available in the 2864 series.

**Special Functions** - Section four is comprised of chapter 10 (ERROR CONTROL AND DATA COMPRESSION) through chapter 18 (DIAGNOSTICS) and describes many special functions of the 2864 series modems in detail, including data compression, synchronous and leased-line operation, remote configuration, caller ID, cellu-

lar mode, fax sending and receiving, voice mail, network management, and diagnostic features.

**Hints and Tips** - Section five is the trouble-shooting and special advice section. Here you will find additional information on how to use a 2864 series modem with your computer, and some hints and tips relating to a number of communication software applications.

**Appendices** - An extensive glossary, several appendices with technical details, information on standards, and a thorough index complete this manual.

Those who need more detailed technical information may contact ZyXEL Communications Corporation directly. The address can be found in the disclaimer section at the beginning of this manual.

## Compatibility

ZyXEL 2864 series modems are high performance universal modems capable of transmission speeds up to 28.8 Kbps full-duplex on a 2-wire dial-up line. 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	Bit rate (+/-0,01%) [bps]	Baud rate (+/-0,01%) [baud]	Modulation	Carrier frequency [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

Standard	Bit rate (+/-0,01%) [bps]	Baud rate (+/-0,01%) [baud]	Modulation	Carrier frequency [Hz]
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† (BELL 212A)	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.			

\*. V.33, V.29, V.27bis and V.26bis are only available in model 2864L for 4-wire leased-line operation. The other operation modes are common to all models. V.26bis works in half-duplex mode on 2-wire dial-up line.

†. 1800 Hz guard tone for V.22bis/V.22 answer mode, 6 dB below data signal level.

## The 2864 Series Standard Features

- Synchronous/Asynchronous operations for external stand alone models and rack mount models. (Parallel port interface is for asynchronous transmission only)
- Asynchronous operations for PC internal card model.
- MNP class 4/5 error correction/data compression.
- V.42/V.42bis error correction/data compression. V.42 with selective reject.
- Extended AT command set.
- V.25bis async/sync command set.
- Operation on 2-wire dial-up line or 2/4-wire leased line. (4-wire leased line on 2864L only.)
- Auto-dial/answer and manual originate/answer.
- Tone/Pulse dialing.
- Dial tone, busy signal, and ringback detection.
- Programmable speaker volume control.

- Non-volatile memory for parameter/setting storage.
- Remote configuration.
- Security call back.
- Caller ID detection.
- Distinctive ring detection.
- Extensive status reports.
- Diagnostics available for:
  - **Modem full self-test**
  - **Analog loopback (with self-test)**
  - **Remote digital loopback (with self-test)**
  - **Digital loopback**
- XON/XOFF software and CTS/RTS hardware flow control.
- Line status monitoring available for (only Supreme 2864):
  - **Signal-to-noise ratio**
  - **Received signal level**
  - **Frequency offset**
  - **Phase jitter**
  - **Retrain granted**
  - **Retrain requested**
  - **Round trip echo delay**
  - **Carrier loss counter**
  - **Rate change granted.**
  - **Rate change requested**
  - **Blocks retransmitted**
  - **Blocks received in error**
- 20×2 LCD and directional keypads. (Supreme 2864 only)
- G3 Fax sending and receiving capability with speeds up to 14400 bps.
- Fax-Polling / Fax-Grouping.
- Automatic detection of data or fax call.
- Digitized voice capability with speech compression.
- DTMF tone detection.
- Special cellular modes for data communication through cellular link.

## Additional specific features

### ISDN Ready or Upgradeable

The 2864I model has an ISDN module to connect to an ISDN line. On the other 2864 models the phone line interface module may be removed and replaced instead by an ISDN module to become an ISDN modem. The ISDN modem has both ISDN capability and normal modem/fax/voice capability.

For ISDN capability, the 2864I supports a 2B+D ISDN basic rate interface. On the B channel, the 2864I supports one B channel at 64Kbps or two B channels bundled at 128Kbps. With data compression, the throughput is up to a few hundred Kbps. The 2864I also supports one B channel for data and the other B channel for voice communication. On the D channel, the 2864I supports 1TR6 protocol for German ISDN, DSS1 protocol for Euro ISDN and NI1, AT&T 5ESS and Northern Telecom DMS-100 for North America ISDN.

A full feature analog port (a/b adapter) is provided. Thus, a regular telephone equipment may be connected to the ISDN line to make and receive ISDN calls through this port. The metering pulse is also supported on this analog port for countries supporting it.

For modem/fax/voice capability, the 2864I can initiate and receive modem/fax calls to/from a modem or fax machine connected to a PSTN analog telephone line. Voice mail capability is also supported for voice calls to/from an ISDN or analog PSTN line.

### Voice Playback and Recording

A normal telephone set may be connected to the phone jack of the modem for local voice message playback or recording. The modem provides the necessary DC voltage and current for the telephone set to operate.

A microphone and a speaker jack are also provided for voice recording or playback. An external microphone, speakers or a headset may be connected to the modem through these jacks.

A large and good quality internal speaker is installed to provide better sound for voice and music playback.

### Telephony Capability

The 2864 series modem can detect the on/off-hook status or polarity change of the phone line connection and the attached telephone set. These will be reported as events in voice mode to the connected computer. The modem can also control and switch between telephone connecting to line and modem connecting to line. It can

also control the switching between the phone line connecting to the modem and the telephone set connecting to the modem. Both the modem and the telephone set may also be connected to the line at the same time. A telephony software program can utilize these capabilities to support various telephony functions.

## Parallel and Serial Port Interface

The Supreme and Elite models have both a serial port and a parallel port. The Omni model has either a serial or a parallel port. The serial port has a speed up to 460.8Kbps with auto speed detection (AT autobaud). The parallel port can connect to either a PC's parallel port or a printer's parallel port. When it is connected to a bidirectional PC parallel port, the PC can communicate with the modem through the parallel port. The parallel port connection has the advantage that no data loss due to overrun will occur and there is no serial port speed limit. When the modem's parallel port is connected to a laser printer with a Centronics type interface (the normal PC to printer parallel interface), the modem can send received fax pages directly to the printer without the need to start up a PC.

## DRAM Expandability

8 Mbyte DRAM expandability is standard on the Supreme and Elite series modems. Four DRAM sockets are provided on board to accept four 4M×4 16M DRAM chips. The DRAM memory is useful for overnight stand-alone fax receiving. About 200 pages of normal fax can be stored without overflowing the DRAM memory. The stored fax pages are available for later retrieval or printing.

## Flash EPROM for Easy Firmware Update

With the versatile and feature rich hardware architecture, the 2864 series modems are ready for firmware updates/upgrades for added and enhanced features. An 8 Mbit high-speed flash EPROM is standard on every 2864 modem (4 Mbit on Omni models). A firmware update is only an AT command to upload a new firmware file. It is not necessary to open the case or burn any EPROM.

## Before You Start

Before you proceed further, please check the modem package and make sure nothing is missing. The complete package should include:

- one (1) 2864 series universal modem
- one (1) power adapter (external model)
- one (1) RJ11 telephone cable
- one (1) JM8 leased-line cable (2864L model only)  
one (1) RJ45 ISDN telephone cable (2864I model only)
- one (1) 2864 series user's manual
- one (1) ZFAX 3.5" floppy disk and floppy disk(s) for drivers and other utilities.
- one (1) warranty/registration card
- one (1) Quick Reference 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 the 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 on your warranty card.**

## How To Become A Registered Owner

**Fill in the registration card and mail it to the address found on the reverse side of the card. Registered owners will receive future product and update information. You don't have to register to receive warranty service. A dated invoice as proof of purchase along with the warranty card are sufficient.**

## What You Need To Have

**You must provide the following additional equipment to operate your modem:**

- A Computer/Terminal with communication software.
- A RS-232 serial cable or a 25-wire DB25 parallel cable (with one male and one female connector).
- A telephone line from your telephone company (dial-up or leased line).

## Communication Software

**Communication software controls the modem connected to the computer and directs data to and from the modem. In most PC environments, the modem is used in an asynchronous mode and the software controls the modem by AT commands.**



ZyXEL modems support the extended AT command set and are compatible with most communication software packages. However, there are some unique features in the ZyXEL modem and there are a few unique commands to control them.

Some communication packages need a file with information about the commands and features the modem supports. Basic information on how to set up communication software can be found in chapter 20 (THE FIRST CONNECTION). Information and sample data files for popular communication software packages are available in the Application Driver Area of the ZyXEL BBS (+886-35-787045).

## Connecting To Your Phone

If you would like to use a single phone line for voice and modem connections, remove your phone cable from the RJ11 junction box and plug one end of the RJ11 cable (supplied with the modem) into the phone junction box on the wall, then plug the other end of the cable into the rear panel of the modem labeled DIAL-UP LINE or WALL. Finish by plugging your phone cable into the rear panel of the modem labeled PHONE. Please refer to the illustrations in chapter 3 (MODEM INSTALLATION).

## Dial-Up Or Leased Line

The 2864 and Omni 288 models may connect to 2-wire dial-up or leased lines only. The 2864L offers you a choice of connecting to 2-wire dial-up lines (more commonly known as public lines) and 2/4-wire leased lines. To use the 2864L on a leased line, you must order and install a USOC JM8 jack. You must also specify 4-wire operation without TEK leads for the wiring option. When setting up a pair of modems for leased line point-to-point operation, one modem must be configured for originate mode and the other for answer mode. Both RJ11C and JM8 cables are supplied for your convenience.



# Chapter 2

## MODEM AND FAX BASICS

This chapter is intended for those readers who want to know the details behind modem and fax operations; what's going on behind the scenes. In addition to introducing basic modem and fax terminology, this chapter helps users to understand and be able to utilize the available features. Experienced modem and fax users may wish to skip this chapter.

### Modem

Modem is a compound word of MODulator and DEModulator. A modem is used for computer communications. Refer to Fig. 2.1 for a standard modem setup and application.

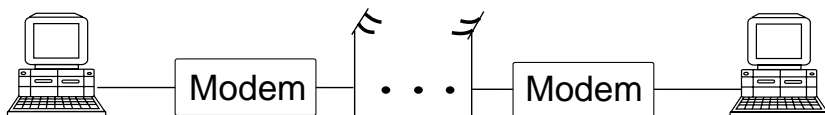


Fig. 2.1: Modems are used in computer communications.

A modem translates computer data to analog signals (modulation) that can travel through the telephone network and reach another modem. The remote modem translates the analog signal received back into data (demodulation) and sends the information to the receiving-end computer. Modems are telephones for computers, what they use to talk to each other.

### DTE and DCE

DTE and DCE are terminologies used in data communication. DTE stands for Data Terminal Equipment and DCE stands for Data Circuit terminating Equipment (Data Communication Equipment). Referring to Fig. 2.1, the computer or terminal is the DTE and the modem is the DCE.

## 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 RS-232 standard is the "C" revision. For the "D" revision, the prefix was changed to EIA. Except for a few added, but not commonly used signals, 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. Also refer to the Modem Standards and Speeds section below.

## 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 are going from the DTE port to DCE port, and some signals are going in the other 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.

## 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 RS-232C cable is sufficient in most applications. The PC-AT's serial port has only 9 connector pins, eliminating the unnecessary pins. For high-speed DTE-DCE communication, use a low-capacitance cable, as short as possible.

## Synchronous and Asynchronous Communication

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. 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 get lost. In this case, a UART with data buffer is needed, such as the NS16550A type device.

## Modem Standards and Speeds

The ITU-T or ITU-TSS (International Telecommunications Union - Telecommunications Standardization Sector), is the international standard-making body for telecommunications. They draft recommendations. The recommendations they make for modem applications have a "V" prefix and are called V-series recommendations. The commonly used ITU-T modem standards for 2-wire dial-up line are:

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.

ZyXEL 2864 series modems support all the above mentioned modem standards and are compatible with existing modems.

## Type of Telephone Line

The commonly used phone service is a 2-wire dial-up line. There are only two wires connecting the modem to the phone company's central office. The same two wires are used for DC current feeding, ringing, dialing, on/off-hook monitoring, and sig-

nal transmission in both directions. This is the type of phone service most people have in their home or office. Since the same two wires are used for both transmitting and receiving signals, an echo of the transmitting signal will also be received and it is the modem receiver's task to remove the echo before demodulation.

Leased-line phone service is also available from phone companies in a 4-wire form. Here, both the transmitting and receiving signals each use a separate 2-wire pair and thus no echo problem will result. Normally, no DC current feeding, ringing, or dialing function is provided on a leased line.

There is also the 2-wire leased line which is a permanent 2-wire connection.

## Intelligent Modem

Formerly, modem functions, settings, and operations were simple and everything was controlled by manual switches, either internal or external, or by wire-strapping settings. No computer control was provided.

All of an intelligent modem's functions, including dialing and answering, are controllable by the computer or terminal it is connected to by means of the same RS-232 serial interface used for data connection.

An intelligent modem operates in one of two states - the command state or the data state. In command state, the modem interprets data received from the serial interface as commands and sends back an action result in response. In data state, the modem modulates the data received from the serial interface and sends the demodulated data to the serial interface as received data. The user needs to know whether the modem is in the command state or data state and how to switch it.

## ISDN

The normal telephone network PSTN (Public Switched Telephone Network) transmits voice band analog signals from end to end. A modem is needed at each end to transmit digital data. The digital telephone network ISDN (Integrated Services Digital Network) transmits digital data from end to end, thus no modem is needed to transmit data. Instead, an ISDN telephone is needed at each end to translate voice signals to and from digital data for ISDN digitized voice data transmission.

### ISDN TA

ISDN has a digital interface at the customer site. An ISDN TA (Terminal Adapter) will adapt the user terminal's interface, usually an asynchronous or synchronous serial interface, to the ISDN digital interface, usually the S- or T-interface. With an ISDN TA a user connects a computer/terminal to the ISDN telephone line in the same way as he/she uses a modem to connect a computer/terminal to the PSTN telephone line.

## BRI

BRI, Basic Rate Interface, is the ISDN service provided to a normal home or office. It consists of 2B+D data channels. A D channel offers a speed of 16Kbps for signaling information transmission. Each B channel is for user data transmission at 64Kbps. Each B channel can be used independently for voice or data transmission. A user can place two independent calls through a BRI interface simultaneously.

## U- or S-Interface

ISDN signal transmission is digital from end to end. At every interface point there is a specified signal format. Equipment at every interface point needs to have signal transmission/reception conform to the specified signal format. At the customer site, the interface point for terminating the ISDN line connection from the CO (Central Office) is called the U-interface. A network terminator NT1 terminates the ISDN U-interface and converts it to the S-interface for internal ISDN equipment connection. Non-ISDN capable equipment can use an ISDN TA to connect to the S-interface.

In North America, the NT1 U-interface device is the user's responsibility. The user can either install an NT1 to get the S-interface for internal ISDN equipment connections, or have an ISDN TA to directly adapt to the U-interface. In Europe, the telephone company installs the NT1 U-interface device at the customer site. The user only needs to have the ISDN TA to adapt to the S-interface.

## AT Command Set

The AT command set is the industry de facto standard used to control a modem in command state. It got its name from the fact that every command line has a prefix AT.

AT commands were first used in the Hayes Smartmodem<sup>®</sup> and hence adopted by other modem manufacturers and communication software writers. The original set of AT commands such as dialing, answering, etc., is used by everyone and is standardized. The AT command set is extended by each modem manufacturer for control of ever-increasing modem functions and capabilities. This extended or enhanced command set is not standardized whatsoever.

The AT command set is used only with an asynchronous serial data interface. To send an AT command to a modem the connected computer must be running a terminal software. ZyXEL has defined a set of extended AT commands to support many of its unique functions and features.

## V.25bis Command Set

V.25bis is a set of auto-dialing commands defined by the ITU-T. V.25bis supports both synchronous and asynchronous data interfaces and is mainly used in Europe and in IBM mainframe or mini-environments which use synchronous communication.

## Error Correction

In synchronous data communication, data is checked and corrected in the host by the so-called "link layer protocol" to ensure data integrity. Normally, no data checking is provided in the host for asynchronous data communication. However, file transfer protocols which include error checking are available with asynchronous hosts.

Nowadays, intelligent modems incorporate error correction protocols inside the modem for asynchronous data communication and it is transparent to the host. The modem packs the asynchronous data characters into blocks. The data is transmitted as synchronous data between the modems. The data blocks are error checked at the remote end, and an erroneous block is retransmitted.

The commonly used error correction protocols are MNP<sup>®</sup> and V.42 protocols.

## Data Compression

Intelligent modems use redundancy removing methods to reduce the number of data bits actually sent for asynchronous character transmission. The full character data is recovered at the other end, thus the total throughput of the modem data transmission is increased.

The data compression protocols commonly used by modems are MNP<sup>®</sup> class 5 and V.42bis. (See definitions below.)

Data compression works on redundancy removing and its efficiency is dependent on both the compression algorithm and data statistics.

## MNP<sup>®</sup> Protocols

MNP<sup>®</sup> (Microcom Network Protocol) is a set of protocols first introduced by Microcom, Inc., and later used by many modem manufacturers. It consists of many classes. Classes 1 to 4 are for error correction, and class 5 is for data compression. MNP class 1 and 2 are obsolete. Normally class 4 is used for error correction and it uses class 3 internally.

MNP class 5 is a data compression protocol with a maximum efficiency of 2 to 1. MNP-5 is used with MNP-4 for error correction.



## V.42bis and V.42

V.42bis and V.42 are data compression and error correction standards set by the ITU-T. V.42bis has a better data compression efficiency than MNP-5 and is a more advanced compression scheme. V.42bis is used with V.42 for error correction.

## Xmodem, Ymodem, and Zmodem

These are file transfer protocols. They do error checking and ensure data integrity of the file transferred. Some variations of these protocols also appear, like Xmodem-1k, Ymodem-G, etc.

The "G" types of protocols do not include error checking. They allow very high throughput rates, but can be safely used only when the modems use MNP4 or V.42 error protocols and there is no speed overrun on the computer's serial port.

Whenever possible, we recommend the use of Zmodem for added security and high flexibility. Consult your communications program manual for more information on transfer protocols.

## Fax and Facsimile

Fax is the abbreviation for facsimile. There are four major parts in a normal 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 then it is 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 Card

A fax card is an internal plug-in card which must be specifically designed to fit into your type of computer. It has the modem function of a facsimile machine. A computer loaded with fax software can send or receive faxes through a fax card. The computer is used as the input and output parts of a facsimile machine and the fax card is used as the transmit/receive part and may also do the encoding/decoding function, depending on the design. The computer controls and communicates with the fax card through a set of proprietary hardware and software interfaces which are different for each fax card manufacturer.

## Modem as a Fax

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. Since the data throughput of a serial RS-232 interface is limited, only compressed fax image data should be carried through this serial interface. Fax image coding and decoding must be done in the computer. Modem/Fax, also called faxmodem, 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.

## EIA Class 1 and Class 2/2.0 Fax Commands

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 faxmodems from a computer through the serial RS-232 interface. Faxmodems and fax software supporting this standard will work together. Class 1 commands control the details of how the modem does on-line negotiation and control jobs whereas Class 2 commands allow the modem to do many negotiations automatically. 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.

## Autodetection of Fax or Data Call

Fax and data modems have different handshaking signal sequences at the beginning of a call as specified by the ITU-T. It is possible to automatically detect whether an incoming call is from a modem or a fax device by testing and recognizing its initial handshaking sequence. A modem with this capability can make a computer process both data and fax calls on the same phone line. An example is that a BBS (Bulletin Board System) can also receive faxes. ZyXEL modems can automatically detect data and fax calls. ZyXEL also includes a fax reception and printing program to allow a BBS to receive faxes and print them out.

## Caller ID

Normally called Caller Number Delivery (CND), this is a service available from phone companies in several parts of the USA and some other countries. With this service, the phone company sends calling party information along with the ring signal to the called party. The major part of this information is the telephone number of the calling party or caller ID. ZyXEL modems can detect and report caller ID. Note that different countries have different caller ID schemes. Please check whether the scheme used in your country is supported by the modem.

## Distinctive Ring

This is a service available from some phone companies in some areas of the USA and elsewhere. You can have several phone numbers on the same subscriber phone line. The phone company sends a different ring signal for each phone number assigned to the same line. You can have your phone equipment answer only a certain type of ring corresponding to a certain phone number. ZyXEL modems can be set to answer on one or a combination of four types of ring signals. The problem is that every country may have a different specification for different ring types.

## Digitized Voice

Modems with digitized voice capability can digitize an incoming voice message with the computer storing it as a file. The modem can also playback a recorded digital voice message either locally or to the line as an announcement.

Digital voice messages need speech compression to reduce the storage requirements. This speech compression is done in real time by the modem and it does the decompression during playback. A simple voice capability using an ADPCM (Adaptive Differential Pulse Code Modulation) algorithm can reduce the speech data rate to 1/2 or 1/3 of the original rate. An advanced algorithm is needed to reduce the speech data rate even further.

## Cellular Modem

A cellular modem is a data modem that can be used on the analog cellular mobile phone system. With the rising popularity of notebook computers this is of increasing importance for people on the move.

There are two kinds of phenomena in the cellular mobile phone system that are particularly bad for modem data communications. One is called cell hand-off, meaning that a cellular phone is instructed to change the radio link from one cell site to another when travelling across a site boundary. The radio link will be temporarily interrupted and most modems will retrain or even hang up. When a cellular phone is instructed by the cell site to change transmitting power, it will cause similar problems. The other particularly annoying phenomenon is multipath fading. Here, a moving cellular phone will experience periodical fading or drop-out of the radio signal. This causes high data error rates and low throughput.

ZyXEL developed cellular modes using its proprietary data pump that handles the cell hand-off and multipath problems. The V.42 link layer protocol with selective reject greatly improves data file transfer throughput in high error situations.

## Automatic Redial / Call Hunting

Most modems will automatically redial a telephone number several times if a connection could not be established on the first try. The modems of the 2864 series also offer the ability to do cyclic redials of a set of up to 10 different numbers.

## Modem Approval and Legal Matters

In some countries the PTT authorities require modems to conform to a set of specific rules, e.g., transmitting signal level limitation, line circuit isolation, or restriction of the behavior of modems during automatic redial. Modems must receive an official approval within those countries to be used legally. ZyXEL provides specifically designed models which have received such an approval. Check your local distributor to find out details about approved models.

# Chapter 3

## MODEM INSTALLATION

This chapter describes the panel function of the 2864 series modems and serves as their installation guide.

### External Modems

A shielded RS-232 cable is required to ensure compliance with FCC Part 15, and it is the responsibility of the user to provide and use a shielded RS-232 cable.

Make sure your installation site is clean and well ventilated. The ventilation slots of your ZyXEL modem located on the top, the sides, and the bottom should not be covered and should allow free movement of air.

### Elite 2864

The Elite 2864 model is a V.34 modem with V.34/fax/voice capability and is upgradeable to include ISDN capability. LEDs are used for all display purposes.

### Elite 2864 Front Panel

Fig. 3.1 shows the front panel of the Elite 2864. There are 21 LED indicators and two key switches.

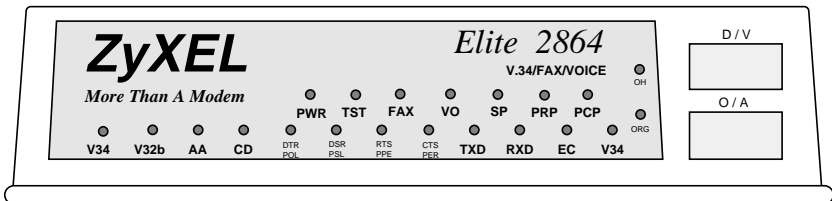


Fig. 3.1: The Elite 2864 front panel

## LED Indicators

PWR	PoWeR on indicator; lights up when the modem's power is ON.
TST	TeST indicator; lights up when the modem is in test mode.
FAX	FAX indicator; lights up when modem transmits or receives a fax.
VO	VOIce mode indicator; lit when modem is in voice mode.
SP *	Serial Port active indicator; lights up when modem is using the serial port for DTE communication.
PRP *	PRInter Parallel port active indicator; lights up when modem is using the parallel port to drive a printer for fax printing.
PCP *	PC Parallel port active indicator; lights up when modem is using the parallel port to communicate with a PC's bidirectional parallel port.

**Note:** \*Only one of the SP, PRP, or PCP LED indicators will light up at one time.

OH	Off-Hook indicator; lit when modem is on-line or in off-hook state. It is turned off when modem is off-line or in on-hook state.
EC	Error Control indicator; lights up when modem is operated in an error controlled mode like MNP4 or V.42. Data compression mode (V.42bis or MNP5) implies error control mode. Also used as retransmission indicator; blinks when retransmitting.
SQ	Signal Quality indicator; lights up when signal quality is good; flashes when it is on margin. At power on it flashes to indicate an error condition; refer to the Diagnostics Chapter (18) for details.
ORG	ORiGinate mode indicator; when lit, the modem will operate in originate mode if it is manually made to go off-hook by toggling the DATA/VOICE switch. If not lit, the modem will be in answer mode.
V34	V.34 (or supported V.fast mode) indicator; flashes alternatively with the V32b indicator when the modem is in a handshaking procedure.
V32b	V.32bis or V.32 mode indicator; flashes when dialing or before handshaking.

**The combinations of the V34 and V32b LEDs indicate the following modes:**

V34	V32b	Mode
OFF	OFF	V.22bis, V.22 and other modes with speed less than 9600bps
OFF	ON	V.32bis or V.32
ON	OFF	V.34 (or supported V.fast mode, if any)
ON	ON	ZyX mode

AA	Auto Answer indicator; lights up when the modem is in auto answer mode; flashes when modem rings.
CD	Carrier Detect indicator; lights up when a valid carrier is detected present on the line.
TXD	Transmit Data indicator; lights up when your DTE/computer transmits data to the modem.
RXD	Receive Data indicator; lights up when your DTE/computer receives data from the modem.

**The following four indicators have different meanings depending on whether the modem is connected to a DTE (computer or terminal) through either of the parallel or serial interfaces (SP or PCP is ON, DTE mode) or whether the modem is connected to a printer through the parallel port interface (PRP is ON, printer mode).**

DTR	DTE mode: Data Terminal Ready indicator; lights up when the DTE or computer indicates that it is ready for communication by raising the corresponding RS232 signal.
POL	Printer mode: Printer On Line indicator; indicates the status of the printer's "Select" (SLCT) signal. It lights up when the printer is selected and is available for data transfer.
DSR	DTE mode: Data Set Ready indicator; lights up when modem is ready for communication.
PSL	Printer mode: Printer SeLect signal; indicates the signal status of "-Select In" from modem to printer. It lights up when printer is enabled to input data.
RTS	DTE mode: Request To Send indicator; indicates the signal status of RS232 signal RTS from DTE. RTS is used for hardware flow control in asynchronous data transmission.
PPE	Printer mode: Printer Paper End indicator; lights up when the printer is out of paper. It indicates the signal status of "PE" from the printer.
CTS	DTE mode: Clear To Send indicator; lights up when modem can accept data for transmission. It indicates the signal status of RS232 signal CTS.
PER	Printer mode: Printer ERror indicator; lights up when an error condition exists in the printer, e.g., out of paper or not on-line. It indicates the signal status of "-Error" from the printer.

## Front Panel Switches

There are two toggle switches on the Elite 2864 front panel.

### D/V (DATA/VOICE)

A toggle switch that switches the modem on-line (off-hook DATA mode) or off-line (on-hook, Voice or Talk mode, the telephone set is connected to the line). The OH LED indicator will be turned on and off by this switch. If S35 bit 4 is set (S35.4=1), pressing this switch will make the modem go off-hook and dial the default number.

### O/A (ORG/ANS)

A toggle switch that determines the mode, Originate or Answer, the modem will operate in, if made go off-hook by pressing the D/V switch. The ORG LED indicator will be turned on and off by this switch.

**Note:** This switch only determines modem operation mode if made go off-hook manually. The **ATD** or **ATA** command will automatically determine the mode.

**Warning:** If this switch is pressed while the modem is turned on, the modem will jump into a special kernel program which allows the user to upload a new firmware into the modem from a connected DTE. If this is not what you intended, turn off the modem and then turn it on again to return the modem to normal operation.

## Elite 2864 Rear Panel

Fig. 3.2 shows the Elite 2864 rear panel.

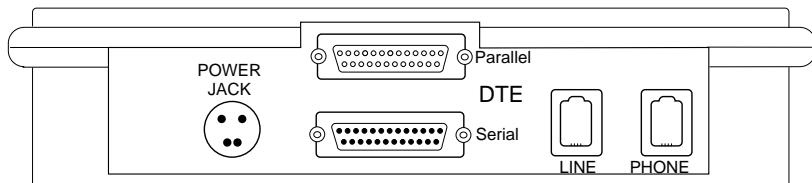


Fig. 3.2: The Elite 2864 rear panel



The following table explains the connectors on the rear panel:

POWER JACK	Input terminal for power adapter. There is no power switch on the modem. The power switch on the power adapter will turn off the power adapter and shut off power to the modem. Always turn off the power adapter before connecting or disconnecting power. For additional safety against possible damage, don't turn on the power with the parallel port connected to a piece of equipment which is under power.
PARALLEL	Parallel port DB25 male connector for connection to a PC's parallel port or a printer's Centronics compatible port.
SERIAL	Serial port DB25 female connector for connection to the serial port of a DTE (computer/terminal).
LINE	Dial-up line RJ11 terminal jack; for connection to a 2-wire dial-up line on the wall jack.
PHONE	RJ11 terminal jack; for connection to a telephone set.

## Connecting the Elite 2864

### Power Connection

Connect the power plug from the adapter to the power jack. Connect one end of the power cord to the power adapter and plug the other end into an electrical outlet. When you connect your 2864 to the power line, make sure you only use the ZyXEL power adapter that is supplied with this unit. Use of another adapter may not allow your modem to operate and could result in serious damage to the unit. This adapter is rated for direct connection to an AC power outlet.

Turn off the power on both the computer and the modem before making connections. Then connect the modem according to the rear panel labels.

**Warning:** Always turn off the power switch on the power adapter before connecting to the modem power jack. Never plug or unplug modem's power jack with the power adapter turned on as this may damage the modem.

### Computer and Printer Connection

The modem has both a parallel port and a serial port connector. You can connect the serial port connector to your computer's serial port or connect the parallel port connector to your PC's bidirectional parallel port or you can connect both ports to your PC's serial and parallel port. You can also connect the serial port to your PC's serial port, and the parallel port to a laser printer. If you have the modem set up for auto



## Elite 2864L Front Panel

The Elite 2864L's front panel is exactly the same as the Elite 2864's except that the Elite 2864L has an LL LED indicator instead of the VO indicator.

LL	Leased-Line indicator; lights up when the modem is operating in the leased-line mode.
----	---

## Elite 2864L Rear Panel

The Elite 2864L has a LEASED line jack and a DIAL-UP line jack. The LEASED line jack is a JM8 leased-line connector for a 2 or 4-wire leased-line connection. Pin assignments for the JM8 jack are listed in appendix B. Pins 1 and 2 are for 2-wire leased-line connections. For 4-wire leased-line connections, pins 1 and 2 are for transmission and pins 7 and 8 are for receiving. The DIAL-UP line connector is an RJ11 connector for dial-up line connections. A normal telephone cable will connect this jack to a telephone line wall jack. There is no PHONE jack for the Elite 2864L model.

## Connecting the Elite 2864L

Connect the power, serial port, and parallel port as described above for the Elite 2864 model. Connect the dial-up line to the DIAL-UP jack and the leased line to the LEASED jack. If no leased line is used, just leave the jack unconnected.

## Turning on the Elite 2864L

Please refer to Turning on the Elite 2864 on page 3–6.

## Elite 2864I and Elite 2864IU

The Elite 2864I is the model with an ISDN S-interface RJ45 connector. The Elite 2864IU is the same model, but with an ISDN U-interface RJ45 connector. The basic panel description for the Elite 2864I and the Elite 2864IU is similar to that of the Elite 2864. Please refer to the separate 2864I ISDN modem user's manual for details.

## Supreme 2864L

The Supreme series model has a LCD display front panel. The Supreme 2864L supports 2/4-wire leased line in addition to the normal dial-up line support.

# Supreme 2864L Front Panel

Fig. 3.3 shows the front panel of the Supreme 2864L. There are 10 LED indicators, a 20×2 LCD display, and four directional key switches.

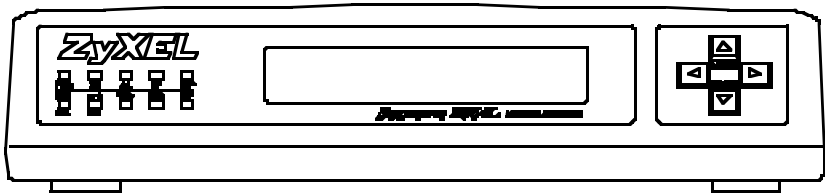


Fig. 3.3: The Supreme 2864L front panel

The 10 LED indicators are labeled as PWR, OH, AA, DTR/POL, RTS/PPE, TXD, RXD, SP, PRP, and PCP. The meaning of these LED indicators can be found on page 3-2 to page 3-3 where the LED indicators of the same label are explained for the Elite 2864 model.

There are four arrow keys on the front panel for panel operations. They allow intuitive menu tree operation and status display. Please refer to chapter 5 (2864 QUICK START) for details regarding the menu key operations.

# Supreme 2864L Rear Panel

Fig. 3.3 shows the rear panel of the Supreme 2864L. The rear panel is similar to the Elite 2864's rear panel shown in , except that the Supreme 2864L has three phone jacks. Besides the dial-up line RJ11 jack and the telephone connection RJ11 jack, there is also a JM8 leased-line jack. Each rear panel connector's explanation can be found starting on page 3-4 where the explanations for the Elite 2864's rear panel are listed. The LEASE D LINE jack is a JM8 type jack with pin assignments listed in appendix B.

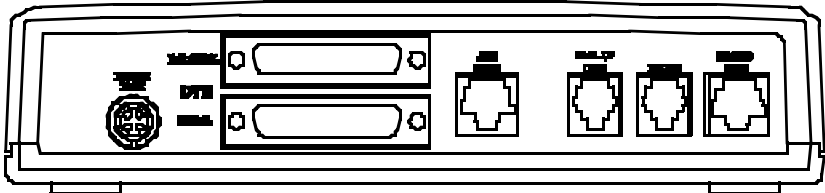


Fig. 3.4: The Supreme 2864L rear panel

# Connecting the Supreme 2864L

Please refer to the section **Connecting the Elite 2864** on page 3–5. The descriptions therein also apply to connecting the Supreme 2864L. The Supreme 2864L has an additional leased-line jack for 2/4-wire leased line connection. Leave the leased-line jack unconnected if the leased line is not used.

## Turning on the Supreme 2864L

Turn on the power switch on the power adapter to turn on the modem. The Supreme 2864L will perform a series of diagnostic tests while a message is shown on the LCD panel. For a more detailed description of these diagnostic tests, please refer to chapter 18 (DIAGNOSTICS).

After performing the diagnostic tests, your Supreme 2864L will display the current modem settings on the front LCD panel as shown in Fig. 3.3. Your Supreme 2864L is now ready for use.

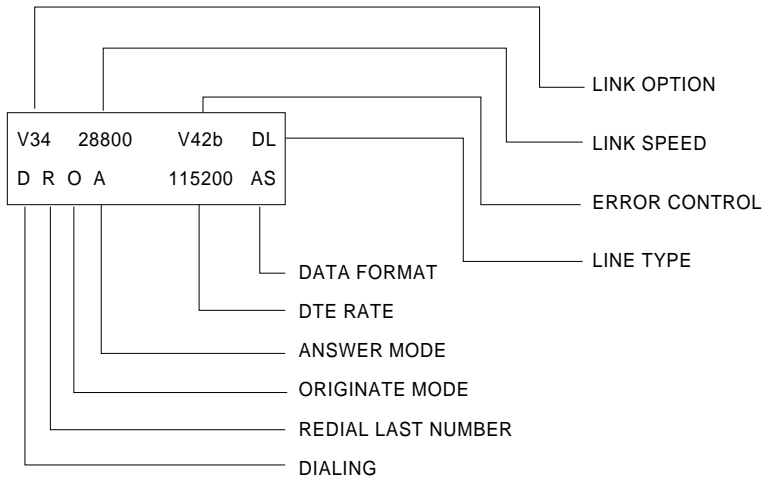


Fig. 3.5: The Supreme 2864L idle screen after powering up

## Supreme 2864I and 2864IU

The Supreme 2864I is the model with an ISDN S-interface RJ45 connector. The Supreme 2864IU is the same model, but with an ISDN U-interface RJ45 connector. The basic panel description for the Supreme 2864I and 2864IU is similar to that of the Supreme 2864L. Please refer to the separate 2864I ISDN modem user's manual for details.

## Omni 288P and Omni 288S

The Omni models are V.34 modems with V.34/fax/voice capability, but without the ISDN capability. The Omni 288P includes a parallel port as DTE interface, the Omni 288S includes a serial port as DTE interface.

### Omni 288P Front Panel

Fig. 3.3 shows the front panel of the Omni 288P. There are 13 LED indicators and one key switch.

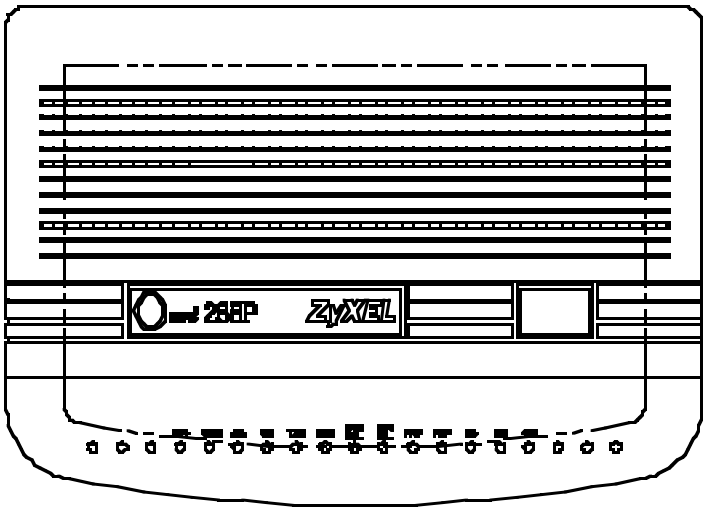


Fig. 3.6: The Omni 288P front panel

The 13 LED indicators are labeled as V34, V32b, AA, CD, TXD, RCD, DTR/POL, DSR/PSL, PRP, PCP, EC, SQ, and OH. Explanations for the meanings of these LED indicators can be found in the table beginning on page 3-2 where the LED indicators of the same label are explained for the Elite 2864 model.

There is only one push-button switch labeled D/V (DATA/VOICE) on the modem's upper case near the lower right corner. Please refer to the description on page 3-4 for an explanation of the switch's use.

### Omni 288S Front Panel

Fig. 3.3 shows the front panel of the Omni 288S. Similar to the Omni 288P, there are 13 LED indicators and one key switch. The LED indicators are labeled the same

as on the Omni 288P except that the Omni 288S has two LED indicators labeled RTS and CTS instead of PRP and PCP as found on the Omni 288P.

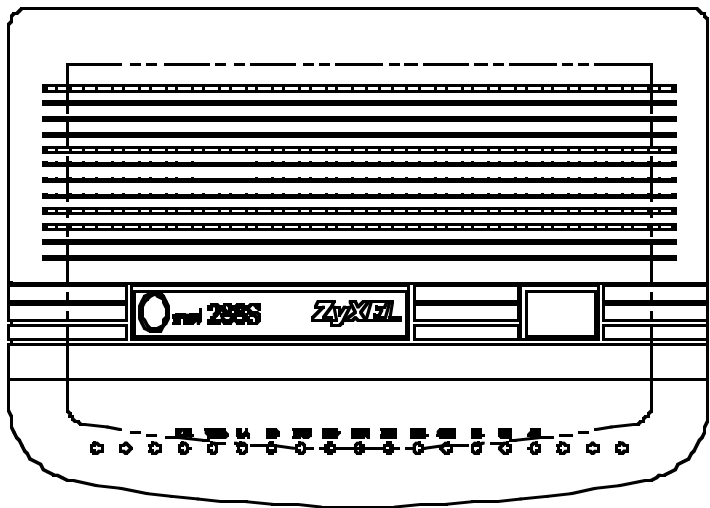


Fig. 3.7The Omni 288S front panel

The meaning of the Omni 288S LED indicators can be found in the table beginning on page 3-2 where the LED indicators of the same label are explained for the Elite 2864 model.

Omni 288P Rear Panel

Fig. 3.8 shows the rear panel of the Omni 288P.



Fig. 3.8: The Omni 288P rear panel

The table below explains the switch and connectors on the rear panel according to their labels:

ON/OFF POWER	The power switch; up position is ON, down position is OFF. Input terminal for the power adapter, connects to an external AC or DC 12V-16V, 1A adapter.
AUX RS232	A RJ45 Jack for an auxiliary RS232 serial port; may be used to issue AT commands and receive responses for monitoring purposes.

TO DTE	This is a parallel port DB25 male connector for connecting to a PC's parallel port or a printer's Centronics compatible port.
MIC	Microphone jack to plug in an external microphone. Used for voice recording purposes.
SPK	Speaker jack to connect an external 8 Ohm speaker. An external speaker may be connected to replace the internal speaker and provide better sound quality.
LINE	Dial-up line RJ11 terminal jack; connects to a 2-wire dial-up line wall jack.
PHONE	RJ11 terminal jack to connect a telephone set.

## Omni 288S Rear Panel

The Omni 288S's rear panel is identical to the Omni 288P's except that the connector labeled TO DTE is a DB25 female connector which connects to a DTE's serial port and there is no AUX RS232 connector.

## Connecting the Omni 288P

Turn off the power on the computer (if possible) and the modem before making connections. Then connect the modem according to the rear panel labels.

### Power connection

Use only the ZyXEL power adapter that is supplied with this modem. Using any other power adapter may cause serious damage to the modem and void warranty.

Connect the power cord from the power adapter to an AC electrical outlet and connect the round power plug from the adapter to the power jack on the modem. This completes the power connection for the Omni 288P.

Warning:	Always turn off the power switch on the modem before connecting the power adapter to the modem. Avoid plugging or unplugging the modem's power jack with the power switch turned on as this may damage the modem.
----------	---

### Computer and Printer Connection

The modem has a parallel port. You can connect this parallel port connector (labeled TO DTE) to your PC's bidirectional parallel port for DTE communication. A normal 25-wire male to female shielded RS-232 cable can be used for this connection. You can also connect the modem's parallel port to a laser printer for direct fax reception and printing operation. A normal PC printer cable together with a female DB25 to female DB25 gender changer can be used for this connection.



If the modem's parallel port is always connected to a laser printer for fax printing, a computer/terminal can connect to the modem's AUX RS232 serial port for issuing AT commands and reception of responses. This is good for configuration and monitoring operation without disconnecting the laser printer. This AUX RS232 serial port is intended only for AT command and response's transmission; it is not intended for DTE data transmission. Auto speed detection is not supported on this AUX RS232 port. Only the speeds 38400 bps and 19200 bps are supported on the AUX serial port, 38400 bps being the default speed. The asynchronous character format accepted on the AUX RS232 port is 8N1 (8 data bits, no parity, one stop bit).

A RJ45 to DB25F connector adapter is needed to convert the RJ45 AUX RS232 port to a normal DCE DB25 female serial port connector. The following table lists the conversion connections:

Signal Name	Pin No. on DB25F	Pin No. on AUX RJ45
TXD	2	1
RXD	3	8
RTS	4	2
CTS	5	7
GND	7	3 and 6
DSR, CD, DTR	6, 8, 20 tied together	-

### Phone Line Connection

Use the telephone cable supplied to connect the modem's LINE jack to the telephone line wall jack. You can also connect a telephone set to the modem's PHONE jack in case you need the telephone for voice communication. A telephone set is not needed for the modem's data, fax, and voice mail communication. The telephone set may also be used to record or to playback voice messages.

### Connecting the Omni 288S

Please refer to the above description for connecting the Omni 288P. The descriptions for the power and phone line connection also apply to the Omni 288S. The descriptions for connection to a computer or a printer through the parallel port do not apply, because the Omni 288S has a serial port for connection to a computer/terminal's serial port only. There is no possibility to connect to a printer by parallel port.

### Turning on the Omni 288P or Omni 288S

Turn on the power switch on the modem to turn on the modem. The modem will do a self-test each time it is turned on. The SQ LED will flash if the power-on self-test fails. For a more detailed description of the diagnostic tests, please refer to chapter 18 (DIAGNOSTICS).



# Chapter 4

## MODEM OPERATION

### Parallel or Serial Port Operation

The 2864 models provide both a parallel port and a serial port for DTE connection, but only one out of three connection modes may be active at any time. The available modes are:

- SP: Serial port mode;
- PRP: Printer parallel port mode;
- PCP: PC parallel port mode.

Only when a port is actively driven and/or terminated externally may that port be active, i.e., the connected device must be turned on and must drive the port. An exception to this is the serial port. The modem defaults to the serial port if no active parallel port device is connected whether an active serial DTE is connected or not.

The modem makes its port selection based on the serial port DTR signal. If it is ON, the modem defaults to serial port (SP) mode; if it is OFF, the modem seeks for an active parallel port device. If an active PC parallel port is connected, the modem will operate in PCP mode; if an active printer is connected, the modem will operate in PRP mode. If no active parallel port device is connected, the modem will default to SP mode.

If both the modem's serial and parallel ports are actively connected and the parallel port is connected to a PC parallel port, the modem makes the port selection based on the serial port DTR signal. The serial port DTE can control the modem's active port through its DTR signal. If both the modem's serial port and parallel port are actively connected and the parallel port is connected to a printer, the modem also makes its port selection based on the serial port DTR signal. If the serial port DTR signal is OFF, the modem operates in PRP mode; if the serial port DTR signal is ON, the modem operates in SP mode. In Class Z mode operation for fax receiving and printing(explained in chapter 15), the modem will temporarily switch to PRP mode to print incoming faxes.

If you use a serial port DTE that does not provide a DTR signal, make sure that no parallel port device is connected to the modem and that the modem defaults to serial port mode. You also need to set the modem DTR setting permanently to ON (&D0).

## PC Parallel Port Operation

If the modem's parallel port is connected to a PC's parallel port, the PC can communicate with the modem through the parallel port link. Be sure that your PC has a bidirectional parallel port. The modem's parallel port will not work with the old unidirectional parallel port. You need not have EPP nor ECP capability on your parallel port.

Using the parallel port, the PC sends and receives 8 data bits at a time to and from the modem. However, for your communications software package the modem appears to be a serial device. A device driver has to be installed to shield the comm software from the actual difference in the hardware setup. The parallel port link accepts hardware and/or software flow control, but setting the serial port speed is only a dummy function; it has no effect on the parallel link.

The parallel port link only supports asynchronous mode communication. Synchronous mode is not supported. The modem buffers the data to and from the PC, direct asynchronous mode is not supported.

## Parallel Port under Windows

You need to install a driver in order to use your Windows comm or fax program. ZyXEL has developed Windows parallel port drivers for which instructions are included on the program disk containing the drivers.

## Parallel Port under DOS

When the DOS comm or fax program directly accesses the serial port, it is not possible for a driver program to intercept the access and redirect it to the parallel port. However, the access can be redirected to the parallel port if a comm or fax program accesses the serial port through a fossil driver, by changing the fossil driver. A fossil driver is included on the companion software disk.

## Parallel Port Speed Limit

Although there is no speed limitation on the parallel port data transfer similar to the serial port, some parallel port I/O read/write operations need to be done for every data byte transfer across the parallel port link. This limits the maximum parallel port transfer speed. The operating system and/or the comm/fax program also does a lot of overhead processing for data received or transmitted as well as for port maintenance. This also limits the maximum speed with which a PC can manage data passing through the parallel port. For the Windows user interface, or the DOS FOSSIL driver, the latter is even a dominating factor. The good point about the parallel port is that data overruns will never occur, no matter how slow the software retrieves data from the port. This is important in the Windows environment.

## ZyXEL Parallel Port Adapter

ZyXEL is developing a special parallel port adapter that will make parallel port transfers much faster between a PC and the Elite 2864. The speed limitation in this case will be determined by how fast and how efficient the PC software program can handle the data.

The operation instructions for this special parallel port adapter are included in the adapter manual. Check ZyXEL's announcements for availability, which is expected to be within a few months of the 2864's introduction. Refer to chapter 21 for information on the ZyXEL serial/parallel I/O adapter.

## Using the Microphone and Speaker Jacks

On the right side or back of the modem, there are two jacks for external microphone and speaker connections. 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 cut 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.

The voice input/output device selection is controlled by voice AT commands. Use **AT+VLS=8** to select the external microphone and **AT+VLS=16** to select the modem internal speaker as input or output device. The external speaker simply physically replaces the internal speaker, and the device selection remains the same.

Usually, the user makes input/output device selection through application software packages according to the program's instructions and the user doesn't need to worry about using commands to make a selection.

## Non-volatile Memory

The Elite 2864 series modem uses a 16Kbit EEPROM for parameter storage, which is four times larger than that of the U-1496 series. There are four user profiles of which each includes 128 S-registers (S0 to S127). 50 phone numbers and 50 passwords can be stored.

## Firmware Update/Upgrade

The 2864 series modem uses 4Mbit flash EPROM(s). The firmware in flash EPROM can be updated by uploading a file from the locally connected DTE. There is no need to open the modem case or use a programming device. The firmware is distributed in a file with the following naming conventions:

**E2864md.vvv**

where

- m is the model with value I, L, or nothing.
- d is the D channel protocol for ISDN. Check the 2864I user's manual for applicable values.
- vvv is the version number.

The first letter is the denomination for the model, with E standing for Elite, S for Supreme and B for an internal card model.

To update the firmware in a flash EPROM is called an "upload". You can run any communications program on your computer that supports the X-modem file transfer protocol to upload. With the modem in command state, type in **ATUPX** and the modem will ask for a confirmation. Answer **yes** and wait for the modem to respond with the prompt:

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

Once the prompt appears, invoke the X-modem protocol to upload the file **E2864md.vvv** to the modem which will update its flash EPROM with the firmware contained in the uploaded file. If the upload is successful, the modem will restart automatically.

If the upload fails, the modem may get stuck with its flash EPROM being erased. Turn off the modem, and then press the O/A button while turning on the modem again. Release the button a few seconds after turning on the modem. A kernel program will take control of the modem. The kernel is responsible for the firmware upload and update process and accepts a limited set of AT commands including the **ATUPX O/A**

ss the O/A; iTD[(ss the )]TJ/F4

For the Supreme models, pressing the MENU key (the UP arrow key) while turning on the modem will have the modem execute the kernel program.

You can also use the **ATUPA** command to upload the firmware file. In this case you can simply dump the firmware file to modem after typing the **ATUPA** command.

## DRAM Upgrade

Open the modem's upper case. You will find four 26-pin sockets on the modem circuit board for 24-pin (26-pin size chip with 2 pins absent) 300 mil., SOJ package DRAM chips. Four 4M×4 organisation 16Mbit DRAM chips may be inserted into these sockets and that makes 8 Mbyte DRAM capability. ZyXEL is developing firmware to accept two DRAM chips or one DRAM chip with DRAM sizes of 4Mbyte or 2Mbyte. If you install two DRAM chips for a 4Mbyte installation, install them into the sockets labeled U38 and U39; for a 2Mbyte installation install one chip into socket U27. The lower left corner of the DRAM sockets has a cut corner, orient the DRAM chips correctly before inserting them into the sockets.

There are basically two types of 4Mx4 DRAM chips, one with 12 row and 10 column addresses and the other with 11 row and 11 column addresses. Both can be used, but the former usually consumes less power. The important thing is to choose the right chip package, some chips are of 400 mil width. An Example of acceptable DRAM chips is TI TMS416400DJ. Both, -60 ns and -70 ns speed parts may be used.

## Resetting The Modem

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

On the LCD model, holding the ENTER key down for a few seconds while powering up will reset the modem.

On the LED model, holding the DATA/VOICE key down for a few seconds (if you own an Omni model, press for less than 10 seconds, otherwise the modem will go to firmware update kernel execution) while powering up the modem will reset the modem. The modem will also run a continuous analog loopback self-test. Printable characters will be shown on the terminal connected to the modem's DTE port. The V34, CD, DSR, CTS, RXD, EC, SQ, TST and PWR LEDs should be ON (The Omni models do not have TST and PWR LEDs, and the parallel port Omni model, Omni 288P, does not have a CTS LED). 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 listed at the beginning of chapter 18.

On the internal card model, short the TS2 jumper with a plug, then power up the computer. The modem will be reset and will run a self-test. Printable characters will be shown on the computer screen. The TS1 LED should be continuously ON. If the LED flashes, the number of flashes indicates the error number corresponding to the error message listed at the beginning of chapter 18.

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.



# Chapter 5

## 2864 QUICK START

This chapter explains how to dial and answer using a modem. If you use this modem with a PC, you probably don't need to worry about modem settings. The factory default should be just right for you. Connect the modem according to the instructions in chapter 3, install the communication software, make the modem dial as instructed in this chapter, and you're all set.

Furthermore, an introduction to the panel operation of the Supreme 2864L is presented. The Supreme 2864L comes with a menu driven 20×2 LCD display. All functions of the modem are displayed and selectable from this menu.

Finally, this chapter will familiarize the user with the menu tree structure. It properly categorizes the modem operations. Non-LCD model modem users can also consult the Supreme 2864L panel menu operations, but must use the equivalent AT commands listed in this chapter instead.

### LCD Panel

The modem's actions, options, and parameters can be set, changed, and viewed from the front panel, or viewed and changed through AT commands by the computer or terminal connected to the modem. We will discuss panel operations in this chapter with reference to equivalent AT commands. Note that in most cases you will use your communication software to send AT commands to your modem. Only in very rare circumstances will it be necessary to use the modem's panel.

Once turned on, the modem goes into the Idle Screen state (except if leased line is selected). It then waits for commands from a computer/terminal or any key pad operation from the front panel. On the LCD screen, there are four on-screen buttons:

D	Dialing operation with submenus
R	Redial last number
O	Originate mode on-line
A	Answer mode on-line

The cursor is blinking above one of these on-screen buttons - a dark rectangle which may be moved using the keys next to the display. The modem also displays the current status and settings in the idle screen:

Information	Example
Link Option	V34 (V.34)
Link Speed	28800 (bps)
Error Control	V42 (implied by V.42bis)
Data Compression	V42b (V.42bis)
Line Type	DL (Dial-up line)
Data Format	AS (asynchronous)
DTE Speed	115200 (bps)

## Panel Operation

Use the four arrow keys to manipulate the menu tree.

Left/Right arrow keys	used for horizontal item selection and option selection.
Up arrow key	also called the MENU key, is used for vertical menu selection and is used to access the previous menu. The up arrow key also serves as a quit command when you want to stop the current action.
Down arrow key	also called the ENTER key, is used solely to register the chosen selection and is very similar to the <i>Carriage Return</i> key or <i>Enter</i> key on a standard keyboard.

## Menu Tree

Fig. 5.1 on the folded pages shows the menu tree structure. There are two main menu trees. One is the CONFIGURATION menu, the other is the DIAGNOSTIC menu. Fig. 5.2 shows the submenus under the CONFIGURATION menu. In Fig. 5.1, there is one idle screen and four data state screens. In data state, screens (1) to (4) can be accessed by pressing the left or right arrow key. A dialing menu can be accessed from the idle screen by activating the D on-screen button. Flip between idle screen and menu screen by pressing the MENU or up arrow key.

## LED Status Screen

Either in idle state or data state, there is an LED status screen that can be accessed and displayed by pressing the left or right arrow key at the menu's top level. This

LED status screen has five status indicators - DCD, DSR, CTS, RTS, and SQ. These status indicators are identical to the LED indicators of the non-LCD modems. Values in one of the other screen displays may give much more detailed information than some of these status indicators; e.g., a data state screen means DCD is on, and an idle screen means DCD is off; SQ is better explained by the S/N ratio reading and the other impairment readings of data screen 2.

## Double Arrows on The Screen

In some menu screens, you will see double left arrows (<<) or double right arrows (>>). This means there are more items on the left or right. Use the left or right arrow key to select them. If you can only see a double right arrow, this indicates that the current item is the first item of the menu. By pressing the left arrow key, the screen will wrap over to the last item. On the other hand, if you only find a double left arrow displayed, this indicates that your current item is the last item in that menu. Similarly, pressing the right arrow key at this point will cause the screen to wrap around to the first item.

## Dialing

From the IDLE SCREEN (1) of Fig. 5.1 you can use the right or left arrow key to scroll through D, R, O, and A. Move the blinking cursor to D, press ENTER, and you will go into the Dialing Directory.

Valid digits/characters for dialing are:

0	1	2	3	4	5	6	7	8	9	*	#
,					(Comma)						Pause
;					(Semicolon)						Return to command state
@					(at-character)						5 second silent wait
!											Hook flash
P											Pulse dial
R											Reverse dial
T											Tone dial
W											Wait for dial tone
-					(Dash)						Digit separator
←					(Backspace)						Backup one character and delete

## Dial Memory

The first menu of the dialing directory is DIAL MEMORY. Pressing the ENTER key will cause the following screen to appear:



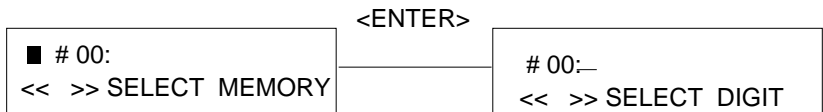
### Equivalent AT Commands

<b>AT&amp;Z?</b>	View all stored phone numbers.
<b>ATDSn</b>	n = 0 - 49; dial stored number.

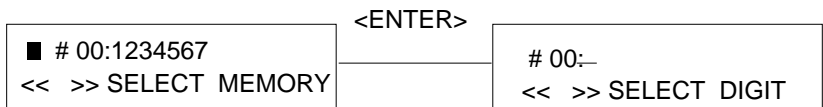
The first stored number shown on the menu is the default dial number which can be selected from the DEFAULT DIAL menu. By pressing the left or right arrow key, you can view up to 50 different numbers stored in the memory. Pressing the ENTER key will cause the selected number to be dialed. The first line of the LCD can display up to 16 characters. However, up to 25 characters can be entered. Characters 17 through 25 are displayed on the second line of the LCD display.

## Storing a Number

Pressing the right arrow key from the DIAL MEMORY display will move the menu to STORE NUMBER. Pressing the ENTER key at this point will produce the following screen display:



### Changing an existing number



### Equivalent AT Commands

<b>AT&amp;Z?</b>	View all stored phone numbers.
<b>AT&amp;Zn=1234567</b>	Store phone number in memory location n (n=0-49).

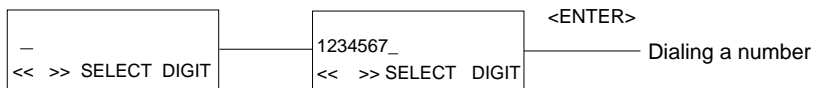
Just like DIAL MEMORY, up to 50 different numbers can be viewed and set. If you want to add a number to the memory, select an unused memory location and press

ENTER. The blinking cursor will change into an underscore and will move to the next position on the right side of the colon(:). SELECT MEMORY will change to SELECT DIGIT. Press the left and right arrow keys to scroll through the valid digits and characters for dialing. Pressing ENTER will confirm the selected digit and cause the cursor to move to the next position.

Repeat the above procedure to finish entering the number, then press ENTER again to save the entry in the EEPROM. The stored numbers will remain in the memory until you revise or delete them. Pressing the up arrow key in the process will abort and exit the current number entry and nothing will be changed or saved.

## Dial Number

The same procedure as in the STORE NUMBER operation is used when entering numbers. Once the number entry is completed, press the ENTER key to dial the number.



### Equivalent AT Commands

<b>ATD1234567</b>	Dial phone number.
-------------------	--------------------

## Manual Dial and the DATA/VOICE Switches

Use of a telephone set to make a call, in which case an answer tone comes back, is normally called Manual Dial. Once the other side answers, access the O(Originate) by using the left or right arrow key so the blinking cursor settles on the O. Then press the ENTER key to start the modem handshaking sequence.

### Equivalent AT Commands

<b>ATD</b>	Go on-line in Originate mode.
------------	-------------------------------

When dialing a person, use the telephone to make the call. When someone on the other side answers, decide who will be the Originate modem and who will be the Answer modem. Once an agreement is reached, use the left or right arrow key to select the O or A for Originate or Answer. Then press the ENTER key to start the modem handshaking sequence.

### Equivalent AT Commands

<b>ATD</b>	Go on-line in Originate mode.
<b>ATA</b>	Go on-line in Answer mode.

When you want to switch from modem to voice communication, simply lift up the handsets of both sides and press the ENTER key while the blinking cursor is on the H or Hang Up. The LCD display will show DISCONNECTING ? to ask for a confirmation. Press ENTER again and the modem will change from data to voice communication. When both sides wish to return to data communication, one side should press O while the other side presses A (as explained previously). This operation will reinitiate the modem handshaking and enable data communication.

For the non-LCD model, use the VOICE/DATA toggle switch for data/voice switching and use the ORG/ANS switch to select originate mode or answer mode on-line. For the Omni model, the **AT\*Mn** command or **S14b0** will decide originate or answer mode on a manual connection. Whenever your modem establishes a connection with another modem, one of the modems must be in answer mode and the other modem in originate mode or a connection is not possible.

Equivalent AT Commands

<b>+++</b>	Escape sequence code; causes a modem to return to command state. Enter the escape sequence while in data state and wait for the modem to respond.
<b>ATH</b>	Go on-hook; disconnect the modem.
<b>ATD</b>	Go on-line in Originate mode.
<b>ATA</b>	Go on-line in Answer mode.

## Repeat Last Dial

Access R (Repeat last dial) by pressing the left or right arrow key and the ENTER key. Before a connection is made, any key pressed from the front panel or terminal keyboard will abort the redial operation.

Equivalent AT Commands

<b>ATDL</b>	Repeat last dial.
<b>A/</b>	Repeat last command once.
<b>A&gt;</b>	Repeat last command once, retry the last call up to 9 times. (country specific)

## Auto Answer

Move to the STATUS REGISTER menu, and change the **S0** value to the desired number of rings until the modem automatically answers. Setting this value to zero disables auto answer.

Equivalent AT Commands

<b>ATS0=0</b>	Disable auto answer.
<b>ATS0=n</b>	Automatically answer on the nth ring.

# Dialing Messages

Dialing will cause the following screen to be displayed on the LCD:

DIALING.....  
1234567

The dialed phone number will be displayed on the second line of the 20×2 LCD screen. If the number exceeds 20 digits, only the first 20 digits/characters will be displayed. If the modem's DIAL-UP LINE jack is not plugged in or not connected, the LCD screen will display the following:

NO DIAL TONE.....  
1234567

then the modem will go back to the IDLE STATUS screen. If the line is busy, after three to five seconds, the LCD displays:

BUSY.....  
1234567

then goes back to the IDLE STATUS screen. If the phone company is ringing the remote modem, a RINGING message is sent to the terminal. Setting `S42.6 = 1` will disable this RINGING result code. If any key interruption occurs (from the terminal or panel) and breaks in before the connection is made, the screen displays:

ABORT.....  
1234567

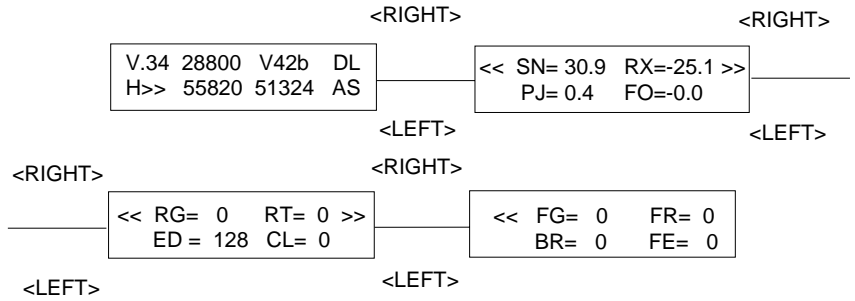
then goes back to the IDLE STATUS screen. If the time interval depicted in the `S7` register expires, and the line is still not connected, the LCD screen shows:

DISCONNECTING.....  
1234567

then goes back to the IDLE STATUS screen. If the first handshaking signal has been detected, the LCD screen will display:

HANDSHAKING.....  
1234567

If a connection has been made, the LCD will display the actual connected status. These are data state screens:



On-line Status Screen 1

Status	Display	Unit/Meaning
Link Option	V34	V.34
Line Speed	28800	bps
Error control	V42b	V.42bis
Line Type	DL	Dial-up Line
Data Format	AS	ASynchronous
Instant Transmission Throughput	55820	bps; Blank in synchronous mode
Instant Receiving Throughput	51324	bps; Link Speed in synchronous mode

On-line Status Screen 2

Status	Display	Unit
Signal to Noise ratio	30.9	dB
Receiving Signal level	-25.1	dBm
Phase Jitter in received signal	0.4	degrees
Frequency Offset in received signal	-0.0	Hz

On-line Status Screen 3

Status	Display	Unit
Retrain Granted	0	
Retrain requestEd	0	
Round trip Echo Delay	128	T; 1/2400 s
Carrier Loss counts	0	

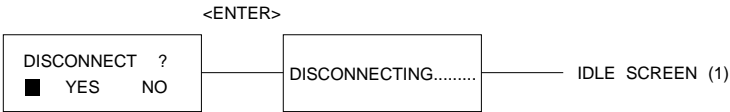


On-line Status Screen 4

Status	Display	Unit
FRN ( Fast Rate reNegotiation) Granted	0	
FRN Requested	0	
Blocks Retransmitted	0	
FCS (Frame Check Sum) Errors	0	

Pressing the left or right arrow key in any one of the ON-LINE STATUS screens will cause the LCD to scroll through the four screens. We will discuss the ON-LINE STATUS screens 2, 3, and 4 in more detail in chapter 18.

Pressing the ENTER key while in any ON-LINE STATUS screen will cause the LCD to display the following:



Equivalent AT Commands

+++	Escape sequence code; causes the modem to return to command mode. Enter escape sequence in the data state and wait for the modem to respond.
ATH	Go on-hook (hang up); disconnect the modem.

Pressing the up arrow key (MENU) or selecting NO will switch the screen back to the ON-LINE STATUS screen 1 and the modem remains on-line. Pressing ENTER will hang up the line and cause the modem to revert to the IDLE STATUS screen to await your next command.

Pressing the up arrow key (MENU) in any of the four data state screens will change your current screen to the CONFIGURATION menu. This will be discussed in chapter 6.

Panel Lock

The panel keyboard can be locked to prevent inadvertent changes in modem settings. This is done by setting the S-register S28 bit 1 to 1 or using the PANEL LOCK menu from the panel, or by issuing the AT\*L1 command from the terminal. Issuing the AT\*L0 command will return the key operation to normal. Alternatively, pressing the left and right arrow keys simultaneously will unlock the panel. In locked panel mode, the ENTER key will lose its effectiveness in changing or saving settings; panel command execution is also disabled. However, viewing in the panel is not affected.



# Chapter 6

## MODEM PARAMETER SETTINGS

This chapter explains how to view and set various major modem parameters using the Supreme 2864L CONFIGURATION menu tree. The non-LCD model users can also consult this menu tree for available parameter options, but must use the equivalent AT command to set the parameter.

The various levels of the CONFIGURATION menu tree are defined here as:

CONFIGURATION menu  
    submenu  
        parameter menu  
        parameter selection

whereby the CONFIGURATION menu is the root of this menu tree. Some submenus, like STATUS REGISTER, SAVE TO, and RESET, have a direct parameter selection under them and do not have the parameter menu level.

Under the CONFIGURATION menu, there are seven submenu (see also Fig. 5.1):

- TERMINAL OPTIONS (parameters for local DTE connection)
- MODEM OPTIONS (parameters for connection to a remote DCE)
- ERROR CONTROL (how to react to transmission errors)
- AUDIO OPTIONS (controlling the internal speaker)
- STATUS REGISTER (see chapter 8)
- SAVE TO (saving a set of parameters into a profile)
- RESET (loading a profile)

Every submenu screen defines certain parameters of the modem's operation. Submenu selections are made by using the left and right arrow panel keys. Pressing the ENTER key will access the parameter menu and pressing the up arrow key (MENU) will return you to the CONFIGURATION menu.

### Parameter Menu

The parameter menu selections are made by using the left and right arrow keys to move from one selection to another. Pressing the up arrow key (MENU) will return you to the submenu screen. Press ENTER to go into Parameter Selection. You will notice that a blinking cursor will appear at the left side of the equal sign (=).

## Parameter Selection

Press the left or right arrow key to view and scroll the available parameters. Only the parameters currently in effect have the equal sign (=) before their respective selections, otherwise a colon (:) appears, meaning that this parameter choice is a selectable option. By pressing MENU to quit the viewing, the screen will return to the parameter menu and the parameter will remain unchanged. Press ENTER to activate the selected parameter.

To save the current parameter settings to the non-volatile EEPROM, access the SAVE TO submenu in the CONFIGURATION menu and select the profile you wish to save the changes to from the various profiles offered. The parameter settings will then be in that profile permanently. You can always recall these settings by resetting from that profile. Access RESET and choose =FACTORY DEFAULT and the active parameter settings will revert to the original factory defaults. Also, any S-register's contents can be individually modified in the STATUS REGISTER submenu.

## Status Register Content Modification

When you access the STATUS REGISTER submenu in the CONFIGURATION menu, the blinking cursor will be changed into an underscore (\_) and the contents will be blanked out. Press the left or right arrow key to scroll through a series of hex digits, then press ENTER when the desired digit appears. Remember that both digits must be entered. Pressing the up arrow key (MENU) will quit the entry procedure. The blinking cursor will reappear and the contents will remain unchanged.

## Menu Tree Elements

In the rest of this chapter, we will explain the parameter selections of each parameter menu and of each configuration submenu. The **large boldface** title of each section is the name of a configuration submenu under which each boldface subtitle is the name of a parameter menu. Under each parameter menu, there are tabulated parameter items. These are the selectable parameter items in this parameter menu. On the right of each parameter item is the equivalent AT command to select or set this parameter. A brief explanation of each parameter follows. A plus sign (+) in front of a parameter item denotes the default parameter setting.

## TERMINAL OPTIONS

### DATA FORMAT

+	ASYNC	<b>AT&amp;M0</b>	Operates as an asynchronous modem with data buffering, may work with data compression and/or error control. Fixed DTE speed with flow control. (Default)
	SYNC DATA	<b>AT&amp;M1</b>	The modem accepts asynchronous commands, but changes to synchronous operation in data mode and exchanges data synchronously with a remote modem.
	DIRECT	<b>AT&amp;M2</b>	Direct asynchronous mode without data buffering. DTE speed equals link speed.
	SYNC	<b>AT&amp;M3</b>	The modem accepts synchronous commands (V.25bis) and exchanges data synchronously with a remote modem. As an alternative, you can dial from the front panel or use a telephone set to connect.

**DATA FORMAT** defines the methods your modem employs to exchange data with the local DTE and the remote DCE.

### CHARACTER LENGTH

+	10	<b>AT*C0</b>	10-bit characters. (Default)
	11	<b>AT*C1</b>	11-bit characters.
	9	<b>AT*C2</b>	9-bit characters.
	8	<b>AT*C3</b>	8-bit characters.

**Note:** The character length includes the start, data, parity, and stop bit(s).

### COMMAND SET

+	AT	<b>AT*I0</b>	The modem accepts asynchronous AT commands. (Default)
	V.25bis	<b>AT*I1</b>	The modem accepts asynchronous or bit-oriented synchronous V.25bis commands.
	DUMB	<b>AT*I2</b>	No commands will be accepted. The modem ignores the DTE data in idle state.

**Note:** Only asynchronous commands are accepted on the parallel port or internal card DTE interface.

## DTE RATE

+ FIXED	<b>AT&amp;B1</b>	Modem serial port speed is always fixed, no matter what link rate (modem speed) is connected. If <b>S44.6=1</b> and a non-ARQ connection is made, DTE rate follows link rate as if &B0 were set. (Default)
FOLLOWS LINK RATE	<b>AT&amp;B0</b>	Modem serial port speed is set in accordance with the link rate. If <b>S44.6=1</b> , the DTE speed is fixed at 38400 bps when the link speed is above 9600, at 9600 when the link speed is 7200, and at link speed when it is below 7200.

Note: If you wish to keep your DTE rate fixed, you should choose a buffered transfer. (see DATA FORMAT)

## DTR OPTIONS

IGNORED	<b>AT&amp;D0</b>	The modem assumes that DTR is always ON and ignores the DTR signal on the serial port.
108.1	<b>AT&amp;D1</b>	An OFF-ON DTR transition causes the modem to dial the number specified under the DEFAULT DIAL of the MODEM OPTIONS submenu. An ON-OFF transition disconnects the modem from the line.
+ DTR / 108.2	<b>AT&amp;D2</b>	An ON-OFF transition of the DTR signal will disconnect the modem from the line. (Default)
108.2 + RST	<b>AT&amp;D3</b>	Same as &D2 but DTR OFF also causes reset from profile 0.

Note: Not all computers provide a DTR signal at their serial port connector. If this is true for your computer (e.g., Apple Macintosh), you must use the IGNORED setting (**AT&D0**).

## DCD OPTIONS

+ TRACKS CARRIER	<b>AT&amp;C1</b>	DCD ON when a carrier is detected (see also S38b3). If <b>S42.7=1</b> , DCD only pulses off for 0.5 sec when carrier loss occurs. (Default)
ALWAYS ON	<b>AT&amp;C0</b>	The modem forces DCD to always remain ON.

## RTS OPTIONS

+ IGNORED	<b>AT&amp;R1</b>	The modem assumes that RTS is always ON and ignores the serial port signals. (Default)
CTS TRACKS RTS	<b>AT&amp;R0</b>	Delay before CTS responds to RTS's change. The delay is set in S26.

Note: Effective only in synchronous mode. This setting is ignored in asynchronous mode. RTS is always used as a hardware flow control signal in this case.

## DSR OPTIONS

+ ALWAYS ON	<b>AT&amp;S0</b>	The modem forces DSR to always remain ON. (Default)
DATA SET READY	<b>AT&amp;S1</b>	According to ITU-T. DSR ON during handshake. If <b>S41.5=1</b> , DSR follows CD, and pulses off for 0.5 sec for CD on-off transition. If <b>S44.4=1</b> , DSR follows DTR.

## COMMAND ECHO

+ ENABLED	<b>ATE1</b>	The modem echoes commands. (Default)
DISABLED	<b>ATE0</b>	The modem does not echo commands.

## RESULT CODE

+ ENABLED	<b>ATQ0</b>	The modem returns result codes. (Default)
DISABLED	<b>ATQ1</b>	The modem does not return result codes.
	<b>ATQ2</b>	If <b>S40.1=1</b> , the modem does not return result codes in answer mode.

## DTE ASYNC SPEED

230400	Selects DTE port asynchronous serial speed. AT command auto speed detection will override this selection.
115200	
76800	
57600	307200
38400	153600
19200	102400
16800	61400
14400	51200

12000	624000
9600	124800
7200	62400
4800	41600
2400	31200
1200	24960
460800	20800
300	921600

## MODEM OPTIONS

### LINK OPTIONS

+ MULTI-AUTO	<b>AT&amp;N0</b>	Auto handshaking with	
		V.34	28800 to 2400
		ZyX19200	19200 (Disabled with <b>s43.1=1</b> )
		ZyX16800	16800 (Disabled with <b>s43.0=1</b> )
		V.32bis	14400/12000/7200
		V.32	9600T/9600/4800
		V.22bis	2400/1200
		V.22	1200
		BELL212A	1200
		G3 Fax	14400 /12000/9600/7200/ 4800/2400 (V.17, V.29, V.27ter) (To turn fax reception off: <b>s38.4=1</b> )
		Cellular Modes	14400 to 4800 (Enabled with <b>s43.3=0</b> ).
V.33 14400	<b>AT&amp;N1</b>	V.33	14400/12000
V.33 12000	<b>AT&amp;N2</b>	V.33	12000
V.32 9600T	<b>AT&amp;N3</b>	V.32	9600T/9600/7200T/4800
V.32 9600	<b>AT&amp;N4</b>	V.32	9600(non-trellis coded)/7200T/4800
V.32 4800	<b>AT&amp;N5</b>	V.32	4800
V.29 9600	<b>AT&amp;N6</b>	V.29	9600
V.29 7200	<b>AT&amp;N7</b>	V.29	7200
V.29 4800	<b>AT&amp;N8</b>	V.29	4800
V.27b 4800	<b>AT&amp;N9</b>	V.27bis	4800
V.27b 2400	<b>AT&amp;N10</b>	V.27bis	2400
V.26b 2400	<b>AT&amp;N11</b>	V.26bis	2400
V.23 1200	<b>AT&amp;N12</b>	V.23	1200/75
V.23 600	<b>AT&amp;N13</b>	V.23	600/75



V.22b 2400	<b>AT&amp;N14</b>	V.22bis	2400/1200
V.22 1200	<b>AT&amp;N15</b>	V.22	1200
V.21 300	<b>AT&amp;N16</b>	V.21	300
V.32b 14400	<b>AT&amp;N17</b>	V.32bis	14400/12000/9600/7200/4800
V.32b 12000	<b>AT&amp;N18</b>	V.32bis	12000/9600/7200/4800
V.32b 7200	<b>AT&amp;N19</b>	V.32bis	7200/4800
B212A 1200	<b>AT&amp;N24</b>	BELL 212A	1200
B103 300	<b>AT&amp;N25</b>	BELL 103	300
V17 G3 FAX	<b>AT&amp;N32</b>	ZyXEL FAX	14400/12000/9600/7200/ 4800/2400
Set <b>s42.4=1</b> to disable V.17 in calling mode.			
ZyX 19200	<b>AT&amp;N34</b>	ZyXEL	19200
ZyX 16800	<b>AT&amp;N35</b>	ZyXEL	16800
ZyX 14400	<b>AT&amp;N36</b>	ZyXEL	14400
ZyX 12000	<b>AT&amp;N37</b>	ZyXEL	12000
ZyX 9600	<b>AT&amp;N38</b>	ZyXEL	9600
ZyX 7200	<b>AT&amp;N39</b>	ZyXEL	7200
CELL 14400	<b>AT&amp;N42</b>	CELL	14400
CELL 12000	<b>AT&amp;N43</b>	CELL	12000
CELL 9600	<b>AT&amp;N44</b>	CELL	9600
CELL 7200	<b>AT&amp;N45</b>	CELL	7200
CELL 4800T	<b>AT&amp;N46</b>	CELL	4800T
V.34 28800	<b>AT&amp;N62</b>	V.34	28800
V.34 26400	<b>AT&amp;N63</b>	V.34	26400
V.34 24000	<b>AT&amp;N64</b>	V.34	24000
V.34 21600	<b>AT&amp;N65</b>	V.34	21600
V.34 19200	<b>AT&amp;N66</b>	V.34	19200
V.34 16800	<b>AT&amp;N67</b>	V.34	16800
V.34 14400	<b>AT&amp;N68</b>	V.34	14400
V.34 12000	<b>AT&amp;N69</b>	V.34	12000
V.34 9600	<b>AT&amp;N70</b>	V.34	9600
V.34 7200	<b>AT&amp;N71</b>	V.34	7200
V.34 4800	<b>AT&amp;N72</b>	V.34	4800
V.34 2400	<b>AT&amp;N73</b>	V.34	2400

## QUALITY ACTION

AUTO RE- TRAIN	<b>AT*Q1</b>	Retrains automatically when poor signal quality is detected. <b>S41.2=1</b> extends retrain time out to 5 minutes.
+ ADAPTIVE RATE	<b>AT*Q2</b>	Falls back automatically to next lower speed when poor signal quality is detected. Falls forward automatically to the next higher speed when the signal quality is improved. (Default)
DISCONNECT	<b>AT*Q3</b>	When poor signal quality is detected, the modem disconnects itself.
NORESPONSE	<b>AT*Q0</b>	No response to poor signal quality.

## DEFAULT DIAL

PH0 - PH49	<b>AT*D0</b>	Default dial pointer. This will be the first phone number displayed in the DIAL MEMORY menu (default: PH0). If the DTR option 108.1 is active, a DTR OFF-ON transition causes the modem to dial the number stored in the memory address selected (memory address 0 to 49). (See also S35b4)
...		
	<b>AT*D49</b>	

## DIAL BACKUP

+ DISABLED	<b>AT*B0</b>	Leased line dial backup disabled. (Default)
PH0 - PH49	<b>AT*B1</b>	When a leased-line cannot continue operation, the originate mode modem will automatically dial the number stored in the memory address selected. The answer mode modem also needs to select a non-zero memory address to enable answering at the dial-up line during dial backup. (See also S44b2)
...		
	<b>AT*B50</b>	

## GUARD TONE

(For V.22 and V.22bis answer mode operation).

+ NONE	<b>AT&amp;G0</b>	No guard tone provided. (Default)
RESERVED	<b>AT&amp;G1</b>	Reserved.
1800 Hz	<b>AT&amp;G2</b>	1800 Hz guard tone provided.

## RDL REQUEST

GRANT	<b>AT&amp;T4</b>	Accepts remote digital loopback test request from remote modem. Must be set when remote configuration is needed.
+ DENY	<b>AT&amp;T5</b>	Ignores remote digital loopback test request from remote modem. (Default)

## LLINE TX POWER (Leased LINE)

0 to -15 dBm	<b>AT*P0</b>	Selects transmission power from 0 dBm to -15 dBm. Default is -9 dBm. Effective in leased-line operation only. Select in the range of -12 to -27 dBm when S35b3 is set. The Omni 288P and 288S have a maximum TX power of -9dBm and -3dBm, respectively.
...		
	<b>AT*P15</b>	

## PHONE JACK

+ SINGLE RJ11	<b>AT&amp;J0</b>	RJ11 permissive telephone jack for dial-up line. (Default)
MULTIPLE RJ12/13	<b>AT&amp;J1</b>	The modem supports A/A1 multi-extension telephone.

## MAKE/BREAK RATIO

+ 39% / 61%	<b>AT&amp;P0</b>	For use in the USA/Canada and some other countries. (Default)
33% / 67%	<b>AT&amp;P1</b>	For use in the UK and some other countries.

Note: Controls the ratio of Make (Off-hook) and Break (On-hook) interval for pulse dialing. Some countries have **AT&P1** as default.

## SECONDARY CHANNEL (Optional feature)

+ DISABLED	<b>AT*S0</b>	Secondary channel is disabled. (Default)
ENABLED	<b>AT*S1</b>	Secondary channel is enabled.

Note: This option is available for models with the *N* suffix (networking).

## PANEL LOCK

+ UNLOCK	<b>AT*L0</b>	Panel key operation is normal. (Default)
LOCK	<b>AT*L1</b>	Panel key is ocked.

Note: When the panel key is locked, it can only be used to view menu items but not to make changes. You can use the PANEL LOCK menu to lock the key, but you cannot unlock the key from this menu. Press the *left* and *right* buttons *simultaneously*, or use **AT\*L1** to unlock the key. However, you can use this menu to view panel lock status.

## SYNC CLOCK

+ INTERNAL	<b>AT&amp;X0</b>	The modem provides the transmission clock. (Default)
EXTERNAL	<b>AT&amp;X1</b>	The DTE provides the transmission clock.
SLAVE	<b>AT&amp;X2</b>	The modem's receiver clock is used as the transmission clock.

## AUTO HANDSHAKE

+ ORIGINATE	<b>AT*M0</b>	When operating on a leased line, the modem will handshake in <i>originate</i> mode. (Default)
ANSWER	<b>AT*M1</b>	When operating on a leased line, the modem will handshake in <i>answer</i> mode.

Note: If you need two modems to automatically connect on a leased line when the power is turned ON, one modem must be set to originate mode, and the other set to answer mode. These settings should be saved in the power-on default profile.

## LINE TYPE

+ DIAL-UP	<b>AT&amp;L0</b>	The modem is connected to a dial-up telephone line. (Default)
2W LEASED	<b>AT&amp;L1</b>	The modem is connected to a 2-wire leased line; plug the phone jack into the LEASED LINE receptacle at the rear of the modem.
4W LEASED	<b>AT&amp;L2</b>	The modem is connected to a 4-wire leased line. Plug into the LEASED LINE receptacle.

Note: For information about wiring a leased line, please refer to appendix B. Models without a leased-line jack can only be connected to a 2-wire leased line through their dial-up jack.

## ERROR CONTROL

### CONTROL LEVEL

Level		Error Control	Compression
NONE	<b>AT&amp;K0</b>	disabled	disabled
MNP4 (MNP3)	<b>AT&amp;K1</b>	MNP4	disabled
MNP4 + MNP5	<b>AT&amp;K2</b>	MNP4	MNP5
V.42 (MNP4)	<b>AT&amp;K3</b>	V.42 or MNP4	disabled
+ V.42(b) + MNP4(5)	<b>AT&amp;K4</b>	V.42 or MNP4	V.42bis based on V.42 or MNP5 based on MNP4 (Default)

Note: **S38.5=1** disables MNP5 with no interference to other settings.

### FLOW CONTROL

DISABLED	<b>AT&amp;H0</b>	DTE flow control is disabled.
+ CTS / RTS	<b>AT&amp;H3</b>	Hardware flow control CTS/RTS is enabled. (Default)
LOCAL XON/ XOFF	<b>AT&amp;H4</b>	Local software flow control XON/XOFF is enabled.
PASS XON/XOFF	<b>AT&amp;H5</b>	reserved.

### NEGOTIA(TION) FALLBACK

+ STAYS ON-LINE	<b>AT*E0</b>	A non-error control connection is maintained if error control negotiation fails. (Default)
DISCONNECT	<b>AT*E1</b>	Disconnects if no error control is established.

### BREAK HANDLING

DESTRUCTIVE	<b>AT&amp;Y0</b>	Destructive, expedited. Sends break, throws away data in buffer.
+ EXPEDITED	<b>AT&amp;Y1</b>	Non-destructive, expedited. Sends break first ahead of data in buffer. (Default)
IN SEQUENCE	<b>AT&amp;Y2</b>	Non-destructive, non-expedited. Sends break in sequence with data.

---

Note: Only the expedited break is implemented in transmission, but all types of break are accepted in reception.

## AUDIO OPTIONS

### SPEAKER CONTROL

ALWAYS OFF	<b>ATM0</b>	The speaker is always OFF. The ring is independently controlled by RING VOLUME.
+ ON UNTIL CONNECT	<b>ATM1</b>	The speaker is ON until a carrier is detected. (Default)
ALWAYS ON	<b>ATM2</b>	The speaker is always ON.
DIALED TO CONNECT	<b>ATM3</b>	The speaker is ON after the final digit is dialed out and the speaker is OFF when a carrier is detected. Tone dialing is inaudible.

### SPEAKER VOLUME

0 - 7	<b>ATL0</b> ... <b>ATL7</b>	Default is 4. The higher the value, the higher the volume. If not <b>ATM0</b> , the speaker volume is set to maximum when in call progress monitoring.
-------	-----------------------------------	--

### RING VOLUME

0 - 7	<b>ATN0</b> ... <b>ATN7</b>	Default is 5. The higher the value, the higher the volume. A value of 0 disables the ring function.
-------	-----------------------------------	---

# Chapter 7

## PROFILES

The 2864 series modems let you save up to 4 sets of configurations which are called profiles. You can save each entire modem configuration in the non-volatile EEPROM memory for later use as default settings, or you can use it as the power-on default. Use the SAVE TO configuration submenu to save the current configuration to a profile, or use the **&Wn** command to save to profile n.

**AT&Wn**

Please note the different use of profile numbers in the **AT&Vn** and **AT&Wn** commands.

There are 5 sets of pre-programmed profiles that come with each 2864 series modem. One is the factory default that is stored in the ROM and is not user alterable. The other four are stored in the non-volatile memory and are pre-programmed to suit the most common applications. You can modify these profiles and save them for your specific applications. You can view each set of profile settings by typing **AT&Vn** (n=0-5) from the terminal. The commands and their responses are as follows. The value shown for each register is a decimal number.

**AT&V0**

Current Settings.....

B0	E1	L4	M1	N5	Q0	V1	X5					
&B1	&C1	&D2	&G0	&H3	&J0	&K4	&L0	&M0	&N0	&P0	&R1	&S0
&X0	&Y1											
*B0	*C0	*D0	*E0	*F0	*G0	*I0	*L0	*M0	*P9	*Q2	*S0	
S000=000		S001=000			S002=043		S003=013		S004=010			
S005=008		S006=003			S007=060		S008=002		S009=006			
S010=007		S011=070			S012=000		S013=000		S014=002			
S015=130		S016=000			S017=018		S018=000		S019=000			
S020=001		S021=178			S022=000		S023=105		S024=138			
S025=000		S026=000			S027=156		S028=068		S029=000			
S030=000		S031=017			S032=019		S033=255		S034=030			
S035=032		S036=000			S037=000		S038=000		S039=032			
S040=000		S041=000			S042=000		S043=008		S044=000			
S045=100		S046=028			S047=064		S048=000		S049=006			
S050=000		S051=000			S052=000		S053=000		S054=000			
S055=000		S056=000			S057=000		S058=000		S059=000			
S060=000		S061=000			S062=000		S063=000		S064=000			

```

...
S115=000    S116=000    S117=000    S118=000    S119=000
S120=000    S121=000    S122=000    S123=000    S124=000
S125=000    S126=000    S127=000

```

OK

**Current settings are the active settings which will effect the modem's functions until the power is turned OFF. You can temporarily change a setting in this set and use it, but the setting will be lost when you turn the power off.**

AT&V1

Profile 0 Settings.....

```

B0    E1    L4    M1    N5    Q0    V1    X5
&B1  &C1  &D2  &G0  &H3  &J0  &K4  &L0  &M0  &N0  &P0  &R1
&S0  &X0  &Y1
*B0  *C0  *D0  *E0  *F0  *G0  *I0  *L0  *M0  *P9  *Q2  *S0

s000=000    s001=000    s002=043    s003=013    s004=010
s005=008    s006=003    s007=060    s008=002    s009=006
s010=007    s011=070    s012=000    s013=000    s014=002
s015=130    s016=000    s017=018    s018=000    s019=000
s020=001    s021=178    s022=000    s023=105    s024=138
s025=000    s026=000    s027=156    s028=068    s029=000
s030=000    s031=017    s032=019    s033=255    s034=030
s035=032    s036=000    s037=000    s038=000    s039=032
s040=000    s041=000    s042=000    s043=008    s044=000
s045=100    s046=028    s047=064    s048=000    s049=006
s050=000    s051=000    s052=000    s053=000    s054=000
s055=000    s056=000    s057=000    s058=000    s059=000
s060=000    s061=000    s062=000    s063=000    s064=000

...
s115=000    s116=000    s117=000    s118=000    s119=000
s120=000    s121=000    s122=000    s123=000    s124=000
s125=000    s126=000    s127=000

```

OK

**Profile 0 satisfies most asynchronous applications. ZyXEL presets this profile to be the same as the factory default. A summary of this profile is:**

DTE speed	115200 bps
Link Option	MULTI-AUTO
Data Format	ASYNC
Command Set	AT
DTR	108.2 Data Terminal Ready
RTS	Ignored



DCD	Tracks Carrier
DSR	Always On
Error Control	V.42bis + MN5
Flow Control	CTS/RTS
Quality Action	Adaptive Rate
Line Type	Dial-up

## AT&V2

Profile 1 Settings.....

B0	E1	L4	M1	N5	Q0	V1	X5				
&B1	&C1	&D0	&G0	&H3	&J0	&K4	&L1	&M0	&N0	&P0	&R1
&S0	&X0	&Y1									
*B0	*C0	*D0	*E0	*F0	*G0	*I0	*L0	*M0	*P9	*Q2	*S0

s000=000	s001=000	s002=043	s003=013	s004=010
s005=008	s006=003	s007=060	s008=002	s009=006
s010=007	s011=070	s012=000	s013=000	s014=004
s015=130	s016=000	s017=018	s018=000	s019=000
s020=001	s021=050	s022=000	s023=105	s024=138
s025=000	s026=000	s027=156	s028=068	s029=000
s030=000	s031=017	s032=019	s033=255	s034=030
s035=034	s036=000	s037=000	s038=000	s039=032
s040=000	s041=000	s042=000	s043=008	s044=000
s045=100	s046=028	s047=064	s048=000	s049=006
s050=000	s051=000	s052=000	s053=000	s054=000
s055=000	s056=000	s057=000	s058=000	s059=000
s060=000	s061=000	s062=000	s063=000	s064=000
...				
s115=000	s116=000	s117=000	s118=000	s119=000
s120=000	s121=000	s122=000	s123=000	s124=000
s125=000	s126=000	s127=000		

OK

**Profile 1 is set for the needs of an asynchronous 2-wire leased-line operation. For the parallel port internal card model, the default setting for this profile is the same as for profile 0.**

DTE speed	115200 bps
Link Option	MULTI-AUTO
Data Format	ASYNC
Command Set	AT
DTR	Ignored
RTS	Ignored
DCD	Tracks Carrier
DSR	Always On

Error Control	V.42bis + MNP5
Flow Control	CTS / RTS
Quality Action	Adaptive Rate
Line Type	2W Leased Line
Terminal Keyboard Aborting	Disabled
Auto Handshake	Originate

## AT&V3

Profile 2 Settings.....

B0	E1	L4	M1	N5	Q0	V1	X5				
&B1	&C1	&D2	&G0	&H0	&J0	&K0	&L0	&M3	&N0	&P0	&R0
&S1	&X0	&Y1									
*B0	*C0	*D0	*E0	*F0	*G0	*I0	*L0	*M0	*P9	*Q2	*S0

s000=000	s001=000	s002=043	s003=013	s004=010
s005=008	s006=003	s007=060	s008=002	s009=006
s010=007	s011=070	s012=000	s013=000	s014=192
s015=130	s016=000	s017=018	s018=000	s019=000
s020=001	s021=154	s022=000	s023=105	s024=138
s025=000	s026=000	s027=128	s028=068	s029=000
s030=000	s031=017	s032=019	s033=255	s034=030
s035=032	s036=000	s037=000	s038=000	s039=032
s040=000	s041=000	s042=000	s043=008	s044=000
s045=100	s046=028	s047=064	s048=000	s049=006
s050=000	s051=000	s052=000	s053=000	s054=000
s055=000	s056=000	s057=000	s058=000	s059=000
s060=000	s061=000	s062=000	s063=000	s064=000
...				
s115=000	s116=000	s117=000	s118=000	s119=000
s120=000	s121=000	s122=000	s123=000	s124=000
s125=000	s126=000	s127=000		

OK

**Profile 2 is set for the needs of a synchronous dial-up line operation. For the internal card or parallel port model, the default setting for this profile is the same as for profile 0 since there is no synchronous mode.**

Link Option	MULTI-AUTO
Data Format	SYNC
DTR	108.2, Data Terminal Ready
RTS	CTS Tracks RTS
DCD	Tracks Carrier
DSR	CCITT (ITU-T)
Quality Action	Adaptive Rate

Sync Clock	Internal
Line Type	Dial-up

## AT&V4

Profile 3 Settings.....

B0	E1	L4	M1	N5	Q0	V1	X5				
&B1	&C1	&D0	&G0	&H0	&J0	&K0	&L2	&M3	&N0	&P0	&R0
&S0	&X0	&Y1									
*B0	*C0	*D0	*E0	*F0	*G0	*I0	*L0	*M0	*P9	*Q2	*S0

s000=000	s001=000	s002=043	s003=013	s004=010
s005=008	s006=003	s007=060	s008=002	s009=006
s010=007	s011=070	s012=000	s013=000	s014=200
s015=130	s016=000	s017=018	s018=000	s019=000
s020=001	s021=018	s022=000	s023=105	s024=138
s025=000	s026=000	s027=128	s028=068	s029=000
s030=000	s031=017	s032=019	s033=255	s034=030
s035=032	s036=000	s037=000	s038=000	s039=032
s040=000	s041=000	s042=000	s043=008	s044=000
s045=100	s046=028	s047=064	s048=000	s049=006
s050=000	s051=000	s052=000	s053=000	s054=000
s055=000	s056=000	s057=000	s058=000	s059=000
s060=000	s061=000	s062=000	s063=000	s064=000
...				
s115=000	s116=000	s117=000	s118=000	s119=000
s120=000	s121=000	s122=000	s123=000	s124=000
s125=000	s126=000	s127=000		

OK

**Profile 3 is set for the needs of a synchronous 4-wire leased-line operation. For models without 4-wire leased line, the default setting for this profile is the same as for profile 0 since they don't have a 4-wire mode.**

Link Option	MULTI-AUTO
Data Format	SYNC
DTR	Ignored
RTS	CTS Tracks RTS
DCD	Tracks Carrier
DSR	Always On
Quality Action	Adaptive rate
Sync Clock	Internal
Line Type	4W Leased Line
Auto Handshake	Originate

## AT&V5

Factory Settings.....

B0	E1	L4	M1	N5	Q0	V1	X5				
&B1	&C1	&D2	&G0	&H3	&J0	&K4	&L0	&M0	&N0	&P0	&R1
&S0	&X0	&Y1									
*B0	*C0	*D0	*E0	*F0	*G0	*I0	*L0	*M0	*P9	*Q2	*S0
s000=000		s001=000		s002=043		s003=013		s004=010			
s005=008		s006=003		s007=060		s008=002		s009=006			
s010=007		s011=070		s012=000		s013=000		s014=002			
s015=130		s016=000		s017=018		s018=000		s019=000			
s020=001		s021=178		s022=000		s023=105		s024=138			
s025=000		s026=000		s027=156		s028=068		s029=000			
s030=000		s031=017		s032=019		s033=255		s034=030			
s035=032		s036=000		s037=000		s038=000		s039=032			
s040=000		s041=000		s042=000		s043=008		s044=000			
s045=100		s046=028		s047=064		s048=000		s049=006			
s050=000		s051=000		s052=000		s053=000		s054=000			
s055=000		s056=000		s057=000		s058=000		s059=000			
s060=000		s061=000		s062=000		s063=000		s064=000			
...											
s115=000		s116=000		s117=000		s118=000		s119=000			
s120=000		s121=000		s122=000		s123=000		s124=000			
s125=000		s126=000		s127=000							

OK

The factory default setting is stored in ROM. ZyXEL presets user profile 0 to the same values as the factory default setting.

## Resetting from Profile

You can reset the modem and load a user profile as the active settings, or you can designate a user profile as the power-on default profile. This can be done from the panel control of the LCD model, or by issuing commands from your terminal.

On the RESET submenu screen, the profile that follows the equal sign (=) is the one that will be loaded when the modem is turned on. This setting also affects the SAVE TO submenu default profile (see next section).

<< RESET  
 = FACTORY DEFAULT

: PROFILE 0  
 : PROFILE 1  
 : PROFILE 2  
 : PROFILE 3  
 = FACTORY DEFAULT

PROFILE 0	<b>ATZ0</b>	Resets the modem and loads user profile 0.
PROFILE 1	<b>ATZ1</b>	Resets the modem and loads user profile 1.
PROFILE 2	<b>ATZ2</b>	Resets the modem and loads user profile 2.
PROFILE 3	<b>ATZ3</b>	Resets the modem and loads user profile 3.
FACTORY DEFAULT	<b>ATZ4</b>	Resets the modem and loads the factory default profile.

Selecting profile *n* will reset the modem and load user profile *n*. Profile *n* is also set as the power-on profile.

### Saving to Profile

You can save your current settings to one of the four user profiles. If you want to modify one of the profiles, recall it as the active settings, then use the panel menu or **AT** command to do modifications. Save it by using the **SAVE TO** submenu or **&Wn** command. For example, to save to profile 2, you can issue **AT&W2** from the terminal or select the **SAVE TO** submenu from the LCD panel, then press the ENTER key on profile 2. On the **SAVE TO** submenu screen, the profile accompanying the equal sign (=) is the profile selected in the **RESET** submenu, i.e., the power-on default profile, unless the power-on profile is set to factory default. In this case, profile 0 is the **SAVE TO** default.

```
<<  SAVE TO  >>
      =PROFILE  0
```

```
: PROFILE 1
: PROFILE 2
: PROFILE 3
= PROFILE 0
```

PROFILE 0	<b>AT&amp;W0</b>	Saves the current settings to the user profile 0.
PROFILE 1	<b>AT&amp;W1</b>	Saves the current settings to the user profile 1.
PROFILE 2	<b>AT&amp;W2</b>	Saves the current settings to the user profile 2.
PROFILE 3	<b>AT&amp;W3</b>	Saves the current settings to the user profile 3.

### Profile Protection

If S35 bit 6 of profile 0 is set, this profile is protected. A save operation using **AT&W0** will prompt the user to enter the supervisory password. Using the **SAVE TO** menu to save to profile 0 will have no effect. Refer to chapter 8 for more information on S-registers.

Note that only profile 0 can be protected.

Setting S35 bit 6 in profile 0 will also protect the supervisor password. If this bit is set, the supervisor password cannot be reset to the default ZyXEL by a modem hardware reset (see chapter 18). Memorize your password well before setting this bit.

## Resetting Profiles

After you have changed the user profile settings, you can reset all four user profiles to factory preset values if you wish. This is done by holding the ENTER key down on a Supreme model while turning on the modem. On a non-LCD model, a reset is done by holding the DATA/VOICE switch down while turning on the modem. On an internal card model, shorting the wire strapping TS2 and then turning on the power will reset the modem. Remember that by resetting the modem, all of your user profile settings are lost. Unless you have set S35 bit 6 of profile 0, this will also reset the supervisor password to ZyXEL (see last section).

---

Note:	The reset stated here is a total reset to factory state. If you get somewhere and cannot get back, this is the way to get to a known state. The modem also does continuous self-testing after this reset (see Chapter 18 for details). Turn off the power to stop the testing.
-------	--

# Chapter 8

## STATUS REGISTERS

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

Every user profile corresponds to a set of S-register values, but when we mention S-registers, we are referring to the ones that correspond to the active profile. If you want to read or change the values in a profile that is currently inactive, you will have to recall the profile to make it active (see chapter 7).

The 2864 series modems are provided with 128 S-registers from S0 to S127. S0 to S11 are standard AT S-registers, and S12 to S127 are mostly bit-map configured. Changes in the bit-map configuration can have the same effect as issuing AT commands. However, using the equivalent AT commands is recommended.

### Reading and Setting S-Registers

See Status Register Content Modification section in chapter 6 for reading and setting S-registers using the LCD model's LCD panel. When using AT commands, use:

**ATSr?**

to display the value stored in S-register r; use:

**ATSr.b?**

to display the content of bit b of S-register r.

In order to modify the corresponding units use:

**ATSr=n**                      ( $0 \leq r \leq 127$ ;  $0 \leq n \leq 255$ )

**ATSr.b=n**                    ( $0 \leq r \leq 127$ ;  $0 \leq b \leq 7$ ;  $0 \leq n \leq 1$ )

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

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

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

- Read the value from S38 using `ATS38?`.
- Convert it to its binary value, using the following weight table.

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

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

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

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

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

- Using the result decimal value, do an `ATS38=n` to set the register.

Note: If you enter values from the LCD front panel, use the hexadecimal (hex) values.



## S-Register Descriptions

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

### The Standard AT-Registers

Register	Default	Min.	Max.	Description
S0	0	0	255	Sets the number of rings on which the modem will answer automatically. <b>S0=0</b> disables auto-answer. The maximum and minimum numbers of rings are country specific.
S1	0	0	255	Counts the incoming rings and stores the value to this register. Users can read this value, but should not change it.
S2	43	0	255	S2 contains the ASCII decimal value for the Escape Sequence character. The default character is the plus character (+). A value of 128-255 disables the escape code.
S3	13	0	255	Contains the ASCII decimal value of the Carriage Return character.
S4	10	0	255	Contains the ASCII decimal value of the Line Feed character.
S5	8	0	255	Holds the ASCII decimal value of the Backspace character. A value of 128-255 disables the Backspace key's delete function.
S6	3	0	255	Sets the number of seconds the modem will wait before dialing if X0 or X1 is selected. If X2, X3, X4, X5, X6 or X7 is selected, the modem will dial as soon as it detects a dial tone. This S-register also sets the time-out interval for the <i>W</i> dial modifier to wait for the dial tone. (See also S41b4 and <b>ATD</b> command)

Register	Default	Min.	Max.	Description
S7	60	0	255	Sets the number of seconds the modem will wait for a carrier. If the modem does not detect a carrier within this time limit, it hangs up and returns the NO CARRIER result code.
S8	2	0	255	Sets the duration of delay generated by the comma (,) dial modifier. Also sets the pause between command re-execution for the repeat (>) command.
S9	6	0	255	Sets the duration, in tenths of a second, that the remote modem's carrier signal must be present before recognition. When in non-FSK or half-duplex operation, the modem ignores the setting of this register.
S10	7	0	255	Sets the duration, in tenths of a second, that the modem will wait after loss of carrier before hanging up. This guard time allows the modem to distinguish between a line hit, or any other cause that momentarily breaks the connection, and a true disconnection (hanging up) by the remote modem.
S11	70	0	255	Sets the duration and spacing, in milliseconds, in touch-tone dialing.

**Note:** The numerical values of the ASCII codes are always given as decimals. If you enter values from the LCD front panel, you must convert these values to hexadecimal (hex) values.

## ZyXEL-specific Registers

**S12 Reserved.**

**S13 Bit-mapped register; default: 0:**

Code	Bits	Bin.	Dec.	Description
	(1)	0	0	Doesn't capture modem manufacturer info. (Default)
		1	2	Captures modem manufacturer information during V.42 handshake. Will be displayed in <b>ATI2</b> Last Speed/Protocol line if available.

**S14 Bit-mapped register; default: 2:**

Code	Bits	Bin.	Dec.	Description
&M0	(7,6)	00	0	Async, buffered. (Default)
&M1		01	64	Async command, sync data.
&M2		10	128	Async direct, unbuffered.
&M3		11	192	Sync.
&X0	(5,4)	00	0	Internal clock. (Default)
&X1		01	16	External clock (from DTE).
&X2		10	32	Remote clock (Slave).
&L0	(3,2)	00	0	Dial-up line. (Default)
&L1		01	4	2W leased line.
&L2		10	8	4W leased line.
&T4	(1)	0	0	Grants remote digital loopback test request.
&T5		1	2	Denies remote digital loopback test request. (Default)
*M0	(0)	0	0	Originate mode auto-handshake in leased-line operation. (Default)
*M1		1	1	Answer mode auto-handshake in leased-line operation.

**S15 Bit-mapped register; default: 130:**

Code	Bits	Bin.	Dec.	Description
Z0	(7,6,5)	000	0	Profile 0 as active settings; also active after the next power turn-on.

Code	Bits	Bin.	Dec.	Description
Z1		001	32	Profile 1 as active settings; also active after the next power turn-on.
Z2		010	64	Profile 2 as active settings; also active after the next power turn-on.
Z3		011	96	Profile 3 as active settings; also active after the next power turn-on.
Z4		100	128	Profile 4 as active settings; also active after the next power turn-on. (Default)
*C0	(4,3)	00	0	10-bit character length. (Default)
*C1		01	8	11-bit character length.
*C2		10	16	9-bit character length.
*C3		11	24	8-bit character length.

Note: Character length includes start bit, data bits, parity, and stop bit(s).

Code	Bits	Bin.	Dec.	Description
	(2)	0	0	1 stop bit. (Default)
		1	4	2 stop bits.
	(1,0)	00	0	Even parity.
		01	1	Odd parity.
		10	2	No parity. (Default)

#### S16 Test status register; default: 0:

Code	Bits	Bin.	Dec.	Description
&T0			0	No test is in progress. (Default)
&T1			1	Analog loopback test is in progress.
&T2			2	Reserved.
&T3			3	Local digital loopback test is in progress.
&T6			6	Remote digital loopback test is in progress.
&T7			7	Remote digital loopback with self-test is in progress.
&T8			8	Analog loopback with self-test is in progress.

Note: This S-register may not be set directly and may not be read while a test is in progress. Use the **AT&Tn** command codes.

**S17 Bit-mapped register; default: 18:**

Code	Bits	Bin.	Dec.	Description
*I0	(7,6)	00	0	AT command set. (Default)
*I1		01	64	V.25bis command set.
*I2		10	128	Dumb mode (no commands accepted).
D	(5)	0	0	Dials and goes online normally. (Default)
DR		1	32	Reverse dial: dials and goes online in answer mode.
*P0	(4,3,2,1)	0000	0	Sets "leased-line transmission" power level. (See also S35b3)
...		...	...	
*P15		1111	30	
*S0	(0)	0	0	Disables secondary channel. (Default)
*S1		1	1	Enables secondary channel.

Note: The secondary channel is only available in models with network management capability.

**S18 Set DTE speed for auto answer;**

**Default: 0:** Same value format as S20 (exception: set to 32 for 230400 bps). If non-zero, it forces the modem to use the fixed baud rate indicated by this value when answering. A value of zero disables this function.

**S19 Modem connection mode; default: 0:**

Code	Dec.	Description
&N0	0	Multi-Auto; auto negotiates the highest possible link rate. (V.34 28800 - 2400, ZyX 19200, ZyX 16800, V.32bis 14400/12000/7200, V.32 9600T/9600/7200T/4800, V.22bis 2400/1200, V.22 1200, BELL 212A 1200, V.17 FAX 14400/12000/9600/7200, V.29 FAX 9600/7200, V.27ter FAX 4800/2400, cellular modes)
&N1	1	V.33 14400/12000
&N2	2	V.33 12000
&N3	3	V.32 9600T/9600/7200T/4800
&N4	4	V.32 9600/7200T/4800
&N5	5	V.32 4800

Code	Dec.	Description
&N6	6	V.29 9600
&N7	7	V.29 7200
&N8	8	V.29 4800
&N9	9	V.27bis 4800
&N10	10	V.27bis 2400
&N11	11	V.26bis 2400
&N12	12	V.23 1200/75
&N13	13	V.23 600/75
&N14	14	V.22bis 2400/1200
&N15	15	V.22 1200
&N16	16	V.21 300
&N17	17	V.32bis 14400/12000/9600/7200/4800
&N18	18	V.32bis 12000/9600/7200/4800
&N19	19	V.32bis 7200/4800
&N24	24	Bell 212A 1200
&N25	25	Bell 103 300
&N32	32	V.17 FAX 14400/12000/9600/7200 V.29 FAX 9600/7200 V.27ter FAX 4800/2400
&N34	34	ZyX 19200 19200
&N35	35	ZyX 16800 16800
&N36	36	ZyX 14400 14400
&N37	37	ZyX 12000 12000
&N38	38	ZyX 9600 9600
&N39	39	ZyX 7200 7200
&N42	42	CELL 14400 14400
&N43	43	CELL 12000 12000
&N44	44	CELL 9600 9600
&N45	45	CELL 7200 7200
&N46	46	CELL 4800 4800T
&N62	62	V.34 28800
&N63	63	V.34 26400
&N64	64	V.34 24000

Code	Dec.	Description	
&N65	65	V.34	21600
&N66	66	V.34	19200
&N67	67	V.34	16800
&N68	68	V.34	14400
&N69	69	V.34	12000
&N70	70	V.34	9600
&N71	71	V.34	7200
&N72	72	V.34	4800
&N73	73	V.34	2400

Note: Not all models support all modes. Check the compatibility table in chapter 1 for available modes.

## **S20 DTE speed (auto-detected from AT command); default: 1:**

Dec.	Description	Dec.	Description
0	230.4 Kbps	1	115.2 Kbps (Default)
2	76.8 Kbps	3	57.6 Kbps
4	38.4 Kbps	5	19.2 Kbps
6	16.8 Kbps	7	14.4 Kbps
8	12.0 Kbps	9	9.6 Kbps
10	7.2 Kbps	11	4.8 Kbps
12	2.4 Kbps	13	1.2 Kbps
14	460.8 Kbps	15	300 bps
16	307.2 Kbps	17	153.6 Kbps
18	102.4 Kbps	20	61.44 Kbps
21	51.2 Kbps	22	624 Kbps
24	124.8 Kbps	25	62.4 Kbps
26	41.6 kbps	27	31.2 Kbps
28	24.96 Kbps	29	20.8 kbps
46	921.6 Kbps		

Note: Only the first 16 speeds (0 to 15) are supported by AT auto-speed detection (autobaud).

**S21 Bit-mapped register; default: 178:**

Code	Bits	Bin.	Dec.	Description
&D0	(7, 6)	00	0	The modem ignores the DTR signal, DTR is always assumed to be ON.
&D1		01	64	108.1; DTR OFF-ON transition causes dial of the default number. DTR OFF causes hang-up.
&D2		10	128	108.2, Data Terminal Ready, DTR OFF causes the modem to hang up and return to the command state. (Default)
&D3		11	192	108.2 + RST; DTR off causes the modem to hang up and reset the modem to profile 0.
&R0	(5)	0	0	CTS follows RTS in synchronous mode. Response delay is set in S26.
&R1		1	32	Ignores RTS (CTS is always ON) in synchronous mode. (Default)
&C0	(4)	0	0	CD is always ON.
&C1		1	16	CD tracks presence of data carrier. (Default; see also S38b3)
&S0	(3)	0	0	DSR is always ON. (Default)
&S1		1	8	DSR according to ITU-T. (See also S44b4, S41b5)
M0	(2, 1)	00	0	The speaker is always OFF.
M1		01	2	The speaker is ON until a carrier is detected. (Default)
M2		10	4	The speaker is always ON.
M3		11	6	The speaker is ON after the last digit is dialed out until the carrier detected.
*E0	(0)	0	0	Maintains a non-error control connection when the error control handshake fails. (Default)
*E1		1	1	Drops the connection if no error control is possible.

**S22 Reserved.**



**S23 Bit-mapped register; default: 105:**

Code	Bits	Bin.	Dec.	Description
Q0	(7)	0	0	The modem returns result codes. (Default)
Q1		1	128	The modem does not return result codes. (See also S40b1)
V0	(6)	0	0	Displays result code in numeric format. (See also S35b7)
V1		1	64	Displays result code in textual format. (Default)
X0	(5,4,3)	000	0	Basic result codes (0-4). (See result code table for <b>ATXn</b> in chapter 9)
X1		001	8	Result code: 0 to 5; 10 to 21.
X2		010	16	Result code: 0 to 6; 10 to 21.
X3		011	24	Result code: 0 to 5; 7 to 21.
X4		100	32	Result code: 0 to 21.
X5		101	40	Error control result code is enabled. (Default)
X6		110	48	Error control result code is enabled.
X7		111	56	Error control result code is enabled.
&P0	(2)	0	0	Pulse dial make/break ratio=61%:39%. (Default)
&P1		1	4	Pulse dial make/break ratio=67%:33%.
T	(1)	0	0	Tone dial. (Default)
P		1	2	Pulse dial.
E0	(0)	0	0	Command echo disabled.
E1		1	1	Command echo enabled. (Default)

**S24 Bit-mapped register; default: 138:**

Code	Bits	Bin.	Dec.	Description
L0	(7,6,5)	000	0	Speaker volume control: OFF
L1		001	32	Low.
L2		010	64	
L3		011	96	
L4		100	128	Medium. (Default)
L5		101	160	
L6		110	192	

Code	Bits	Bin.	Dec.	Description
L7		111	224	High.
N0	(3,2,1)	000	0	Ring volume control: OFF
N1		001	2	Low.
N2		010	4	
N3		011	6	
N4		100	8	Medium.
N5		101	10	(Default)
N6		110	12	
N7		111	14	High.

#### S25 DTR detection delay;

**Default: 0:** Specifies in units of 10ms the minimum time that the DTR signal must be OFF in order to be detected. If S25=0, the delay time is 4ms.

#### S26 RTS/CTS delay;

**Default: 0:** Sets the delay, in 10 millisecond units, between RTS and modem's CTS response in synchronous mode. (See &Rn)

#### S27 Bit-mapped register; default: 156:

Code	Bits	Bin.	Dec.	Description
*Q0	(7,6)	00	0	No reaction to poor signal quality.
*Q1		01	64	Initiates retrain if signal quality is poor. (See also S41b2)
*Q2		10	128	Adaptive rate (auto fall-back and fall-forward when signal quality changes; default)
*Q3		11	192	Disconnects when signal quality is poor.
&H0	(5,4,3)	000	0	Flow control is disabled.
&H1		001	8	Reserved.
&H2		010	16	Reserved.
&H3		011	24	Hardware CTS/RTS flow control. (Default)
&H4		100	32	Software XON/XOFF flow control.
&H5		101	40	Reserved.
&K0	(2,1,0)	000	0	No error correction.
&K1		001	1	MNP4 (Includes MNP3, see also S41b0).
&K2		010	2	MNP4 + MNP5. (See also S41b0, S38b5)

Code	Bits	Bin.	Dec.	Description
&K3		011	3	V.42 + MNP4.
&K4		100	4	V.42 + V.42bis (Compatible with &K2; default; see also S38b5).

**S28 Bit-mapped register; default: 68:**

Code	Bits	Bin.	Dec.	Description
B0	(7)	0	0	Selects ITU-T V.22 for 1200 bps communication. (Default)
B1		1	128	Selects Bell 212A for 1200 bps communication.
&B0	(6)	0	0	DTE/DCE rate follows link rate. (See also S18, S44b6)
&B1		1	64	DTE/DCE rate is fixed at the DTE setting, range from 300 to 460.8 Kbps. (Default; see also S44b6)
&G0	(5,4)	00	0	No guard tone. (Default)
&G1		01	16	Reserved.
&G2		10	32	1800 Hz guard tone.
&Y0	(3,2)	00	0	Destructive, expedited break.
&Y1		01	4	Non-destructive, expedited break. (Default)
&Y2		10	8	Non-destructive, un-expedited break.
*L0	(1)	0	0	Panel key is normal. (Default)
*L1		1	2	Panel key is locked.
&J0	(0)	0	0	Single line, RJ11 phone jack. (Default)
&J1		1	1	Multiple phone/modem line, RJ12/RJ13 phone jack.

**S29 Default dial phone number pointer; default: 0:**

Use **AT&Zn=<number>** to store a phone number at address n.

Code	Dec.	Description
*Dn	0-49	Sets the default dial phone number pointer at location n in the phone directory stored in EEPROM.

**S30 Dial-backup phone number pointer; default: 0:**

Code	Dec.	Description
*B0	0	Disables dial backup.
*Bn	1-50	Enables dial backup and sets the dial backup phone number pointer at location n-1 in the EEPROM. (See also S44b2)

Note: When the leased line has become unoperational, the modem will automatically switch to dial line and the originate mode modem will dial the number according to the pointer saved here if dial backup was enabled; the answer mode modem will try the leased line and wait for a ring if dial backup is enabled (a non-zero number is selected).

**S31 Default: 17; contains the ASCII decimal value of the XON character.**

**S32 Default: 19; contains the ASCII decimal value of the XOFF character.**

**S33 Reserved.**

**S34 Default: 30; dial-backup restoral lookback timer, in minutes.**

Note: In dial backup operation, in addition to switching to the dial-up line, the modem automatically looks back to determine whether the leased line is again operational. This timer disconnects the current dial-up line and attempts to connect on the original leased line. If it is still unavailable, the dial-up line continues to be used.

**S35 Bit-mapped register; default: 32:**

Code	Bits	Bin.	Dec.	Description
	(7)	1	128	Enables an extended numerical result code: 50 to 65 when an error control connection is made, used with <b>ATV0</b> (See also S23b6):
			50	CONNECT
			51	CONNECT1200
			52	CONNECT2400
			53	CONNECT4800
			54	CONNECT7200
			55	CONNECT9600
			56	CONNECT12000
			57	CONNECT14400
			58	CONNECT 16800
			59	CONNECT 19200
			60	CONNECT 21600
			61	CONNECT 24000
			62	CONNECT 26400
			63	CONNECT 28800
			64	CONNECT 31200
			65	CONNECT 33600

Code	Bits	Bin.	Dec.	Description
	(6)	1	64	Enables password protection to profile saving. When <b>AT&amp;W0</b> is issued and profile 0 in the EEPROM has this bit set, the supervisory password will be requested. This bit in profile 0 also protects the supervisory password from a hardware reset.
	(5)	1	32	SREJ option: Enables Selective Reject in V.42. (Default)
	(4)	1	16	Effective only on models with a DATA/VOICE switch. When the DATA/VOICE switch is pressed, the modem will dial the default number. (See also <b>*Dn</b> , S29)
	(3)	1	8	Add 12dBm attenuation to the leased-line transmission power. (See <b>also *Pn</b> , S17b1, S49b0)
	(2)	1	4	V.26bis alternative A.
	(1)	1	2	Disables aborting from connection during modem handshaking.
	(0)	1	1	Uses CELL 4800T trellis coded 4800 for V.32 4800.

**S36 Bit-mapped register (Security function control): default: 0:**

Code	Bits	Bin.	Dec.	Description
*G0	(7,6,5)	000	0	No security function. (Default)
*G1		001	32	Type 1* security, with password check.
*G2		010	64	Type 1* security, with password check and call back.
*G3		011	96	Type 2* security, with password check.
*G4		100	128	Type 2* security, with password check and call back.
*G5		101	160	Type 2* security, with password check and call back; call-back number from remote.

**Note:** In security type 1, the remote site must be a ZyXEL modem. In security type 2, the remote site can be any other brand of modem.

### Remote configuration control:

Code	Bits	Bin.	Dec.	Description
	(4,3,2)			Reserved.
*Wab	(1)	0	0	Writes from the local profile <i>a</i> to the remote profile <i>b</i> .
*Rab		1	2	Reads from the remote profile <i>b</i> to the local profile <i>a</i> .
*F1	(0)	0	0	Denies remote request for configuration.
*FO		1	1*	Grants remote request for configuration.

\*. Remote digital loopback request must also be granted. (**AT&T4**).

### S37 Bit-mapped register;

**Default: 0** For remote configuration using the panel menu: (See \*Wab, \*Rab)

Code	Bits	Dec.	Description
	(7 to 4)	0 to 5	Local profile number.
	(3 to 0)	0 to 5	Remote profile number.

Note: 0 through 3 are profiles 0 to 3, 4 is the current profile, and 5 is the factory default (4 and 5 are read-only).

Note: When using the LCD panel for remote configuration, set S36b1 and S37 first, then activate it in the DIAGNOSTIC menu.

### S38 Bit-mapped register, default: 0:

Code	Bits	Bin.	Dec.	Description
	(7, 6)			Reserved.
	(5)	1	32	Disables MNP5 negotiation regardless of error control setting.
	(4)	0	0	Multi-Auto answer with fax answering enabled. (Default)
		1	16	Disables fax answering in Multi-Auto mode. Hangs up if a fax call is received.

Code	Bits	Bin.	Dec.	Description
	(3)	0	0	CD tracks the carrier. (Default)
		1	8	The CD on/off sequence follows the UNIX standard. CD is turned ON before the connection message is sent and CD is turned OFF after the last DCE response is sent. (A UNIX system needs CD ON to enable serial port receiving.) (See <b>&amp;C1</b> , S21b4.)
	(2,1)			Reserved.
	(0)	1	1	Enables repeat dialing of the default number if not connected. (See also <b>*Dn</b> , S29)

**S39 Bit-mapped register, default: 32:**

Code	Bits	Bin.	Dec.	Description
	(7,6)			Reserved.
	(5)	1	32	Disables scrambler/descrambler in V.26bis mode. Enables compatibility with older V.26bis modems which have no such unit.
	(4)	1	16	Class 2 fax with DTE speed shifting; +FCON at current DTE rate; next phase at 19200.
	(3)	1	8	Class 2 fax with Bitfax compatibility; +FCON at 2400 and shift to 19200 at next phase.
	(2)	1	4	Reverses the answer; the modem answers in originate mode.
	(1, 0)			Reserved.

**S40 Bit-mapped register, default: 0:**

Code	Bits	Bin.	Dec.	Description
	(7)			Reserved.
	(6)	1	64	Enables type 4 ring detection.
	(5)	1	32	Enables type 3 ring detection.
	(4)	1	16	Enables type 2 ring detection.
	(3)	1	8	Enables type 1 ring detection.
	(2)	1	4	Enables caller ID detection. (See S24b2, <b>*T</b> )

Code	Bits	Bin.	Dec.	Description
Q2	(1)	1	2	The modem does not return result codes when answering. No RING or CONNECT message.
	(0)			Reserved.

Note: Bits (6,5,4,3) enable ring detection on a combination of four ring types. All zeroes enable ring detection on any ring longer than 100ms. Please refer to Chapter 13 for details on EDR operation.

#### S41 Bit-mapped register, default: 0:

Code	Bits	Bin.	Dec.	Description
	(7)	1	128	Ignores calling tone. Not for fax detection.
	(6)	1	64	Does not answer on the first ring, forces S0≥2.
	(5)	1	32	DSR follows CD, off for 0.5 s after a CD on-off transition. (See &S <sub>n</sub> )
	(4)	1	16	If one of X2-X7 is set, the modem waits for the number of seconds set in register S6 before dialing, and it ignores the dial tone detection.
	(3)	1	8	Enables ITU-T signals 140 and 141 on EIA-232D interface.
	(2)	1	4	Extends the retrain time-out timer to 5 minutes. (See *Q <sub>n</sub> , S27b6)
	(1)	0	0	Selects flag idle in V.25bis HDLC. (Default; see *I1, S17b6)
		1	2	Selects mark idle in V.25bis HDLC.
	(0)	1	1	Special MNP compatibility. (See also &K <sub>n</sub> , S27b0, S38b5)

#### S42 Bit-mapped register, default: 0:

Code	Bits	Bin.	Dec.	Description
	(7)	1	128	CD pulses off for 0.5 sec at carrier loss, CD is always on otherwise.
	(6)	1	64	Disables RINGING result code. (See ATX <sub>n</sub> )



Code	Bits	Bin.	Dec.	Description
	(5)	1	32	Disables DATA/VOICE button switch.
	(4)	1	16	Disables V.17 fax in calling mode, no effect on answering mode. (See <b>&amp;N0</b> and <b>&amp;N32</b> )
	(3)	1	8	Disables escape sequence in answer mode.
	(2)	1	4	CND message will be forced on even if <b>ATQ2</b> is set. (See S40b1)
	(1)	1	2	Enables throughput averaging.
	(0)			Reserved.

#### S43 Bit-mapped register, default: 8:

Code	Bits	Bin.	Dec.	Description
	(7)	1	128	The modem hangs up if the line condition does not permit the modem to run at the highest speed set by the last <b>AT&amp;Nn</b> command.
	(6,5,4)			Reserved.
	(3)	0	0	Enables cellular mode.
		1	8	Disables cellular mode. (Default)
	(2)	1	4	Disables cellular mode Auto Transmit Power Adjustment. Uses S49b0–3 to set transmission power.
	(1)	1	2	Disables ZyX19200 in Multi-Auto mode.
	(0)	1	1	Disables ZyX16800 in Multi-Auto mode.

#### S44 Bit-mapped register, default: 0:

Code	Bits	Bin.	Dec.	Description
	(7)	1	128	Enables UK (Australia, Singapore, India) type 'short-short ring' ringback detection.
	(6)	1	64	When selected with <b>&amp;B0</b> , the DTE speed is fixed at 38400 when the link speed is above 9600; at 9600 if link speed is 7200 and at link speed if it is below 7200. When selected with <b>&amp;B1</b> , the DTE speed is fixed at current rate when an ARQ connection is made; when a non-ARQ connection is made, the DTE speed follows the link rate.

Code	Bits	Bin.	Dec.	Description
	(5)	1	32	Enables V.13 half-duplex simulation in synchronous mode.
	(4)	1	16	DSR follows DTR. (See also S41b5)
	(3)	1	8	Enables cyclic dial with <b>ATDSn</b> .
	(2)	1	4	Semi-auto dial backup; the modem waits for user input from the panel before dialing the back up number.
	(1, 0)			Reserved.

**S45** Delay during which the CND silence detection is disabled. Unit is 20ms; default: 87: (See also S46)

**S46** CND silence detection interval. To process the CND signal, silence must be detected for the specified interval. Unit: 20ms; default: 3.

**S47** Reserved.

**S48** Bit-mapped register, default: 0:

Code	Bits	Bin.	Dec.	Description
	(7 - 6)			Reserved.
	(5)	1	32	The voice commands and responses follow IS-101.
		0	0	Voice commands and responses are compatible with the U-1496 series modems.
	(4)	1	16	(Works with &D1 command) DTR ON lets the modem dial the default number and DTR OFF lets the modem hang up and reset to profile 0. When the modem is idle (waiting for a command), it will not dial any number when DTR changes from ON to OFF.
	(3)	1	8	Reverse V.23 channel speed: Originate mode modem speed (Send/Receive) 1200/75 Answer mode modem speed (Send/Receive) 75/1200
	(2)	1	4	Enables data calling tone (CNG) sending.

Code	Bits	Bin.	Dec.	Description
	(1)	2	1	Enables DATA ONLY mode. Auto-detects V.34/ZyX/V.32bis/V.22bis/V.23/V.21/Bell 103 when answering. If the connection attempt fails, the modem will continuously recycle the handshaking procedure until the S7 register times out.
	(0)	1	1	Causes CND information to be reported in raw data format.

**S49 Bit-mapped register, default: 6:**

Code	Bits	Bin.	Dec.	Description
	(7)	0	0	Cellular mode; modem is installed in office. (Default)
		1	128	Cellular mode; modem is connected to a cellular mobile phone.
	(6,5,4)			Reserved.
	(3 - 0)	000 ... 111	0 ... 15	Sets cellular mode transmit power -9 to -24 dBm. (See also S43b2)

**S50**                      **Inactivity timer in 10-second units. 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.**

**S51 Bit-mapped register, default: 0:**

Code	Bits	Bin.	Dec.	Description
	(7,6)	00 01 10 11	0 64 128 192	Disables data CNG tone detection. Reports RING for data CNG tone. Reports RING 1 for data CNG tone. Reports RING 3 for data CNG tone.
	(5,4)	00 01 10 11	0 16 32 48	Disables Fax CNG tone detection. (Default) Reports RING for fax CNG tone. Reports RING 1 for fax CNG tone. Reports RING 2 for fax CNG tone.
	(3,2)	00 01	0 4	Disables DTMF tone detection. Reports RING for a DTMF tone.

Code	Bits	Bin.	Dec.	Description
		10	8	Reports RING <DTMF> for a DTMF tone.
		11	12	Reserved.
	(1,0)	00	0	Disables EDR.
		01	1	Reports RING twice.
		10	2	Reports RING four times.
		11	3	Reports RING six times.

**S52 Bit-mapped register, default: 0:**

Code	Bits	Bin.	Dec.	Description
	(7)	0	0	Selects 'Mark' as the first signal of the V.23 handshaking sequence. (Default)
		1	128	Selects 'Space' as the first signal of the V.23 handshaking sequence.
	(6,5)			Reserved.
	(4,3)	00	0	Receive level sensitivity -43 dBm. (Default)
		01	8	Receive level sensitivity -33 dBm.
		10	16	Receive level sensitivity -26 dBm.
		11	24	Receive level sensitivity -26 dBm.
	(2,1,0)			Reserved.

**S53**            **Reserved.**

**S54**            **Reserved.**

**S55**            **Reserved.**

**S56**            **Hook flash time in 10ms units. A value of zero activates the standard specification of the country the modem is approved in; default: 0.**

**S57 Bit-mapped register, default: 0:**

Code	Bits	Bin.	Dec.	Description
	(7)			Reserved.
	(6)	1	64	Enables busy detection in dialing period.
	(5)			Reserved
	(4)	1	16	Enables the reporting of Class 1 capability in the response to <b>+FCLASS=?</b> .
	(3-0)			Reserved.

**S58-S70      Reserved.**

**S71 Bit-mapped register (fax printing and storing control), default: 0:**

Code	Bits	Bin.	Dec.	Description
	(7,6)			Reserved.
	(5)	0	0	Fax pages already downloaded to the DTE will not be printed.
		1	32	Fax pages already downloaded to the DTE will also be printed.
	(4)	0	0	Fax pages already printed will not be downloaded to the DTE when retrieving.
		1	16	Fax pages already printed will also be downloaded to the DTE when retrieving.
+FZF	(2,1,0)	000	0	Fax to printer; hangs up on data call.
		001	1	Fax to printer; data call to serial port.
		010	2	Fax to DRAM and printer; hangs up on data.
		011	3	Fax to DRAM; hangs up on data.
		100	4	Fax to DRAM and printer; data to serial port.
		101	5	Fax to DRAM; data to serial port.

**S72      Reserved.**

**S73 Bit-mapped register (fax printing control), default: 0:**

Code	Bits	Bin.	Dec.	Description
	(7,6)			Reserved.
	(5,4)	00	0	Paper Size: LETTER (8.5" × 11")
		01	16	Paper Size: LEGAL (8" × 14")
		10	32	Paper Size: A4 (210mm × 297 mm)
	(3)			Reserved.
	(2)	0	0	Resolution on laser printer: 300 dpi
		1	4	Resolution on laser printer: 150 dpi
	(1,0)			Reserved.

**Note:**      S-registers S70 through S79 are reserved for function control;  
S100 through S127 are reserved for ISDN functions.

**S74-S127      Reserved.**



# Chapter 9

## AT COMMAND SET SUMMARY

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

An **AT** command prefix (**AT**tention) precedes each command line, except in the case of **A/**, **A>**, and **+++**. **A/** re-executes the last command once. **A>** re-executes the last command once, and repeats the last call up to 9 times until aborted by physically pressing any key on the keyboard or front panel or until a successful connection with a remote modem has been made. These commands are not preceded by **AT** or followed by more characters. Up to 40 commands can be entered in a command line with a single **AT** prefix. Be sure to either use all capital letters (**AT**) or none at all (**at**).

**+++** is the escape sequence code that is entered in data state to return the modem to command state. The modem will accept **AT** commands only while it is in command state.

### Basic AT Command Set

A list of the basic **AT** command set follows. Each command should be entered after an **AT** prefix. A plus sign (+) placed before a command in the list indicates that it is a default setting.

- |                    |   |
|--------------------|---|
| <b>A</b>           | Goes on-line in answer mode. (See also S39b2, S43b6)  |
| <b>+</b> <b>B0</b> | Selects ITU-T V.22 for 1200 bps communication. (Default)  |
| <b>B1</b>          | Selects Bell 212A for 1200 bps communication.   |
| <b>D</b>           | Enters originate mode, dials the number that follows; attempts to go on-line. (See also S35b4, S38b0) |
|                    | Digits and modifiers that can be used with the <b>D</b> command:                                      |
| <b>0-9,*,*</b>     | Digits for dialing.   |
| <b>P</b>           | Pulse dial.   |
| <b>T</b>           | Tone dial.  |
| <b>W</b>           | Wait for a second dial tone. (See also S6)  |

	<b>R</b>	Originate a call in answer mode; must be entered as the last digit.
	<b>!</b>	Hook flash. (Call transfer; see also S56)
	<b>,</b>	Pause for a time designated by S8.
	<b>;</b>	Return to command state after dialing.
	<b>@</b>	Wait for a 5-second silence before proceeding, otherwise return NO ANSWER.
	<b>DL</b>	Dials the last-dialed number.
	<b>DSn</b>	Dials the number stored in EEPROM at location n(0-49). S44 . 3=1 enables cyclic dialing. If the first dial is not successful, the modem will cycle dial through the first ten numbers stored in memory.
	<b>E0</b>	Disables character echo in command state.
+	<b>E1</b>	Enables character echo in command state. (Default)
	<b>H0</b>	Goes on-hook (hang-up). Same as ATH.
	<b>H1</b>	Goes off-hook.
	<b>I0</b>	Display product code for modem. Same as ATI.
	<b>I1</b>	Displays ROM checksum and product information.
	<b>I2</b>	Displays link diagnostic status report.
	<b>L0 - L7</b>	Speaker volume control. The higher the value, the higher the volume. (Default is L4)
	<b>M0</b>	The speaker is always OFF.
+	<b>M1</b>	The speaker is ON until carrier detected. (Default)
	<b>M2</b>	The speaker is always ON.
	<b>M3</b>	The speaker is ON after the last digit is dialed out and OFF when carrier is detected. Tone dialing is not heard.
	<b>N0 - N7</b>	Ring volume control. When a call comes in, the speaker will ring to indicate an incoming call. N0 will disable the ring function. (Default is N5)
	<b>O</b>	Returns to on-line state. The modem will continue its data state connection. If not connected, this is equivalent to ATD.
	<b>O1</b>	Forces modem to request a retrain.
	<b>P</b>	Pulse dial.
+	<b>Q0</b>	The modem returns a result code. (Default)
	<b>Q1</b>	The modem does not return a result code.



- Q2**      The modem returns a result code but quiet after answering on a RING. (See also S42b2)
- Sr=n**     Sets S-register r to value n; n must be a decimal number between 0 and 255.
- Sr?**      Displays value stored in S-register r.
- Sr.b=n**   Sets 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.
- + **T**      Tone dial. (Default)
- V0**      Displays the result code in numeric form. (See also S35b7 and the result code table of ATXn.)
- + **V1**      Display the result code in textual form. (Default)
- Xn**      Result code and call progress monitor options (Default is x5):

Result Codes for ATV0          ATV1		X0	X1	X2	X3	X4	X5	X6	X7
0	OK	●	●	●	●	●	●	●	●
1	CONNECT	●	●	●	●	●	+	+	+
2	RING**	●	●	●	●	●	●	●	●
3	NO CARRIER	●	●	●	●	●	●	●	●
4	ERROR	●	●	●	●	●	●	●	●
5	CONNECT 1200		●	●	●	●	+	+	+
6	NO DIAL TONE			●		●	●	●	●
7	BUSY				●	●	●	●	●
8	NO ANSWER				●	●	●	●	●
9	RINGING***				●	●	●	●	●
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		●	●	●	●	+		

Result Codes for ATV0                  ATV1		X0	X1	X2	X3	X4	X5	X6	X7
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		●	●	●	●	+		
34	CONNECT 41600		●	●	●	●	+		
35	CONNECT 31200		●	●	●	●	+	+	+
36	CONNECT 24960		●	●	●	●	+		
37	CONNECT 20800		●	●	●	●	+		
38	CONNECT 33600		●	●	●	●	+	+	+
39	CONNECT 28800		●	●	●	●	+	+	+
40	CONNECT 26400		●	●	●	●	+	+	+
41	CONNECT 24000		●	●	●	●	+	+	+
42	CONNECT 21600		●	●	●	●	+	+	+

Note: If error control result codes are enabled (X5, X6 or X7), the resulting message will be formatted as:  
X5: CONNECT DTE speed/Link speed/Error control level\*  
X6: CONNECT Link speed/ARQ  
X7: CONNECT Link speed/ARQ/Error control level\*  
whereas ARQ denotes that Automatic Retransmission reQuest type of error control is enabled.

\*. Data compression included. /SREJ is appended if a V.42 connection with selective reject is established.

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

\*\*\*. Use S42b6 to disable RINGING result code.

### Examples:

X5 :       CONNECT 38400/V.32 9600T/MNP5  
          CONNECT 115200/V.34 28800/V.42b

**Error control level is from NONE to V.42b.**

X6 :       CONNECT 9600/ARQ  
          CONNECT 28800/ARQ

**Error control level is either ARQ or not given at all.**

X7 :       CONNECT 9600/ARQ/MNP5  
          CONNECT 28800/ARQ/V.42b

**Use S35.7=1 to enable the following numerical result codes when an error control connection is being made:**

ATVO Code	ATV1 String	ATVO Code	ATV1 String
50	CONNECT	58	CONNECT 16800
51	CONNECT 1200	59	CONNECT 19200
52	CONNECT 2400	60	CONNECT 21600
53	CONNECT 4800	61	CONNECT 24000
54	CONNECT 7200	62	CONNECT 26400
55	CONNECT 9600	63	CONNECT 28800
56	CONNECT 12000	64	CONNECT 31200
57	CONNECT 14400	65	CONNECT 33600

- Z0**       Reset modem and load user profile 0.
- Z1**       Reset modem and load user profile 1.
- Z2**       Reset modem and load user profile 2.
- Z3**       Reset modem and load user profile 3.
- Z4**       Resets the modem and loads the factory settings, also sets the factory default as power-on profile.

**Note:**       Factory default (**Z4**) is the default power-on profile when the modem is shipped out of the factory. **ATZn** also sets profile n to be the power-on profile. **ATZn** sets FCLASS=0.

- +++ Escape sequence code, entered in data state, wait for modem to return to command state.
- \$ Basic command summary help.
- &\$ Extended AT& command summary help.
- \*\$ Extended AT\* command summary help.

## Extended AT& Command Set

- &B0 DTE/DCE rate follows link rate. (If the communication software package has auto baud rate detection, please turn it ON.) (See also S44b6)
- + &B1 Fixes the DTE/DCE to the DTE setting, range from 300 bps to 460.8 Kbps. (Default) (See also S18, S20, S44b6)
- &C0 Assumes that the carrier is always present; forces CD to always remain ON.
- + &C1 CD tracks presence of carrier. (Default) (See also S38b3 and S42b7)
- &D0 Ignores DTR signal, assumes DTR to always remain ON.
- &D1 108.1, DTR OFF-ON transition causes dial of the default number. (See also \*Dn)
- + &D2 108.2, Data Terminal Ready, DTR OFF causes the modem to hang up and return to command state. (Default)
- &D3 Same as &D2, but DTR OFF also causes the loading of and reset with data from profile 0.
- &F Loads factory settings to RAM as active configuration.
- + &G0 No guard tone (within the USA, Canada). (Default)
- &G1 Reserved.
- &G2 1800 Hz guard tone.
- &H0 Disables flow control.
- &H1 Reserved.
- &H2 Reserved.
- + &H3 Hardware CTS/RTS flow control. (Default)
- &H4 Software XON/XOFF flow control.
- &H5 Reserved.
- + &J0 Single phone line RJ11 phone jack. (Default)
- &J1 Multiple-phone/modem line RJ12/RJ13 phone jack.

	<b>&amp;K0</b>	No error control.
	<b>&amp;K1</b>	MNP4 (includes MNP3).
	<b>&amp;K2</b>	MNP4 + MNP5. (See also S38b5, S41b0)
	<b>&amp;K3</b>	V.42 + MNP4.
+	<b>&amp;K4</b>	V.42 + V.42bis, compatible with &K2 . (Default) (See also S38b5)
+	<b>&amp;L0</b>	Normal 2-wire dial-up line. (Default)
	<b>&amp;L1</b>	2-wire leased line.
	<b>&amp;L2</b>	4-wire leased line.
+	<b>&amp;M0</b>	Asynchronous mode, buffered data. (Default)
	<b>&amp;M1</b>	Asynchronous command, synchronous data.
	<b>&amp;M2</b>	Direct asynchronous mode, no buffering.
	<b>&amp;M3</b>	Synchronous mode.
+	<b>&amp;N0</b>	Multi-Auto; auto-negotiates the highest possible link rate (V.34 28800-2400, ZyX19200, ZyX16800, V.32bis 14400/12000/7200, V.32 9600T/9600/7200/4800, V.22bis 2400/1200, V.22 1200, Bell 212A 1200, V.17 FAX 14400/12000/9600/7200, V.29 FAX 9600/7200, V.27ter FAX 4800/2400, and cellular modes 14400 - 4800). (Default)
	<b>&amp;N1</b>	V.33 14400/12000 (models with 4-wire leased line only)
	<b>&amp;N2</b>	V.33 12000 (models with 4-wire leased line only)
	<b>&amp;N3</b>	V.32 9600T/9600/7200/4800
	<b>&amp;N4</b>	V.32 9600/7200/4800
	<b>&amp;N5</b>	V.32 4800
	<b>&amp;N6</b>	V.29 9600 (models with 4-wire leased line only)
	<b>&amp;N7</b>	V.29 7200 (models with 4-wire leased line only)
	<b>&amp;N8</b>	V.29 4800 (models with 4-wire leased line only)
	<b>&amp;N9</b>	V.27bis 4800 (models with 4-wire leased line only)
	<b>&amp;N10</b>	V.27bis 2400 (models with 4-wire leased line only)
	<b>&amp;N11</b>	V.26bis 2400 (4-wire leased line or 2-wire half-duplex)
	<b>&amp;N12</b>	V.23 1200/75 (see also S48b3, S52b7)
	<b>&amp;N13</b>	V.23 600/75 (see also S52b7)
	<b>&amp;N14</b>	V.22bis 2400/1200
	<b>&amp;N15</b>	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	Bell212A	1200
&N25	Bell103	300
&N32	V.17 FAX	14400/12000/9600/7200
	V.29 FAX	9600/7200
	V27.ter FAX	4800/2400
&N34	ZyX 19200ZyXEL	19200
&N35	ZyX 16800ZyXEL	16800
&N36	ZyX 14400ZyXEL	14400
&N37	ZyX 12000ZyXEL	12000
&N38	ZyX 9600 ZyXEL	9600
&N39	ZyX 7200 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

- + **&P0** Pulse dial make/break ratio= 39%:61%. (Default)
- &P1** Pulse dial make/break ratio= 33%:67%.
- &R0** CTS tracks RTS, response delay is set in S26.
- + **&R1** The modem assumes that RTS is always ON, ignores the changes. (Default)

---

Note: **&Rn** controls the synchronous mode operation only. In asynchronous mode, CTS/RTS are used for flow control.

- + **&S0** The modem forces DSR to always remain ON. (Default)
- &S1** DSR according to ITU-T. If S44.4=1, DSR follows DTR. If S41.5=1, DSR is always on, but follows CD off for 0.5 second.
- &T0** Terminates test in progress.
- &T1** Initiates Analog LoopBack (ALB) test.
- &T2** Reserved.
- &T3** Initiates Local Digital Loopback (LDL) test.
- &T4** Grants Remote Digital Loopback request from the remote modem.
- + **&T5** Denies Remote Digital Loopback request from the remote modem. (Default)
- &T6** Initiates Remote Digital Loopback (RDL) test.
- &T7** Initiates Remote Digital Loopback with self test (RDL+ST).
- &T8** Initiates Analog LoopBack with self test (ALB+ST).
- &V0** Views current active settings.
- &V1** Views user profile 0 settings.
- &V2** Views user profile 1 settings.
- &V3** Views user profile 2 settings.
- &V4** Views user profile 3 settings.
- &V5** Views factory default settings.
- &W0** Saves current settings to user profile 0. (See also S35b6)
- &W1** Saves current settings to user profile 1.
- &W2** Saves current settings to user profile 2.
- &W3** Saves current settings to user profile 3.
- + **&X0** The modem provides synchronous transmit clock signal. (Internal clock to pin 15 of EIA-232D.) (Default)

- &X1** The terminal provides synchronous transmit clock signal. (External clock from pin 24 of EIA-232D.)
- &X2** The receiving carrier provides synchronous transmit clock signal. (Remote or Slave clock to pin 15 of EIA-232D.)
- &Y0** Destructive break, expedited. (Destructive break clears the buffer, expedited break is sent immediately.)
- + **&Y1** Non-destructive break, expedited. (Default)
- &Y2** Non-destructive break, un-expedited.
- &Zn=s** Stores the dial string(s) to EEPROM at location *n* ( $0 \leq n \leq 49$ ).
- &Z?** Displays all the phone numbers stored in EEPROM.

## Extended AT\* Command Set

- + **\*B0** Disables dial-backup. (Default)
- \*Bn** Enables dial-backup and sets dial backup pointer at location *n*-1. (See also S44b2)
- + **\*C0** 10-bit character length. (Default)
- \*C1** 11-bit character length.
- \*C2** 9-bit character length.
- \*C3** 8-bit character length.
- \*Dn** Sets default dial pointer at phone directory location *n*. (See also S35b4, S38b0, &Zn, &D1.)
- + **\*E0** If error control negotiation fails, the modem keeps the non-error control connection. (Default)
- \*E1** If error control negotiation fails, disconnects the call (hang-up).
- + **\*F0** Denies remote configuration. (Default)
- \*F1** Accepts remote configuration (and Remote Digital Loopback must be granted - AT&T4).
- + **\*G0** Disables security function. (Default)
- \*G1** Enables type 1 security, with password check.
- \*G2** Enables type 1 security, with password check and call back.
- \*G3** Enables type 2 security, with password check.
- \*G4** Enables type 2 security, with password check and call back.



**\*G5** Enables type 2 security, with password check and call back; remote site enters the call-back number.

Note:

1. The command **\*Gn** requests supervisor password checking.
2. In security type 1, the remote site must be a ZyXEL modem.
3. In security type 2, the remote site can be any other type of modem.
4. The modem can store 50 (0-49) telephone numbers. If call back security is disabled, the modem will search the password table to check the remote modem's password. If they match, the modem will keep the connection, otherwise the modem will hang up. If call back security is enabled, the modem will complete the password checking. If there is no match, the modem will disconnect the line, otherwise the modem will disconnect the line, find the corresponding phone number and call back immediately. The remote modem should be set to auto-answer the call and response.

**\*HS** Modifies supervisor password.

Note: The default supervisor password is ZyXEL.

**\*Hn** Modifies the user password table at location  $n$  ( $0 \leq n \leq 49$ ).

Note: The commands **\*Hn** and **\*HS** require the supervisor password before execution. Any character can be entered in the password (0-255). Maximum password length is eight.

+ **\*I0** AT command set. (Default)

**\*I1** V.25bis command set.

Note: Entering **RST** command in V.25bis mode will revert the modem to asynchronous AT command mode.

**\*I2** Dumb mode.

Note: Use the menu selection on the LCD panel to leave the dumb mode. For non-LCD models, turn off the power to leave dumb mode.

+ **\*L0** Panel key normal. (Default)

**\*L1** Panel key locked. (See also S28.1)

+ **\*M0** Leased line auto-handshake on originate mode. (Default)

	<b>*M1</b>	Leased-line auto-handshake on answer mode.
	<b>*P0-15</b>	Sets leased-line transmission power level, range from 0 dBm to -15 dBm (Default = -9 dBm); range from -12 dBm to -27 dBm if S35b3 is set. The maximum transmission power for Omni 288P and 288S is -9dBm and -3 dBm, respectively.
	<b>*Q0</b>	No action to poor signal quality.
	<b>*Q1</b>	Retrain action taken if signal quality is poor.
+	<b>*Q2</b>	Adaptive rate; auto fall-back or fall-forward. (Default)
	<b>*Q3</b>	Disconnect for poor signal quality.
	<b>*Rab</b>	Read remote profile b to local profile a: a= 0-3,    local user profile number. b= 0-3,    remote user profile number. 4,    remote active configuration. 5,    remote factory default.
<hr/> <div> <div>Note:</div> <div>The command <b>*Rab</b> only works when the modem is on-line, independent of the type of connection involved.</div> </div> <hr/>		
+	<b>*S0</b>	Secondary channel disabled. (Default)
	<b>*S1</b>	Secondary channel enabled.
	<b>*T</b>	Displays last caller ID message.
	<b>*V</b>	Views password table.
<hr/> <div> <div>Note:</div> <div>This command requires the supervisor password before execution.</div> </div> <hr/>		
	<b>*wab</b>	Writes the local configuration profile a to remote user profile b and resets the remote modem from that profile: a= 0-3,    local user profile number. 4,    local active configuration. 5,    local factory default settings. b= 0-3,    remote user profile number.
<hr/> <div> <div>Note:</div> <div>The command <b>*wab</b> only works when the modem is on-line independent of the type of connection involved.</div> </div> <hr/>		

# Chapter 10

## ERROR CONTROL AND DATA COMPRESSION

### Error Control

Error control keeps the modem data link error-free by detecting and retransmitting 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 newly developed standard by CCITT (now called ITU-T) - the international telecommunications standard making organization. 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.

#### 1) Asynchronous to Synchronous Conversion

An error control function can be applied only when the DTE (terminal or computer) to DCE (modem) interface is asynchronous. If the interface is synchronous, then the hosts on both sides will do the error control function. The modem converts asynchronous characters to a synchronous data stream. The error control protocol (LAPM or MNP4) removes the start and stop framing bits in the asynchronous format and forms the data stream into blocks. Every block is framed by a start flag (01111110) and an end flag (01111110). The maximum data block size used in the 2864 series is 256 bytes. The maximum number of outstanding blocks without acknowledgement is 31 for 128-byte blocks. These values are adjustable according to the modem on the other side.

#### 2) 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 alright. If not, an error(s) has occurred somewhere in the block. The modem checks every block received for error(s).

### 3) 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 acknowledgement 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 acknowledgement for block 15 is received in a given time, this block must have been damaged. Acknowledgements of blocks 16 through 18 are ignored. Blocks starting from 15 are resent.

### 4) ARQ Error Correction with Selective Reject

ZyXEL modems support V.42 error control with selective reject. Using this feature, the modem only resends 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.

Error control protocols can detect and recover almost 100% of all errors to make an error-free transmission possible.

## Data Compression

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 removing. Its effectiveness is both algorithm and data dependent. A random data file is not compressible. A data file with a high degree of predictability, like an ASCII English text file, graphic file, or database file, is suitable for data compression.

In the modem, the data compression is activated between asynchronous to synchronous conversion in an attempt to reduce the number of bits actually sent. The receiving modem applies these techniques in reverse to recover the actual data from the compressed data stream.

2864 series modems support both V.42bis and MNP5 data compression protocols. Data compression needs an error-free data link to work correctly, otherwise the corrupted compressed data stream will ruin the decompression process. 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 appearing 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. 2864 series 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.

For the 2864 series of modems, the error control and data compression option can be enabled either from the front panel or the terminal.

Control Level	AT Command	Error Control	Data Compression
NONE	<b>AT&amp;K0</b>	none	none
MNP4 (MNP3)	<b>AT&amp;K1</b>	MNP4	none
MNP4 + MNP5	<b>AT&amp;K2</b>	MNP4	MNP5
V.42 (MNP4)	<b>AT&amp;K3</b>	V.42 / MNP4	none
V.42(b) + MNP4 (5) *	<b>AT&amp;K4</b>	V.42 / MNP4	V.42bis / MNP5

\*. default

**&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.

# Bidirectional Compression

Processing data compression consumes a lot of the modem controller CPU's computation power. Though data compression protocols of V.42bis and MNP5 are bidirectional, most modems slow down when doing bidirectional file transfers because of limited processing power.

ZyXEL 2864 series modems use a powerful 16-bit processor that does not slow down during bidirectional file transfers.

# Negotiation Fail Fall-Back

There are two options you can choose from if the error control negotiation fails at the initial modem connection handshaking:

STAYS ON-LINE	<b>AT*E0</b>	Maintains the non-error control connection, if error control negotiation fails. (Default)
DISCONNECT	<b>AT*E1</b>	Disconnects the line if not error control linked.

# DTE to DCE Connection

No matter what control level is enabled, DTE speed can always be set separately from the modem's speed, except in the case where you set FOLLOW LINK RATE. For maximum throughput, it is better to set **AT&B1** (default) FIXED AT DTE RATE. The DTE speed will be independent of the speed the modem is linked to. The DTE speed options range from 300 bps to 460800 bps. What DTE speed is optimized for your application depends on how fast your computer and communication software can process the serial port data. 2864 series modems use certain controls and commands to enable the modem to optimize its performance.

# Averaging Throughput

At high DTE speeds, slow computers tend to lose characters. Even though most transfer programs offer protocols with error correction capabilities, it will still take time to recover from errors. ZyXEL modems average the throughput before sending characters to the DTE. This will decrease the probability of the computer losing characters due to "burst" high-speed character strings.

Since new computers are much faster and there is an increasing use of serial port chips with internal buffers like the 16550A UART, the computer's speed has become less of a problem. The default setting for throughput averaging is disabled. This will reduce data delay and increase throughput in Unix applications. You can enable throughput averaging by setting **S42b1** to 1.

## Hints for High-speed Operation

The communication software tends to lose incoming serial data when it is doing block disk data transfers, because the hard disk interrupt priority level is usually higher than that of the serial port interrupt in the computer. The communication software can do a hardware flow control during disk data transfer to prevent this.

Enabling a disk cacheing software such as SMARTDRV will help. Please refer to chapter 21 for more information on high-speed PC-modem communication.

Choice of an efficient assembly coded communication software is also very important. When using communication software, use a simple protocol without error control (the modem has accomplished this job) such as YModem-G and ZModem. Software with complicated protocol handling will slow down its speed in handling serial data.

## Flow Control

This feature refers to stopping and restarting the flow of data into and out of the modem's transmission and receiving data buffers. Flow control is necessary so that a device (computer or modem) does not receive more data than it can handle. The 2864 series modems provide two kinds of flow control methods.

### Hardware CTS/RTS Flow Control

This is a bidirectional 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 2864 always responds to the RTS signal as a flow control signal. The 2864 defaults automatically to this hardware flow control setting and it is a better choice.

### Software XON/XOFF Flow Control

This is a bidirectional 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 11

## SYNCHRONOUS OPERATION

This chapter introduces you to the use of the 2864 series modem for synchronous operation. Use the modem as a synchronous modem when it is connected to a synchronous computer or terminal. Be 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.

The serial port models support synchronous mode operation. The internal card model has a built-in PC asynchronous serial port and can only be used in asynchronous mode. The parallel port interface supports asynchronous mode only.

Before synchronous transfers are started, some initial settings should be made.

### 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. 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. The slave clock is used when in remote digital loopback mode. The external clock is a signal generated by the sending DTE.

+	INTERNAL	<b>AT&amp;X0</b>	The modem provides the clock and sends it to the DTE. Adaptive rate can be used. (Default)
	EXTERNAL	<b>AT&amp;X1</b>	The DTE provides the clock and sends it to the modem. Must use auto-retrain, cannot use adaptive rate.
	SLAVE	<b>AT&amp;X2</b>	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	<b>AT&amp;R1</b>	RTS is ignored; always assumed to be ON. (Default)
	CTS TRACKS RTS	<b>AT&amp;R0</b>	Delay before CTS responds to RTS's change. The delay is set in the S26 register.

# Half-Duplex Operation

For a half-duplex modem, the carrier only exists in one direction at any specific time. The carrier, the local CTS signal, and the remote CD signal will follow the RTS signal in a certain manner. Some communication software packages written for half-duplex modems rely on these RTS, CTS and CD signals. For a full-duplex modem, carriers are always present in both directions. In order for it to simulate a half-duplex modem, the V.13 protocol is provided where the local CD signal follows the remote modem's RTS signal. Set `S44.5=1` to enable V.13.

## Mode 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	<b>AT&amp;M1</b>	The modem accepts asynchronous command in command state, but exchanges data synchronously in data state.
SYNC	<b>AT&amp;M3</b>	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.

## Dial 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.

On the model with a DATA/VOICE switch, with `S35b4` set, pressing the DATA/VOICE switch will also cause dialing of the default number.

#### 4) Dial from the panel.

This is available only with an a LCD model's LCD panel. Set the modem to synchronous mode, then select DIAL MEMORY or DIAL NUMBER to dial out the number you want. After the modem is connected, the modem will enter synchronous operation.

#### 5) 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) or press **O** in the IDLE SCREEN menu from the panel. With the ORG/ANS switch set to ORG on the non-LCD models, press the DATA/VOICE switch. The modem will go into synchronous operation after connection.

### Auto-answer from Synchronous Mode

Set the modem to synchronous mode. Just as in the asynchronous setup, 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 from Synchronous Mode

Type **ATA** from the terminal (if &M1 is set) or press **A** on the IDLE SCREEN menu from the front panel. With the ORG/ANS switch set to ANS on the non-LCD model, press the DATA/VOICE switch.

### Change from Synchronous Mode into Asynchronous Mode

Set the modem to asynchronous mode from the panel, or just reset from an asynchronous profile. On the non-LCD model, pressing the DATA/VOICE button while turning on the power will reset all profiles to their factory presets. The active setting is the factory default, which is asynchronous.

If the modem is in &M1 mode, use the AT command **AT&M0** to change back to asynchronous mode.

If the modem is in V.25bis command mode, entering the **RST** command will change the modem to asynchronous AT command mode.

## Setting up a ZyXEL Modem with the AS-400

This is a typical application where the user will use both the synchronous feature of the modem and the V.25bis option. Although we are using the IBM AS-400 computer as an example, other mid-range systems and mainframes should be able to use the same strings. Please note that some systems may require other settings depending on the nature of the system or the application that you are running. You can consult our Technical Support Department if help is needed.

You can set up a ZyXEL modem either from the front panel or by using AT commands, depending on whether you have an LCD-model or not.

The AT commands or settings that might be related to this setup are:

Link Speed	Multi-Auto
Data Format	SYNC for AS-400 in most cases; <b>AT&amp;M3</b>
Command Set	V.25bis; <b>AT*I1</b>
DTR Option	108.2, Data Terminal Ready; <b>AT&amp;D2</b>
RTS Option	CTS tracks RTS; <b>AT&amp;R0</b>
DCD Option	Tracks Carrier; <b>AT&amp;C1</b>
DSR Option	CCITT (ITU-T), modem control; <b>AT&amp;S1</b>
Sync Clock	Internal; <b>AT&amp;X0</b>
Line Type	Dial-up line; <b>AT&amp;Ln</b>

Most of the settings are already stored in Profile 2. All you need to change after the reset from Profile 2 is the COMMAND SET. The changes can be made either by selection from the front panel menu or by issuing AT commands from an asynchronous terminal.

Setting from the LCD front panel

- 1) Press the up arrow MENU key from the idle screen then the down arrow ENTER key and you should see TERMINAL OPTIONS.
- 2) Press the right arrow key until the screen reads RESET = FACTORY DEFAULT. Press the ENTER key (down arrow key) here and use the right arrow key to pick PROFILE 2, then press the ENTER key again. The modem will display SYSTEM RESETING and you will then see the idle screen of the new setup.

Now press the MENU key (up arrow key), followed by the ENTER key. TERMINAL OPTIONS should appear. Press the ENTER key, then press the right arrow key until you reach COMMAND SET.

- 3) Press ENTER, then the right arrow key until V.25bis should appear in the display. Press ENTER to select it.

- 4) To save the settings to a profile, press MENU once, and press the right arrow key until you see SAVE TO. Press ENTER and then the right arrow key to choose the profile you would like to save to; then press ENTER again to select it.
- 5) To activate these settings as your power-on default, you need to reset from this profile at least once. To do it from where we left off in 4), press the right arrow key and stop at the RESET submenu. Press ENTER and use the right arrow key to select the profile to which you saved the settings in 4). Press ENTER to reset the modem and make the profile the power-on default.

#### Setting using the AT Command Set

You will have to issue these commands from an asynchronous terminal if the ZyXEL modem you own does not provide a front panel. You can use this method for all ZyXEL modems which provide the SYNC option.

Issue from any terminal program the following commands:

**ATZ2&M3\*I1&N0&W0Z0**

After this command is executed, you should see the RXD LED of your modem stay on most of the time.



# Chapter 12

## 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. The 2864L model supports 4-wire and 2-wire leased lines. 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.

### Connecting to a Leased Line

The leased-line model 2864L has a separate jack/terminal for a leased-line connection. The normal dial-up line models have only a phone jack for dial-up line connections. On these models, connect to a 2-wire leased line using the same jack.

For the 2864L, the default line type is dial-up line (DL). It includes a separate leased-line jack. The leased line must be connected to the jack labeled LEASED LINE (located at the rear of the modem) for leased-line operation. You can set the 2864L for leased-line operation by typing commands from the terminal or by selecting it from the front panel. The leased-line phone jack pin assignments are shown in Appendix B.

The rack mount model has both dial-up and leased-line terminal connectors on the rear panel of the rack it is mounted on.

### Line Type

Menu	AT-Command	Description
2W LEASED	<b>AT&amp;L1</b>	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.
4W LEASED	<b>AT&amp;L2</b>	The modem is connected to a 4-wire leased line. Plug the line into the LEASED LINE jack.

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

The modem'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 -9dBm for the Omni 288P and to -3dBm for the Omni 288S.

LLINE TX POWER	<b>AT*P0</b>	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.
	...	
	<b>AT*P15</b>	

## Handshake Mode

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 answer the call after a specified number of rings, or be commanded to answer immediately.

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 Connection

Set the modem to leased-line mode. Type the asynchronous command **ATD** to the originating modem and **ATA** to the answering modem, or press O on the IDLE SCREEN menu of the originating modem and press A on the IDLE SCREEN of the answering modem. On an LED model, press the VOICE/DATA switch to make the modem go off-hook and on-line and use the ORG/ANS switch to select originate or answer mode. For the Omni models, 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 7. 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.

+	ORIGINATE	<b>AT*M0</b>	When operating over a leased line, modem will handshake in originate mode. (Default)
	ANSWER	<b>AT*M1</b>	When operating over a leased line, modem will handshake in answer mode.

## Leased-Line Dial Backup

When a leased-line connection fails, some actions may be taken by the modem.

- 1) Reattempt to connect on the leased line indefinitely if the dial backup option is disabled.
- 2) If the dial backup is enabled, the originating modem attempts to dial a pre-stored telephone number to backup the connection; the answering modem will reattempt to connect on the leased line and monitor the dial-up line for rings. Incoming dial-backup calls will be answered.

## Dial Backup

Only the 2864L and the rack mount model have the dial backup function and capability. They have separate dial-up and leased-line phone jacks/connectors. The dial backup option can be set by issuing an asynchronous AT command from the terminal, or by using the front panel control.

+	DISABLED	<b>AT*B0</b>	Leased-line dial backup disabled (Default).
	PH0-PH49	<b>AT*B1-50</b>	When leased-line cannot continue operation, the originate mode modem will automatically dial the number stored in the memory address selected. The answer mode modem will monitor the dial-up line for rings.

The originating modem will try to dial the number up to nine times or until a 3-minute timeout is activated. If the dial backup attempt fails, the originating modem will go back to try the leased line connection. If this fails, it will try the dial-up line again.

It will try these two alternatives indefinitely. If the dial backup attempt succeeds, the value of S-register S34 determines the interval of the dial backup connection before going back to check the leased line.

<b>ATS34=0</b>	The dial backup line continues to be used indefinitely.
<b>ATS34=n;</b> (1 ≤ n ≤ 255; default: 30)	Reattempts leased line after n minutes. If the leased line has still not been recovered, the modem will continue to use the dial backup line.

A semi-auto dial backup is selected if S44.2=1. In this mode, when making dial backup, the modem will display DIAL BACKUP? and wait for the user's confirmation. Only when the panel confirmation is pressed will the modem start the dial backup. This saves unnecessary dial backup connections when the line is not in use, e.g., non-business hours.

## Aborting from Leased-Line Operation

If the leased line has not been connected, pressing any key on the front panel will abort the attempt to connect on the leased line. If dial backup is enabled, backup action will be taken. Pressing any key again will abort the backup action and revert to the IDLE SCREEN display.

## Disconnecting a Leased-Line Connection

Disconnecting (manually) the leased line will force the LCD-model to switch to the IDLE SCREEN. Either going on-line manually or, if you have set the leased line as the power-on default, turning the power OFF and ON, will make the modem go to the leased line again.

Pressing the DATA/VOICE switch on the non-LCD model will switch the modem on/off the connected leased line.

# Chapter 13

## SPECIAL FUNCTIONS

This chapter describes the special features of the 2864 series modems including their functions and uses.

### Security Function

The 2864 series provides a security function, that (when enabled) prevents an unauthorized user from making a connection. 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 of modem. With the type 1 connection, the dial-in (remote) modem will send in its supervisor password for checking at the initial connection handshake, and the local modem will check this password against its pre-stored acceptable password list. With a 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.

Two levels of security are provided. With level 1 security, the local modem will maintain the connection if the password check is OK, otherwise the line will be disconnected. With level 2 security, the local modem will disconnect the line if the password has been found in its pre-stored acceptable list and then will dial back the phone number corresponding to the dial-in password. The line will be simply disconnected if the password does not match.

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 commands below will enable different types and levels of security:

<b>*G0</b>	Disables security function.
<b>*G1</b>	Enables type 1 and level 1 security, with password check.
<b>*G2</b>	Enables type 1 and level 2 security, with password check and call-back.
<b>*G3</b>	Enables type 2 and level 1 security, with password check.
<b>*G4</b>	Enables type 2 and level 2 security, with password check and call-back.
<b>*G5</b>	Enables type 2 and level 2 security, with password check and call-back, remote site enters the call-back number.

**Note:** Before the security type or level can be 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 call-back number, it will be prompted to do so.

## Remote Configuration

The 2864 series modems provide a remote configuration capability. Remote configuration 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 is transmitted to the remote modem.

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

**AT\*Rab**

whereby

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**

whereby

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.

Remote configuration can also be activated from an LCD (also includes rack-mount) model's LCD panel. The remote modem is set to grant remote configuration by setting bit 0 of S-register *S36*. For the local modem, set *S36b1* to 1 for the read operation or to 0 for the write operation. Set *S37b0-3* to the remote profile number and bits 4-7 to the local profile number. After the S-register settings are done, activate the remote configuration operation by going to the DIAGNOSTIC menu and activating the REMOTE CONFIGURATION submenu.

Batch mode remote configuration is a convenient feature allowing you to preconfigure a remote modem in one of the local modem's user profiles and send it to the re-

note 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(CND)

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 have to pay an additional monthly service charge for 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 rings. 2864 series modems 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 that can be 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.

S-register **S40b2** is used to enable (1) or disable (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 that the caller ID message may confuse some communication software not expecting it.

In the 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
```

whereby **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.

Following is an example:

```
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 be:**

RING  
TIME: MM-DD hh:mm  
CALLER NUMBER: <Caller\_ID>  
CALLER NAME: <Caller\_Name>  
RING

**Following 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 be:**

RING  
TIME: 04-28 12:30  
REASON FOR NO NUMBER: OUT\_OF\_AREA  
REASON FOR NO NAME: PRIVACY  
RING

**The AT\*T command will cause the modem to send the last CND message.**

**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. Please refer to the Bellcore Technical Advisory AT-NWT-000030 document 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

**This 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 being called by recognizing which type of ring is being 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 several uses, e.g., 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 2864 series modems can distinguish between 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 in 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. Set the bit to "1" to enable answering, set it to "0" to reject 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 S40 and different ring types are:

Type	Bit	Sequence
1	3	1.2s on; 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.

If all of these bits are zero (0), 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.

Other countries may have different specifications for different types of ring. The manufacturer may append other sets of ring type specifications to suit other countries' needs.

## Extended Distinctive Ring

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 calls, voice calls will be missed; on the other hand, if a human being or an answering machine answers calls, fax or data calls may either be missed or the person who answers a call has to go through some trouble 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, and the software can then request 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, a ZyXEL fax/modem can be installed with an answering machine or a voice telephone set at home. In most cases, the modem should be set to neither answer regular rings, nor report them. Thus, the software will not instruct the modem to answer the call when a 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 that the ring signal is gone, will start to listen to the line for a 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.

This is just one of the applications for which EDR can be used. We have designed many different ways to set the modem up to not only cover the basic usages, but also for different extended applications.

## Setting Up The 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.

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

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

**CID:** Caller ID task

Note: During the EDR period, any AT command will immediately disable the EDR function.

## Application Example

In the previous example, an answering machine was installed with a ZyXEL modem. 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 an 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 (she) wants to send a fax.
- 5) Save the settings in a profile and reset the modem from this profile, for example: `AT&W0Z0`

## V.25bis Command Set

V.25bis is a dialing command set standard defined by the ITU-T. It supports both asynchronous and synchronous dialing. People use AT command dialing in most asynchronous cases because it is widely used and supports many more functions than just dialing. However, AT commands only support asynchronous dialing and V.25bis is used in many synchronous dialing situations. Synchronous V.25bis dialing is used in many IBM mainframe and mini-environments where synchronous communications are used. This is supported by the communication software on the computer.

The 2864 series modems support both asynchronous and synchronous V.25bis dialing. However, the internal card supports only the asynchronous mode because it is asynchronous only with its built-in asynchronous serial port. The modem supports the bit-oriented HDLC (High-level Data Link Control) synchronous protocol which most synchronous communication links use. Appendix D lists supported V.25bis commands/indications and their formats.

Use `AT*I1` to enable V.25bis commands. 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 it is turned on. The V.25bis command set is also selectable through the LCD model's LCD panel menu. 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.



# Chapter 14

## CELLULAR MODE OPERATION

The ZyXEL 2864 series models are equipped with a special communication mode - cellular mode - which enables the modem to perform reliable high speed data transmissions over cellular phone links. Although most ZyXEL modems can provide the cellular mode, the U-1496P portable modem is specially designed for mobile use. It is portable in size and capable of using DC12V car battery power. An optional power cable that plugs into the cigarette lighter can be used with the modem. The ZyXEL cellular modes are called the ZyCellular mode for the ZyXEL series modems.

This chapter explains the cellular mode usage and 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 used 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 transmission 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 occur.

A particularly difficult cellular impairment for data communication is called multipath fading. A cellular phone receives the cell site station's radio signal through many indirectly reflected paths. Because of 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 and this is called multipath 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 are 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 a lower signal-to-noise ratio at the receiving end. There is an optimum transmission 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 today 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 called these technologies ZyCELL technologies. A ZyXEL modem utilizing ZyCELL technologies is called a ZyCellular modem. ZyCELL technologies specifically improve the modem data pump's performance with respect to cellular impairments.

## ZyXEL ZyCellular Modes

In addition to normal modem, fax, and voice operation modes, the following cellular modes are offered in 2864 series modems:

Mode	Speed
MULTI-AUTO	V.34/ZyX modes/V.32bis/V.32/V.22bis/G3 FAX/Cellular Modes
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 in 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 for 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 a manual transmission power setting is desired, set S43 . 2=1 to disable automatic transmission power adjustment and use S49 bits 0-3 to set the transmission power to -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

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 using 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 a 2864 series modem, such as the Omni 288S, in the same way.



Fig. 14.1 is an example of a mobile phone that has a handset cradle and a separate transceiver and handset.



Fig. 14.2 is an example of a mobile phone that has a separate transceiver and handset.

Fig. 14.3 is an example of a one-piece hand-held mobile phone.

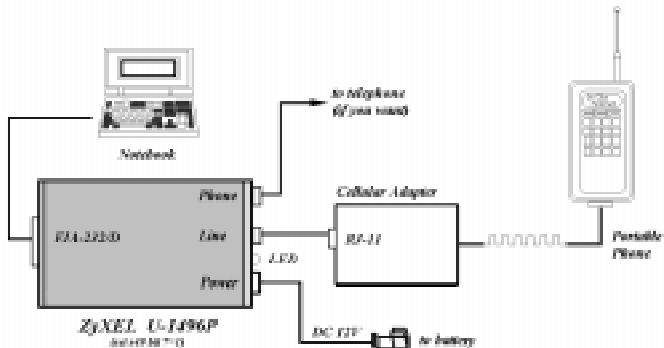


Fig. 14.3: Example 3 - U-1496P with a hand-held phone

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 U-1496P in an office installation, just like all the other ZyXEL models.

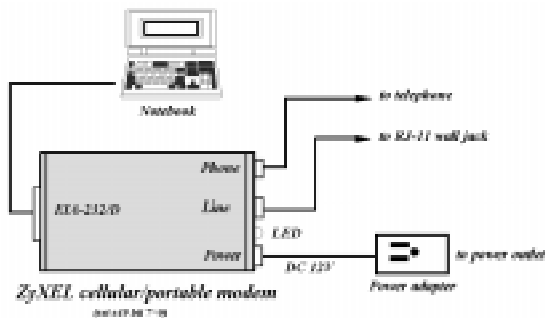


Fig. 14.4: Example 4 - U-1496P in an office installation



## Fax Command Sets

The 2864 series universal modems support four command sets for the fax function, the Class 1 command set, the TIA PN-2388 Class 2 command set, the TIA 592 Class 2.0 command set, and the ZyXEL Extended Fax AT command set. The Class 1 protocol uses the modem to transmit the fax data only. The complete organizational overhead for this protocol is handled by the connected computer. The available Class 1 commands are listed first in this chapter. Following this, we will briefly describe the supported Class 2 commands here. Please refer to the TIA document for a detailed explanation. The newer TIA standard Class 2.0 commands are also supported. Interested programmers should consult the TIA document for command details and consult ZyXEL Technical Support for supported features. The later sections are related to the ZyXEL Extended Fax AT commands.

### Class 1 Command Set

Command	Value	Description
+FCLASS=n		Service class selection
	n=0	Sets to modem mode
	n=1	Sets to Class 1 mode
	n=2	Sets to Class 2 mode
	n=2.0	Sets to Class 2.0 mode
	n=6	Sets to ZFAX mode
	n=8	Sets to Voice mode
	n=Z	Sets to ZyXEL fax parallel port print and/or DRAM store mode. (See also Class Z <b>AT+F</b> commands)
Note:	If S57.4=0 (default), the response to the <b>+FCLASS=?</b> command will not report Class 1 capability. This is due to the fact that some fax software packages may get confused by this response.	
+FTS=n	0-255	Stops transmission and pauses, in 10ms units.
+FRS=n	0-255	Waits for silence, in 10ms units.
+FTM=<MOD>		Transmits data with a <MOD> carrier.
+FRM=<MOD>		Receives data with a <MOD> carrier.
+FTH=<MOD>		Transmits HDLC data with a <MOD> carrier.
+FRH=<MOD>		Receives HDLC data with a <MOD> carrier.

The <MOD> parameter takes on the following values:

## Modulation values

Value	Modulation	Speed	Requirements
3	V.21 ch. 2 +FTH and +FRH support value 3	300	required for FTH & FRH (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>	Executes a command or sets a parameter.
+<command>=?	Reads permissible settings.
+<command>?	Reads the current setting.

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

Command	Value	Description
+FAA=n	n=0 n=1	Auto-answer mode parameter: The DCE answers as set by +FCLASS. The DCE answers and auto-determines the call type.
+FBADLIN= <value>	0-255	Bad line threshold (number of consecutive bad lines for a bad page parameter): Determines if the "Copy Quality OK" on the T.30 flow chart is met. <value>=0 to 255; a value of 0 implies that error checking is disabled.

Command	Value	Description
+FBADMUL= <value>	0-255	Error threshold multiplier: Determines if the "Copy Quality OK" on the T.30 flow chart is met. <value>=0 to 255; a value of 0 implies that error checking is disabled.
+FBOR=n	n=0 n=1	Phase C data bit order: Selects direct bit order. Selects reversed bit order in receiving mode for phase C data.
+FBUF?		Buffer size; a read only parameter: Allows the 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 the +FCLASS Class1 command on page 15-2.
+FCON		DCE response: a fax connection is established.
+FCQ=n	n=0 n=1 n=2	Copy quality check capability parameter: No copy quality check capability. Only checks 1D phase C data. Checks both 1D and 2D phase C data.
+FCR=n	n=0 n=1	"Capability to receive" parameter: The DCE will not receive message data or poll a remote device. The DCE receives message data or polls a remote device.
+FCTCRTY= <value>	0-255	ECM retry count; in Error Correction 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	vr=0 vr=1 br=0 br=1 br=2 br=3	DCE capabilities parameters.  Vertical resolution: Normal; 98 lpi. Vertical resolution: Fine; 196 lpi. Bit rate: 2400 bit/s; V.27ter. Bit rate: 4800 bit/s; V.27ter. Bit rate: 7200 bit/s; V.29 or V.17. Bit rate: 9600 bit/s; V.29 or V.17.

Command	Value	Description
	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 is disabled.
	ec=1	Enables error correction mode.
	bf=0	Disables 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 the +FDCC command.
+FDIS=vr,br,wd,ln,df,ec,bf,st		Current session negotiation parameter; refer to the +FDCC command.
+FDR		Receives phase C data command; initiates document reception.
+FDT (=df,vr,wd ln)		Transmits phase C data command: releases the DCE to proceed with the negotiation.
+FECM=n		Error correction mode control:
	n=0	Error correction mode is disabled.

Command	Value	Description
	n=2	Error correcting mode is enabled, handled by the DCE alone, including buffering of partial pages.
+FET=n	n=0 n=1 n=2 n=4 n=5 n=6	End of page or document command: More pages; same document. End of document; another document follows. No more pages or documents. Procedure interrupt; another page follows. Procedure interrupt; end of document, another document follows. Procedure interrupt; end of document.
+FK		Regular fax abort command.
+FLID="string"		Local ID string parameter.
+FLO=n	n=0 n=1 n=2	Flow control options: No flow control. Sets XON/XOFF software flow control. Sets CTS/RTS hardware flow control.
+FLPL=n	n=0 n=1	Document for polling command: The DTE has no document available for polling. Indicates that a document is available for polling.
+FMDL?		Requests the DCE model identification.
+FMFR?		Requests the DCE manufacturer identification.
+FMINS=n	n=0 n=1 n=2 n=3 n=4 n=5	Minimum phase C speed parameter: 2400 bps. 4800 bps. 7200 bps. 9600 bps. 12000 bps. 14400 bps.
+FPHCTO= <value>	0-255	DTE Phase C response timeout: Determines 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	n=1	Page transfer status: Received page is good.



Command	Value	Description
	n=2	Page is bad; retrain is requested.
	n=3	Page is good; retrain is requested.
	n=4	Page is bad; procedure interrupt is requested.
	n=5	Page is good; procedure interrupt is 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?		Requests the DCE revision identification.
+FSPL=n		"Enable polling" command:
	n=0	Disables polling.
	n=1	Enables 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 prompt: ready to receive data.
+FCIG:"string"		Reports the remote ID response CIG.
+FCON		Facsimile connection response.
+FCSI:"string"		Reports the remote ID response CSI.
+FDCS:vr,br,wd,ln,df,ec,bf,st		Reports the session parameters response; refer to the +FDCC=.... command.
+FDIS:vr,br,wd,ln,df,ec,bf,st		Reports the session negotiation parameters response; refer to the +FDCC=.... command.
+FDTC:vr,br,wd,ln,df,ec,bf,st		Reports the remote capabilities response; refer to the +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	Transmits the error on phase A hang up code.
	n=20	Transmits the error on phase B hang up code.
	n=40	Transmits the error on phase C hang up code.
	n=50	Transmits the error on phase D hang up code.

Response	Value	Function and Description
	n=70	Receives the error on phase B hang up code.
	n=90	Receives the error on phase C hang up code.
	n=100	Receives the error on phase D hang up code.
+FNSC:"HEX string"		Reports the non-standard facilities command frame.
+FNSF:"HEX string"		Reports the non-standard facilities frame response.
+FNSS:"HEX string"		Reports 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 "AT+F" COMMAND SET.

Command Syntax	Description
+<command>=<value>	Executes a command or sets a parameter.
+<command>=?	Reads permissible settings.
+<command>?	Reads the current setting.

## Commands

Command	Value	Description
+FAA=n		Auto-answer mode parameter:
	n=0	The DCE answers as set by +FCLASS.
	n=1	The DCE answers and auto-determines the call type.
+FBO=n		Phase C data bit order:
	n=0	Selects direct bit order.
	n=1	Selects 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 the +FDCC Class 2 command on page 15-4 for parameter settings.
+FCLASS=n		Service class selection: refer to the +FCLASS Class 1 command on page 15-2.
+FCO		DCE response: fax connection is made.
+FCQ=<rq>,<tq>	rq=0 rq=1 rq=2 tq=0 tq=1 tq=2	Copy quality check capability parameter: DCE Receive Copy Quality Checking is disabled. DCE Receive Copy Quality Checking is enabled. DCE Receive Copy Quality Correction is enabled. DCE Transmit Copy Quality Checking is disabled. DCE Transmit Copy Quality Checking is enabled. DCE Transmit Copy Quality Correction is enabled.
+FCR=n	n=0 n=1	"Capability to receive" parameter: The DCE will not receive message data or poll a remote device. The DCE receives message data or polls a remote device.
+FCT=n	0-255	DTE phase C time-out parameter. n=0-255, 1 s units.
+FDR		Receive phase C data command: initiates document reception.
+FDT		Transmit phase C data command: releases the DCE to proceed with the negotiation.
+FEA=n	n=0 n=1	Phase C received EOL alignment parameter: Determines that T.4 EOL patterns are bit aligned (as received). Determines that the last received bits of T.4 EOL patterns are byte aligned by the DCE, with necessary zero fill bits inserted.
+FIE=n	n=0 n=1	Procedure interrupt parameter: Procedure interrupt requests from the remote station are ignored, and are not reported to the DTE. Procedure interrupt requests from the remote station are accepted, negotiated and reported using the +FVO response.
+FIP		Initializes facsimile parameters to factory default.

+FIS=vr,br,wd,ln, df,ec,bf,st	Current session parameter: refer to the +FDCC Class 2 command on page 15-4 for parameter settings.
+FKS	Session termination command.
+FLI="string"	Local ID string parameter.
+FLO=n n=0 n=1 n=2	Flow control options: No flow control. Sets XON/XOFF software flow control. Sets CTS/RTS hardware flow control.
+FLP=n n=0 n=1	Document for polling command: The DTE has no document for polling. Indicates that a document is available for polling.
+FMI?	Requests DCE manufacturer identification.
+FMM?	Requests DCE model identification.
+FMR?	Requests DCE revision identification.
+FMS=n	Minimum phase C speed parameter: refer to the +FMINSF Class 2 command on page 15-6 for parameter settings.
+FNR=rpr, tpr, idr, nsr rpr=0 rpr=1 tpr=0 tpr=1 idr=0 idr=1 nsr=0 nsr=1	Negotiation message reporting control parameters: Receiver parameters are not reported. +FIS: and +FTC: response reports are suppressed. Receiver parameters are reported. +FIS: and +FTC: response reports are generated. Transmitter Parameters are not reported. +FCS: response reports are suppressed. (+FCS parameter is still loaded) Transmitter Parameters are reported. +FCS: response reports are generated. ID Strings are not reported. +FTI: +FCI: and +FPI: response reports are suppressed. ID Strings are reported. +FNF:, +FNS: and +FNC: response reports are generated. Non-standard frames are not reported. +FTI: +FCI: and +FPI: response reports are suppressed. Non-standard frames are reported. +FTI:, +FCI: and +FPI: response reports are generated.

+FNS="string"		Non-standard byte string parameter. "string": string of hexadecimally coded octets.
+FPI="string"		Local fax station ID string, for polling Rx.
+FPP=n	n=0 n=1	Packet protocol control parameter: Disables the DCE-DTE packet protocol. Enables 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	n=0 n>0	Serial port rate control parameter: Automatic DTE rate detection by the DCE. Serial rate is fixed at the value multiplied by 2400bps. For example, when n=8, the DTE rate is equal to 19200bps (8x2400).
+FPS=n		Page transfer status: refer to the +FPTS Class 2 command on page 15-6 for parameter descriptions.
+FRQ=pgl, cbl	pgl= 0-64 (HEX value)  cbl= 0-FF (HEX value)	Receiving quality thresholds parameters: Specifies 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. Specifies 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	n=0 n=1	Enable polling command: Disables polling. Enables polling.

## Class 2.0 Command Responses

Response	Value	Function and Description
+FCI:"CSI ID string"		Reports remote ID response, Called Station ID (CSI).
+FCO		Fax connection established response.
+FCS: vr, br, wd, ln, df, ec, bf, st		Negotiated session parameters (DCS frame information) response: refer to the +FIS=... command for a description of subparameters.
+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>		Call termination status:
	hsc= 0-0F	Call placement and termination. Refer to TIA-592 for details.
	hsc= 10-1F	Transmits phase A and miscellaneous errors. Refer to TIA-592 for details.
	hsc= 20-3F	Transmits phase B hang up codes. Refer to TIA-592 for details.
	hsc= 40-4F	Transmits phase C hang up codes. Refer to TIA-592 for details.
	hsc= 50-6F	Transmits phase D hang up codes. Refer to TIA-592 for details.
	hsc= 70-8F	Receives phase B hang up codes. Refer to TIA-592 for details.
	hsc= 90-9F	Receives phase C hang up codes. Refer to TIA-592 for details.
	hsc= AO-BF	Receives phase D hang up codes. Refer to TIA-592 for details.
+FIS:vr, br, wd, ln, df, ec, bf, st		Remote fax station capabilities (DIS frame information) response: refer to the +FIS=... command for a description of subparameters.

+FNC: "NSC FIF string"	Reports NSC (Non-Standard Commands) frame
+FNF: "NSF FIF string"	Reports NSF (Non-Standard Facilities) frame.
+FNS: "NSS FIF string"	Reports NSF (Non-Standard Setup) frame.
+FPI: "CIG ID string"	Reports remote ID-response-Polling Station ID (CIG).
+FPO	Remote polling indication.
+FPS: ppr, lc, blc, cbcl, lbc	T.30 phase C page reception response:  <div style="margin-left: 100px;"> ppr=1    Received page is good.  ppr=2    Page is bad; retrain is requested.  ppr=3    Page is good; retrain is requested.  ppr=4    Page is good; remote request for procedure interrupt is accepted.  ppr=5    Page is bad; retrain is requested; remote request for procedure interrupt is accepted.  </div> The receiving DCE may count <lc>, <blc>, <cbcl> and <lbc> due to DCE buffer overflow and report them: lc: line count blc: bad line count cbcl: maximum consecutive bad line count lbc: lost byte count
+FTC: vr, br, wd, ln, df, ec, bf, st	Remote fax station capabilities (DCT frame information) response: refer to the +FIS=... command for the description of subparameters.
+FTI: "TSI ID string"	Remote ID response-Transmit Station ID (TSI).
+FVO	Report transition to voice.

## Extended Fax AT Commands

These commands are unique to the 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 the data state, compressed fax image data is flowing between the modem and the 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 modem 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 chapter 9. 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 **AT+FCLASS=6** first. Following are the fax-related AT commands:

#### Mode Settings

<b>#F</b>	Sets the modem into V17G3 FAX mode; same function as the extended AT command <b>AT&amp;N32</b> .
<b>+ #B0</b>	Sets the fax receiving mode. The connection parameters and received fax data are sent to the DTE continuously following the connect message. (Default)
<b>#B1</b>	Sets the fax receiving mode. The connection 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> and then the received fax data. In this mode, the modem will wait for a 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.
<b>#B2</b>	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 connection message.
<b>#B3</b>	Displays the ring cadence.

#### Parameter Settings

<b>#V0</b>	Sets to normal vertical resolution.
<b>#V1</b>	Sets to high vertical resolution.
<b>#T0</b>	Sets to the one dimensional coding scheme.
<b>#T1</b>	Sets to the two dimensional coding scheme.
<b>#R0</b>	Sets recording width: 1728 picture elements along a scan line length of 215mm.
<b>#R1</b>	Sets recording width: 2048 picture elements along a scan line length of 255mm.
<b>#R2</b>	Sets recording width: 2432 picture elements along a scan line length of 303mm.



## Parameter Settings

#L0	Sets maximum recording length: A4 (297mm ).
#L1	Sets maximum recording length: B4 ( 364mm ).
#L2	Sets maximum recording length: unlimited.
#C0	Sets the minimum scan line time capability of the receiver: 20ms at 3.85 line/mm, $T(7.7)=T(3.85)$ .
#C1	Sets the minimum scan line time capability of the receiver: 5ms at 3.85 line/mm, $T(7.7)=T(3.85)$ .
#C2	Sets the minimum scan line time capability of the receiver: 10ms at 3.85 line/mm, $T(7.7)=T(3.85)$ .
#C3	Sets the minimum scan line time capability of the receiver: 20ms at 3.85 line/mm, $T(7.7)=1/2 T(3.85)$ .
#C4	Sets the minimum scan line time capability of the receiver: 40ms at 3.85 line/mm, $T(7.7)=T(3.85)$ .
#C5	Sets the minimum scan line time capability of the receiver: 40ms at 3.85 line/mm, $T(7.7)=1/2 T(3.85)$ .
#C6	Sets the minimum scan line time capability of the receiver: 10ms at 3.85 line/mm, $T(7.7)=1/2 T(3.85)$ .
#C7	Sets the minimum scan line time capability of the receiver: 0ms at 3.85 line/mm, $T(7.7)=T(3.85)$ .
#P<string>	Sets the local phone number; the phone number following the character 'P' can have up to 25 characters. The modem will exchange this phone number with the remote fax machine during the initial handshaking.

## Status Report Result Codes

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

NO DIAL TONE	Tries to dial, but no dial tone is detected.
NO CARRIER	The handshake fails or no carrier is detected or time-out.
BUSY	The other party's phone line is busy.
NO ANSWER	Expected 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.

Snnnn	Fax connection speed; nnnn is a 4-digit number representing the connection speed. nnnn = 1440, 1200, 9600, 7200, etc., whereby 1440 and 1200 stand for 14400 and 12000.
Vn	Vertical resolution; n = 0 or 1.
Tn	Coding scheme; n = 0 or 1.
Rn	Recording width; n = 0, 1, or 2.
Ln	Recording length; n = 0, 1, or 2.
Cn	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 the DTE of the disconnecting status.

DISCONNECT0	Disconnects with remote confirmation.
DISCONNECT1	Disconnects 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 modem always uses hardware (CTS/RTS) flow control. The flow control signaling used while sending a fax is:

CTS is used by the modem 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 modem 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 a fax.

RTS is used to inform the modem 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 modem will turn off CD, then send a status report result code to the DTE.

## Parallel Receiving with the Fax Machine

You can connect the modem and a fax machine on the same line and have the modem answer data calls and the fax machine answer fax calls, respectively. The modem will distinguish a data call from a fax call and make the switch. The setup procedure follows.

- 1) Plug the phone cable from the wall jack into the modem's Line Jack.
- 2) Plug the phone cable from the fax machine into the modem's Phone Jack.
- 3) Turn on the DTE and set `S38b4` to 1 by sending `ATS38.4=1` to the modem. This will disable the modem from receiving a fax.
- 4) Set the modem auto-answer ring number to be the same as your fax machine's setting. For example, if you have set your fax machine to answer an incoming call after 2 rings, then you need to set the modem to the same ring number by sending the command `ATS0=2` to the modem.

Now, when a call comes in, both the modem and the fax machine will go off-hook after the same number of rings. However, the line is initially connected to the modem and cut off from the fax machine when the modem goes off-hook. The modem will try to handshake on the incoming call. If it is a data call, the handshake will be successful and a connection will be made. The fax machine being cut off from the line will fail the handshake and go on-hook after a time-out. If, during the handshake, the modem finds that it is a fax call, it will disconnect since bit 4 of S-register `S38` is set and the fax machine will get the line. The fax machine will handshake successfully in this case.

## Fax reception from within a BBS System

ZyXEL modems have the feature of automatic detection of data and fax calls, and allow a BBS software to receive faxes on the same phone line. To make your BBS receive the incoming fax, you need to do the following setup change 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 connection 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 to the init string : **X7#B1+FCLASS=6**

Change the connection messages as:

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

Set external mail as:

External Mail		
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
```

### Direct FAX Reception and Printing

Use a PC printer cable and a DB25 female-female gender converter to connect the modem's parallel port connector to a laser printer.

Use the serial port to enter the command:

AT+FCLASS=Z

The modem will enter into direct fax reception and print mode. You also need to set the S0 register to a finite number to enable auto-answering. To further detail operation in Class Z mode, the special command AT+FZF has been implemented to define the fax reception mode under Class Z operation.

- +FZF=n

**ZyXEL fax reception mode selection for parallel port printing, auto-data and DRAM storage.**

n=0	Fax to printer, hangs up if data. Upon incoming calls, the modem will check whether an active printer is connected. If so, the modem will answer the call and print the fax, otherwise it will not answer. If the modem answers and the call is not a fax call, it will hang up. Note that the modem is in the printer (PRP) mode only during fax printing, at all other times it will maintain the serial port connection if it is connected. (Default)
n=1	Fax to printer, data to serial port. When a call comes in, the modem will check if there is an active printer connected to the parallel port or an active DTE connected to the serial port. If either one is connected, the modem will answer; otherwise it will not answer. If the modem answers and the call is a fax call, it will check whether an active printer is connected or not. If it is, the modem will print the fax; otherwise it will hang up. If the call is a data call, the modem will check if an active DTE is connected to the serial port or not. If it is, the modem will connect to the DTE through the serial port; otherwise it will hang up.

The +FZF command is only effective in Class Z operation. It only defines the reception mode under Class Z. For transmission, the DTE can send the appropriate +FCLASS command first before starting a transmission. If it is desired to return to fax reception and print mode later, the DTE needs to issue a +FCLASS=Z and a +FZF command again after finishing the transmission. To leave the fax reception and print mode, enter a +FCLASS command to set the modem to another Class mode.

You can also enter commands through the parallel port and have the modem operate in +FZF=0 mode. But then you will often need to switch the modem parallel port connection between a PC and a printer .

The modem supports laser printers compatible with HP Laserjet-II printers or laser printers supporting the HP PCLII programming command language. This includes essentially all HP-compatible laser printers on the market.

Different laser printers may have different print speeds. The fax receiving speed depends on the fax connection speed. For current standards, the connection speed is from 2400 bps up to 14400 bps. For the upcoming V.34 fax standard, the speed may run up to 28800 bps. The printer speed must be greater than or equal to the fax receiving speed, otherwise a fax data overrun will occur. If the printer is slow, the modem may adjust the minimum scan time per line parameter to have the remote site send the fax slower (with a higher "minimum scan time per line" parameter). When a laser printer is connected to the modem and both are turned on, the command

**AT+FZT**

will cause the modem to test the printer speed and store the speed parameter in non-volatile memory. The printer will have one test page print. The modem also sets the `st` (scan time) parameter in the **+FCC Class 2.0** command according to the speed parameter. In the first Class Z mode operation after being turned on, the modem sets a default `st` parameter according to the speed parameter stored in the nonvolatile memory. The user can override the `st` setting by using the **+FCC** command.

Two laser printer resolutions can be selected using **+FZR** command

**+FZR =0 Resolution: 300 dpi**

**+FZR =1 Resolution: 150 dpi**

The default is 300 dpi. 150 dpi is not recommended because of printing quality degradation. If you are using a very slow laser printer, 150 dpi will speed up the fax receiving process. Use the **AT+FZS** command to select the paper size:

**+FZS =0 LETTER (8.5" x 11")**

**=1 LEGAL (8.5" x 14")**

**=2 A4 (210mm x 297mm)**

## Stand-alone FAX Reception and Storing

With the DRAM option installed, you can have the modem receive faxes and store them in the DRAM. To work in this mode, you need to use the **AT+FCLASS=Z** command to set the modem to work in the Class Z mode. Also, you need to use the **+FZF=n** command to set the modem to work in one of the following modes:

n=2	Fax to DRAM and printer, hangs up if data. The modem always answers. If it is a fax call, the received fax pages will be stored in DRAM; if an active printer is connected to the parallel port, the fax pages are also sent to the printer. The modem will hang up if the call is not a fax call.
n=3	Fax to DRAM, hangs up if data. The modem always answers. If it is a fax call, the received fax pages will be stored in DRAM; if it is not a fax call, the modem will hang up.
n=4	Fax to DRAM and printer, data to serial port. The modem operates as with n=2 except that the modem will connect to the serial port if the incoming call is a data call. If no active DTE is connected to the serial port, the modem will hang up.
n=5	Fax to DRAM, data to serial port. The modem operates as with n=3 except that the modem will connect to the serial port if the incoming call is a data call. If no active DTE is connected to the serial port, the modem will hang up.

The modem will respond with **OK** to the **+FZF=n** (n=2-5) command if the DRAM option is installed, otherwise it will return an **ERROR** response.

The modem makes a record of every stored fax page if it has also been printed at reception. In class Z mode, you can have the modem print the unprinted fax pages stored in DRAM by sending an **AT+FZP** command to the modem. If there are no unprinted fax pages, the modem will return **OK**. If there are unprinted fax pages and an active printer is connected to the parallel port, the modem will print the unprinted fax pages and return **OK**. If there are unprinted fax pages, but no active printer is connected, the modem will return **ERROR**.

You can also print fax pages stored in DRAM without turning on a computer to issue commands. In class Z mode, with an active printer connected to the parallel port, pushing the D/V button on the front panel will cause the modem to send unprinted fax pages to the active printer.

You can use a computer with your existing fax software package to retrieve fax pages stored in DRAM. Use either the parallel port or the serial port to connect your computer to the modem and run your favorite fax program. When the fax program sets the modem to fax Class 2 or Class 2.0 mode, the modem will emulate fax calls coming in, have the fax program receive the fax calls, and then dump all stored fax pages to the fax program. Note that each stored fax call, either single-page or multiple-page, will cause the modem to emulate a separate fax call and the fax program will store and log them as a separate fax reception.

There are two S-register bits reserved to control the printing or downloading of fax pages stored in DRAM. For printing to laser printer,

S71b5=0     The modem will not print stored fax pages which are unprinted yet, but which have already downloaded to a computer fax program.

S71b5=1     The modem will print stored fax pages.

The default is S71b5=0.

For downloading faxes to a computer fax program,

S71b4=0     The modem will not download fax pages to a computer fax program which have not yet been downloaded, but which have already been printed.

S71b4=1     The modem will download printed pages.

The default is S71b4=0.

If the modem's DRAM stores fax pages which the modem will either print to a printer or download to a computer fax program, the front panel's FAX LED indicator will flash. This also depends on the settings of S71b5 and S71b4. For the Omni, the V34 and V32b LEDs will flash simultaneously.



# Chapter 16

## ADVANCED VOICE CAPABILITY

Voice capability stands for the modem's ability to digitize incoming voice messages, which the computer stores and forwards. It also means that the modem can play-back 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 that a computer can react according to the remote caller's touch tone input.

### Voice Data Compression

The main issue in the 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. The hard disk will be filled up quickly by digitized voice data at this digitization rate. 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 still maintaining good voice quality requires a sophisticated and complicated signal processing algorithm. It also requires a lot of digital signal processing computation power.

The ZyXEL 2864 series modems support four voice digitization schemes. A summary of these four schemes is listed below:

Digitization Scheme	Speech Compression Algorithm	Data Rate
2-ADPCM	ADPCM, 2bits/sample	19200 bps
3-ADPCM	ADPCM, 3bits/sample	28800 bps
New 3-ADPCM	ADPCM, 3bits/sample	30720 bps
4-ADPCM	ADPCM, 4bits/sample	38400 bps

whereby the sampling rate used is 9600 samples per second.

The New 3-ADPCM scheme is a 3-bit ADPCM scheme with added sync bits in the voice data to avoid loss of sample data synchronization due to data errors or loss

of data. It is the recommended 3-bit ADPCM scheme. It will automatically recover from data errors when playing without producing a noisy voice signal.

The modem also supports simultaneous DTMF (Dual Tone Multiple Frequency) tone detection, thus enabling the use of the keypad of a tone-dialing push-button telephone set to control, instruct, or answer the modem.

## Automatic Detection of Voice, Fax and Data

Since there is no standard and there is no way to specify how a human voice should behave in telephone calling and answering, it is difficult, if not impossible, to automatically make a distinction between voice, fax, or data calls. A common method of accomplishing this detection and switch-over is the use of a human voice announcement as the first step in the answering process. The calling party is instructed to push one number in the push-button pad for fax calling and to push another number for voice calling. By detecting which DTMF tone is received, the computer software and the modem can switch to the appropriate mode accordingly. If no tone is received until timeout, the modem assumes the call to be a data call and starts modem handshaking. The shortcoming of this method is that some modems will get confused by the initial voice message announcement and will not get connected. Even if the data call is connected successfully, the longer handshake delay may not be acceptable in some applications. Some software packages use an initial silence in answering and detect if there is voice energy to decide if it is a voice call. The modem can recognize a fax or data call quicker if a calling tone is received. The voice announcement can be omitted in this case.

ZyXEL will continue to work on improvements of the automatic detection of voice, fax and data. To better support the distinction between voice, data and fax calls, a new feature called EDR (Extended Distinctive Ring) has been added to the firmware of all of the modems of the 2864 series. Refer to chapter 13 and S-registers S40 and S51 regarding this feature. New capabilities or enhancements will be released in future versions of the firmware.

## Voice States and Operation Modes

The Voice Mode DCE control interface for the 2864 series modems basically follows the TIA TR29.2 committee IS-101 Interim Standard. ZyXEL is continuously enhancing its modems' voice capability and voice feature implementation. Please refer to the manual amendment or firmware release notes for updated details. ZyXEL reserved S-register S48b5 for the IS-101 compatibility flag. When this bit is off (default), the command set is compatible with the U-1496 modem. If this bit is set, the 2864 series is compatible with the IS-101 standard.

In ZyXEL voice mode, three states exist that roughly correspond to the flow direction of the digitized voice data; the Voice Command State (no data transfer other than event reports), the Voice Transmission State (digitized voice data transfer from the DTE to the DCE), and the Voice Receive State (digitized voice data transfer from the DCE to the DTE). Note that the 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 in nature (such as calling tone detection), or they may be a result of external switching functions of Telco line activities (Ring), or they may be a combination (Caller ID). 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., 2100Hz)	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 ready to accept commands when the DCE is operating in voice mode and is not communicating with a remote station, nor with any local devices which are capable of translating analog signals to voice (e.g., speaker) or translating voice to analog signals (e.g., microphone). The DCE considers data transfers from the DTE to be commands, and returns responses back to the DTE after completing the processing of the commands. While accepting or processing commands, the DCE also monitors the line which connects the DCE to the remote station or to the local device to detect events, which the DCE later reports to the DTE pertaining to signals carried over the line, such as tones, and pertaining to 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 State

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 translating voice to analog signals (e.g., microphone). The DTE transfers data to the DCE for transmission to the remote station, and 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 and the remote station, and pertaining to requests from the DTE.

Voice Data State has two sub-states: Voice Transmission State and Voice Receival 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 ringing.

To leave the Voice Transmission State you may use either of the following two methods:

- (1) A <DLE><ETX> shielded code is received from the DTE.
- (2) A DTE/DCE inactivity timer time-out occurs.

Item (1) is the DTE-initiated method to terminate the Voice Transmission State, and item (2) is a DCE-initiated means of terminating the Voice Transmission State. Upon termination of the Voice Data State, the DCE will enter the Voice Command State.

### Voice Data Receival State

The DCE is in the Voice Receival 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 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. 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 ZyXEL 2864 series modems provide three ways to leave the Voice Receive State:

- (1) A `<DLE><!>` shielded code is received from the DTE.
- (2) Characters other than `<XON>`, `<XOFF>` or a shielded code is received from the DTE.
- (3) A DTE/DCE inactivity timer time-out occurs.

Items (1) and (2) are the DTE-initiated means of terminating the Voice Receive State, and item (3) is a DCE-initiated means of terminating the Voice Receive State. After termination of the Voice Data State, the DCE shall enter 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, detect tone and cadence events associated with call progress activities, and monitor Telco line-related activities. 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>`, whereby `<code>` can be one of the possible character values listed in the following table:

<code>&lt;code&gt;</code>	Event Report Description
<code>&lt;DLE&gt;</code> (0x10)	Two contiguous <code>&lt;DLE&gt;&lt;DLE&gt;</code> codes indicate a single <code>&lt;DLE&gt;</code> in the data stream.
<code>&lt;SUB&gt;</code> (0x1A)	<code>&lt;DLE&gt;&lt;DLE&gt;</code> in the data stream.
<code>&lt;DC2&gt;</code> (0x12)	Concatenates receival 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 <code>&lt;DLE&gt;&lt;DC2&gt;</code> codes. This resync generation timer is defined by the command <code>AT+VSY</code> .
<code>&lt;ETX&gt;</code> (0x3)	Ends Data State. The DCE sends this code to indicate the end of the voice data.
R (0x52)	Ring: The <code>&lt;DLE&gt;</code> shielded version of the RING result code.

<code>	Event Report Description
1 (0x31)	DTMF 1
2 (0x32)	DTMF 2
3 (0x33)	DTMF 3
4 (0x34)	DTMF 4
5 (0x35)	DTMF 5
6 (0x36)	DTMF 6
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)	Receival 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 breaks (local phone goes on-hook).
H (0x48)	Line current is detected (local phone goes off-hook).
s (0x73)	Silence is 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 is 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 indicate a remote hang-up.

<code>	Event Report Description
L (0x4C)	Loop current polarity reversal. This may indicate a hang-up or other events depending on the implementation of the central office.
r (0x72)	Ringback.
b (0x62)	BUSY. If the DCE continues to detect a BUSY signal, it may report this event repeatedly. The delay between reports is 4.0 seconds.
d (0x64)	DIAL TONE. If the DCE continues to detect a DIAL TONE, the DCE may report this event repeatedly. The time interval 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>, whereby <code> can be one of the possible character values listed in the following table :

<code>	Action Command 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 that a single <DLE> is in the data stream.
<SUB> (0x1A)	<DLE><DLE> is in the data stream.
u (0x75)	Pumps up the volume or gain by one unit.
d (0x64)	Pumps down the volume or gain by one unit.
p (0x70)	Pauses Transmission 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 transmission buffer and the state of its compressors, continue in the Data State, and send silence to the analog destination.
r (0x72)	Resumes Transmission Data 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 Transmission Data 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 Transmission Data 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)	Concatenates transmission 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 Receival Data State: The DTE sends this code to indicate the end of voice data reception and the return to the Voice Command State. The DCE will discard the contents of its receival buffer before switching to the Voice Command State and returning the OK result code.

## Voice AT Commands

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

### AT Command Syntax

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

+V<CM>?	Reads the current setting.
+V<CM>=?	Reads permissible settings.
+V<CM>=<string>	Sets a single-value parameter.
+V<CM>=<value string>	Sets a compound parameter.



whereby <CM> represents a two-letter command syntax. A value string consists of 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 have both action types or be just a 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> (response to ? or =? command)
<CR><LF>
```

The final response is

```
<CR><LF>
OK (or) ERROR (Command line response)
<CR><LF>
```

The ASCII character combination <CR><LF> is not shown in the explanations below. The final response is OK if all the commands in the command line have been successfully executed, otherwise it is ERROR.

### Flow Control

Flow Control is necessary to match the DTE-DCE data rate to the line signaling rate and to the requirements of analog conversion of the voice signals and data. For ZyXEL 2864 series modems, both software XON/XOFF and hardware RTS/CTS flow control are used whereas the software flow control is the default setting. The DTE may turn off the flow control, but some other method must 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 For 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 utilizing 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 upon detection of an answer-tone 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 switches to the data mode (+FCLASS=0) with autobauding, 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 it would 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 -- 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)
Z	ZyXEL fax parallel port print and/or DRAM store mode

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 modes (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 Modes.
2	The DCE disables automatic hang-ups in the other Non-Voice Modes. 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
0	XON/XOFF and RTS/CTS flow control is turned off.
1	Uses software XON/XOFF flow control in either direction.
2	Uses 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

## Action Voice Commands for Voice Mode Operation

- 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: 10ms)
Inactivity timer	+VIT	70 (unit: 0.1 s)
Silence interval	+VSD	70 (unit: 0.1 s)
Ringback disappearance timer	+VRA	70 (unit: 0.1 s)
Ringback non-appearance timer	+VRN	10 (unit: 1 s)
Receival Gain	+VGR	0
Transmission Gain	+VGT	128
Resync timer	+VSY	0 (disabled)
DTMF detection interval and threshold	+VDD	8 (unit: 5ms) 5
Flow control method	+FLO	1 (software)

The DCE returns the OK result code if the DCE accepts this command or returns the ERROR result code if the DCE is not connected to at least one voice I/O device.

- AT+VRX

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

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

The Inactivity Timer is in effect while the receive operation is in progress. If the DTE wishes to use this timer and stop the DCE from performing unwanted re-starts, the DTE must assure that there is data being 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, returns the OK result code, and then returns 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 ZyXEL 2864 series modems support 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 the Voice Command State.

## Configuration Commands for Voice Mode Operation

- AT+VGR=`<gain>`

This command causes the DCE to set the gain for the received voice samples. The receival 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 -18dB gain, 128 for 0dB, and 200 for 18dB, in 0.25dB 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 the current receival gain, followed by the `OK` result code.

- AT+VGR=?

The DCE will return all permitted values for the receival 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 -18dB gain, 128 for 0dB, and 200 for 18dB, in 0.25dB steps.

The DCE returns the result code `OK` if the 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 transmission gain, followed by the `OK` result code.

- `AT+VGT=?`

The DCE returns permitted values for the transmission 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 seconds. 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 time-out value, followed by the `OK` result code.

- `AT+VIT=?`

The DCE returns the permitted Inactivity Timer time-out 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:

<code>&lt;device&gt;</code>	Description
0	The DCE is on-hook. The Local phone is connected to the Telco Line. (default)
1	The DCE is on-hook and is connected to the Local Phone. The Local Phone is provided with power to detect the hook condition.
2	The DCE is off-hook and is connected to the Telco Line. The Local Phone is provided with power to detect the hook condition.
8	The DCE is on-hook and is connected to an External Microphone. The Local Phone is connected to the Telco Line.
16	The DCE is on-hook and is connected to the Internal Speaker. The Local Phone is connected to the Telco Line.

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+VRA=<interval>`

The DCE only uses this command in a call origination transaction. This command sets the amount of time the DCE shall wait between ringbacks before the DCE can assume that the remote station has gone off-hook. The default value is 70 (7 seconds). The range of `<interval>` is from 0 to 255. The units are 0.1 seconds. A value of zero forces the DCE to return the `OK` result code immediately after the first ringback.

The `<interval>` subparameter refers to the silence interval length between the end of one ring interval and the start of the next ring interval. The DCE returns the `OK` result code if the DCE accepts this command, or it returns the `ERROR` result code if the `<interval>` is out of range.

- `AT+VRA?`

The DCE will return the current Ringback Goes Away Timer interval value, followed by the `OK` result code.

- `AT+VRA=?`

The DCE will return the permitted interval of the Ringback Goes Away Timer. The response is:

0-255

`OK`

- `AT+VRN=<interval>`

The DCE only uses this command in a call origination transaction. This command sets the amount of time the DCE will wait looking for a ringback. If the DCE does not detect a ringback within this time period, the DCE assumes that the remote station has gone off-hook, and returns an `OK` result code.

A `+VRN` setting higher than the value in the `S7` register means that only the `S7` timer is in effect. The range of `<interval>` is from 0 to 255. The unit is 1 second. The default value is 10 (10 seconds). A value of zero forces the DCE to return `OK` immediately after dialing.



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

- AT+VRN?

The DCE returns the current Ringback Never Appeared Timer interval value followed by the OK result code.

- AT+VRN=?

The DCE will return the permitted interval for the Ringback Never Appeared Timer. The response is:

0-255

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 receive 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 conditions 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 the 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>

This command causes the DCE to select a compression method as follows:

<cml>	Compression Method Description
2	ZyXEL 2-bit ADPCM (default)
3	ZyXEL 3-bit ADPCM
30	ZyXEL new 3-bit ADPCM
4	ZyXEL 4-bit ADPCM

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

- AT+VSM?

This command causes the DCE to report the current compression setting in the following form:

```
<cml>;<scs>;<vsr>
OK
```

where

<cml> is the compression method label.  
 <scs> is the silence compression sensitivity.  
 <vsr> is the voice sampling rate.

- AT+VSM=?

This command causes the DCE to report the compression methods supported. The response is as follows:

```
2;ADPCM;2;0;(9600)
3;ADPCM;3;0;(9600)
30;ADPCM;3;0;(9600)
4;ADPCM;4;0;(9600)
OK
```

The first item in each line is the compression method label, the second item is the compression scheme, the third item is the number of bits per sample, the fourth item is the silence detection threshold level, and the fifth item is the sampling rate.

- AT+VTD=<dur>,<int>

This command causes the DCE to set the default DTMF tone generation duration <dur> and comma pause interval <int> used in conjunction with AT+VTS command.

The range of <dur> and <int> is from 0 to 255. The units are 10 msec. The default value for <dur> is 50 (500 ms) and for <int> is 7 (70 ms).

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

- AT+VTD?

The DCE returns the current beep duration and pause interval setting followed by the OK result code.

- AT+VTD=?

The DCE returns the permitted values for the beep duration and pause interval. The response is:

(0-255), (0-255)

OK

- AT+VDD=<dds>,<ddi>

This command causes the DCE to set the DTMF detection threshold and the required period of continuous DTMF tone detection before the DCE can report a DTMF event.

<dds> : The DCE uses this subparameter to select the sensitivity threshold level of DTMF detection; a lower value of this subparameter implies that the DTE wants the DCE to detect the DTMF tone more sensitively. The range of the threshold <dds> is from 0 to 15. A value of zero disables the DTMF detection. The default value is 5.

<ddi> : The required period of continuous DTMF tone detection before the DCE can report a DTMF event. A value of zero disables the DTMF detection. The range of the interval <ddi> is from 0 to 255 in units of 5 ms. The default value is 8 (40 ms).

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

- AT+VDD?

This command causes the DCE to report the current <dds> and <ddi> settings. The format of the response is:

<dds>,<ddi>

OK

- AT+VDD=?

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

(0-15), (0-255)

OK

- AT+VSY=<timer>

This command sets the DCE's voice recording resync timer. The range of <timer> is from 0 to 255 in 50ms units. The default value is 0 (disable). A value of 0 disables resync generation. In Voice Receival Mode, the speech coder is reset and generates a resync symbol - <DLE><DC2> in the voice data according to this timer interval.

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

- `AT+VSY?`

The DCE returns the current resync timer value, followed by the **OK** result code.

- `AT+VSY=?`

The DCE returns the permitted interval of the resync timer. The response is:

0-255  
OK

Note:      `AT+VSY` is not defined in the IS-101. The IS-101 did define that the DTE can send a `<DLE><FS>` code to have the DCE reset its de-compressor and concatenate following voice data. The IS-101 did not have a command to have the DCE periodically reset its compressor and generate resync symbols in voice recording mode.

Voice Data Format

The voice data file format is described in the ZFAX documentation on the software floppy disk. Compressed voice data has a continuity property, i.e., you cannot cut and paste to edit the voice files. In order to enable editing, resync symbols can be inserted into the ADPCM voice data at regular intervals. Use the `AT+VSY` command to set the resync interval. Set `AT+VSY=0` (default) to disable resync generation. The unit of a resync interval is 50 ms. The ADPCM coder is reset with every resync symbol, thus the ADPCM voice data will not depend on a too long data history. If you convert the compressed voice data into the uncompressed PCM data file, you can always edit the PCM file with no problem. The resync symbol is a shielded `<DLE>` code - `<DLE><DC2>` (hex 10 and 12).

Note:      The resync symbol can also be used as a timing mark.

Examples of Voice Mode Operation

Greeting message recording  
(Connect a telephone set to the PHONE RJ11C jack).

DTE	DCE	Description
<code>AT+FCLASS=8</code>	→	Switches to voice mode.
	←      OK	
<code>AT+VSM=?</code>	→	

DTE		DCE	Description
	←	2;ADPCM;2;0;(9600) 3;ADPCM;3;0;(9600) 30;ADPCM;3;0;(9600) 4;ADPCM;4;0;(9600) OK	
AT+VSM=4	→		Selects 4-bit ADPCM compression method.
	←	OK	
AT+VLS=1	→		Activates the telephone set on the PHONE jack.
	←	VCON	
AT+VRX	→		Starts recording.
	←	CONNECT	
	←	<DATA>	
<DLE><!>	→		Stops recording.
	←	<DATA>	
	←	<DLE><ETX>	
	←	OK	Returns to the command state.
AT+VLS=0	→		Deactivates the telephone set on the PHONE Jack.
	←	OK	
AT+FCLASS=0	→		Returns to the data mode.
	←	OK	

Voice file playing via internal speaker.

DTE		DCE	Description
AT+FCLASS=8	→		Switches to voice mode.
	←	OK	
AT+VSM=?	→		

DTE		DCE	Description
	←	2;ADPCM;2;0;(9600) 3;ADPCM;3;0;(9600) 30;ADPCM;3;0;(9600) 4;ADPCM;4;0;(9600) OK	
AT+VSM=2	→		Selects the 2-bit ADPCM compression method.
	←	OK	
AT+VLS=16	→		Activates internal speaker.
	←	VCON	
AT+VTX	→		Starts replay.
	←	CONNECT	
<DATA>	→		
<DLE><ETX>	→		
	←	OK	Returns to the command state.
AT+VLS=0	→		Deactivates the internal speaker.
	←	OK	
AT+FCLASS=0	→		Returns to the data mode.
	←	OK	

### Voice file playing via line

DTE		DCE	Description
AT+FCLASS=8	→		Switches to voice mode.
	←	OK	
AT+VSM=?	→		
	←	2;ADPCM;2;0;(9600) 3;ADPCM;3;0;(9600) 30;ADPCM;3;0;(9600) 4;ADPCM;4;0;(9600) OK	
AT+VSM=4	→		Selects the 4-bit ADPCM compression method.
	←	OK	

DTE		DCE	Description
AT+VLS=2	→		Connects to the line.
	←	VCON	
AT+VTX	→		Starts replay.
	←	CONNECT	
<DATA>	→		
<DLE><ETX>	→		
	←	OK	Returns to the command state.
AT+VLS=0	→		Deactivates the line connection.
	←	OK	
AT+FCLASS=0	→		Returns to the data mode.
	←	OK	

#### Answering machine (Voice call)

DTE		DCE	Description
AT+FCLASS=8	→		Switches to voice mode.
	←	OK	
AT+VSM=?	→		
	←	2;ADPCM;2;0;(9600) 3;ADPCM;3;0;(9600) 30;ADPCM;3;0;(9600) 4;ADPCM;4;0;(9600) OK	
AT+VSM=4	→		Selects 4-bit ADPCM for the greeting message.
	←	OK	
AT+VLS=2	→		Connects to the line.
	←	VCON	
AT+VTX	→		Starts to play the greeting message.
	←	CONNECT	
<DATA>	→		
<DLE><ETX>	→		

DTE		DCE	Description
	←	OK	Returns to the command state.
AT+VSM=2	→		Changes to 2-bit ADPCM for recording.
	←	OK	
AT+VRX	→		Starts recording.
	←	CONNECT	
	←	<DATA>	
	←	<DLE>b or <DLE>q	The DCE detects a busy tone or a long period of quiet.
<DLE><!>	→		Stops recording.
	←	<DATA>	The DCE delivers the remaining data.
	←	<DLE><ETX>	
	←	OK	Returns to the command state.
AT+VLS=0	→		Deactivates the line connection.
	←	OK	
AT+FCLASS=0	→		Returns to the data mode.
	←	OK	

### Answering machine (Fax call)

DTE		DCE	Description
AT+FCLASS=8	→		Switches to voice mode.
	←	OK	
AT+VSM=?	→		
	←	2;ADPCM;2;0;(9600) 3;ADPCM;3;0;(9600) 30;ADPCM;3;0;(9600) 4;ADPCM;4;0;(9600) OK	



DTE		DCE	Description
AT+VSM=4	→		Selects 4-bit ADPCM for the greeting message.
	←	OK	
AT+VLS=2	→		Connects to the line.
	←	VCON	
AT+VTX	→		Starts to play the greeting message.
	←	CONNECT	
<DATA>	→		
	←	<DLE>c or <DLE>5	T.30 fax calling tone or DTMF digit '5' is detected.
<DATA>	→		
<DLE><ETX>	→		
	←	OK	Returns to the command state.
AT+FCLASS=2	→		Switches to fax mode.
	←	OK	
ATA	→		Tries to handshake in the fax mode.
Switches to fax mode and answers the fax call...			

Note: If a modem data tone is detected - a <DLE>e response, the modem should be switched to data mode.

#### Answering machine (Data call)

DTE		DCE	Description
AT+FCLASS=8	→		Switches to voice mode.
	←	OK	
AT+VSM=?	→		
	←	2;ADPCM;2;0;(9600) 3;ADPCM;3;0;(9600) 30;ADPCM;3;0;(9600) 4;ADPCM;4;0;(9600) OK	

DTE	DCE	Description
AT+VSM=4	→	Selects 4-bit ADPCM for the greeting message.
	← OK	
AT+VLS=2	→	Connects to the line.
	← VCON	
AT+VTX	→	Starts to play the greeting message.
	← CONNECT	
<DATA>	→	
<DLE><ETX>	→	
	← OK	Returns to the command state.
AT+VSM=2	→	Changes to 2-bit ADPCM for recording.
	← OK	
AT+VRX	→	Starts recording.
	← CONNECT	
	← <DATA>	
	← <DLE>s	The DCE detects silence.
<DLE><!>	→	Stops recording.
	← <DATA>	The DCE delivers the remaining data.
	← <DLE><ETX>	
	← OK	Returns to the command state.
(The DTE ought to delete this silence file.)		
AT+FCLASS=0	→	Switches to data mode
	← OK	
ATA	→	Tries to handshake in data mode.
Switches to data mode and answers the data call...		

Note: If a modem data tone is detected - a <DLE>e response -, the modem should be switched to data mode.

## Connecting a Telephone Set to the Modem's PHONE Jack

A normal telephone set can be connected to the 2864 modem's PHONE jack and be used for recording and playback. A telephone set needs DC voltage and a current supply to work. This DC voltage is normally supplied through the phone line from the telephone company or a PABX.

The ZyXEL 2864 series modems are designed to provide DC voltage and current to the telephone set connected to the PHONE jack. Thus, a normal telephone set can be used to record or playback voice messages.



# Chapter 17

## NETWORK MANAGEMENT CAPABILITY

When there are several modems installed at different places forming a modem network, it is desirable to monitor and control all of the modems and modem links from a central location. When there are hundreds of modems installed at one central location, it is also desirable to control and monitor all of the modems from the desk of a computer workstation. We call this a Modem Network Management System (MNMS). In this chapter, we briefly describe the ZyXEL MNMS capability. For a detailed description, please refer to the rack's user manual and the ZyView NMS software's operation manual.

### ZyXEL Modem Network Management System

ZyXEL's MNMS is centered around its rack system. Each rack chassis has a controller card that controls all of the modem cards in the rack and interfaces to the central NMS control station. A simple twisted pair wiring can be used to link all of the central site racks to a control station which is usually a PC station running the ZyView NMS software under Microsoft Windows.

### Hierarchical Modem Network

ZyXEL MNMS can control and monitor a hierarchical (tree type) modem network. There is a secondary channel that will pass NMS information to and from the remote modem. The NMS information can also be passed to a remote site with a tandem connection to the central site as long as the tandem site(s) is a ZyXEL rack.

### Distributed Management

Any site with a ZyXEL rack(s) can connect a PC workstation running ZyView and can control and monitor all the hierarchical nodes under it. Usually, control down the modem hierarchy is through the secondary channel attached to any existing modem link between two modem sites. Alternatively, a dedicated modem link between two sites with racks can be assigned to pass NMS information and it will be much faster than a communication link using secondary channels. Two sites with many racks each can also link their NMS in this way.

## NMS Capable Models

All ZyXEL rack models except the RE and RE+ models are NMS capable, but only the model with the N suffix has the secondary channel capability. A secondary channel is necessary for remote control and hierarchical control. For a large central site local control, the secondary channel is not needed. Also, for dial-up use, like a couple of racks for a multi-line BBS, remote control and hence a secondary channel is usually not needed. The stand-alone LCD model Supreme 2864LN is equipped with a secondary channel. When it is installed on the end node of a hierarchical modem network, it is remote controllable.

# Chapter 18

## DIAGNOSTICS

**The 2864 series modems provide several diagnostic capabilities:**

- Power-on Self-Test
- Analog Loopback Test
- Analog Loopback with Self-Test
- Local Digital Loopback Test
- Remote Digital Loopback Test
- Remote Digital Loopback with Self-Test
- Line Condition Status Display
- Re-transmission Indicator
- Throughput Display
- Link Status Report
- Modem Reset

**All these tests apply to the 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.**

**On the LCD model, the LCD panel will display the results of the power-on self-test:**

0	SYSTEM TESTING....	Self-test indicator. If no error occurs, this message will last until the end of the test.
1	ROM TEST FAIL....	ROM code checksum error.
2	RAM TEST FAIL....	System RAM fails.

3	XROM CHKSUM ERROR....	EEPROM checksum error. The factory default settings will be downloaded to the EEPROM and the self-test will be re-initiated. This is not a real error.
4	DSPA RAM FAIL....	The testing of DSP RAM fails, condition A.
5	DSPB RAM FAIL....	The testing of DSP RAM fails, condition B.
6	VO CALIBRATION FAIL....	Analog circuit calibration error.
7	VR CALIBRATION FAIL....	Analog circuit calibration error.
8	FR CALIBRATION FAIL....	Analog circuit calibration error.
9	DSPA COMM FAIL....	Communication between controller and DSP fails, condition A.
10	DSPB COMM FAIL....	Communication between controller and DSP fails, condition B.

A reset command from the panel will restart the power-on self-test. If an error message is displayed on the screen, turn off the modem, wait for at least 10 seconds, and then turn the power on again. If the error condition persists, call the ZyXEL Service Center for assistance, or follow the return procedure to return the modem to ZyXEL. If the normal IDLE SCREEN shows up, the original failure was due to a temporary power-on reset problem and will not affect modem operation.

The Elite 2864 models have only LED indicators. The TST LED will be ON during the power-on self-test, and OFF after the test if everything is OK. The SQ LED flashes if the test fails. The number of flashes indicates the error number according to the above table. The Omni models do not have the TST LED, but they use the SQ LED to indicate test failure or not.

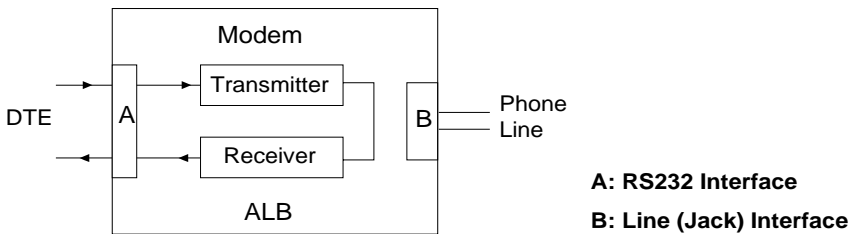
The Analog Loopback Test, Local Digital Loopback Test, Remote Digital Loopback Test, Analog Loopback with Self-Test, and Remote Digital Loopback with Self-Test can all be selected from the terminal or LCD front panel under the DIAGNOSTIC menu. Use the front panel or the **AT&T0** command to terminate the test.

## Analog Loopback Test (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 loopbacked 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. Also, the Control Level field of the LCD screen will indicate ALB. The Elite model will have the TST LED ON dur-



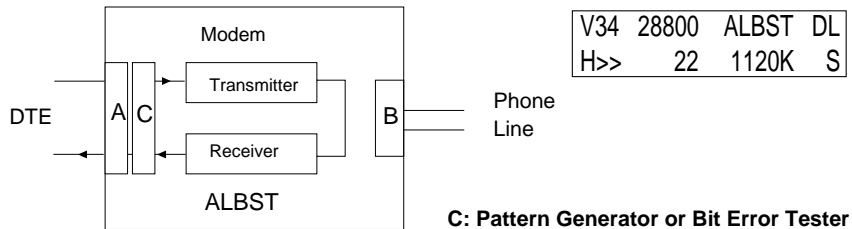
ing the test. This test can only be initiated while the modem is off-line. If the parallel port DTE interface is used, this test will test the parallel port interface.



### 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 be with the Analog Loopback Test. In the 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 Elite 2864 model's TST LED flashes for any bit error and the Omni model's EC LED flashes for any bit error. The Control Level field of the LCD model's LCD screen will be indicated as ALBST, which stands for ALB with self-test.

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.

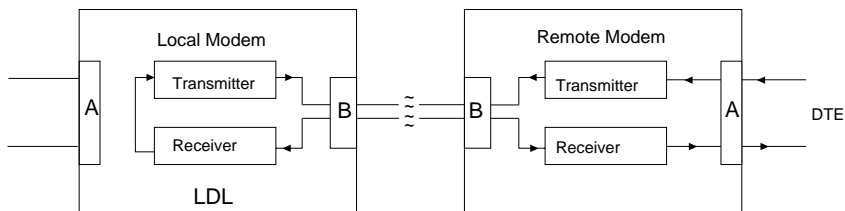


### Local Digital Loopback Test (AT&T3)

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. Also, the Control

Level field of the LCD screen will indicate LDL. The Elite model's TST LED indicator will be ON.

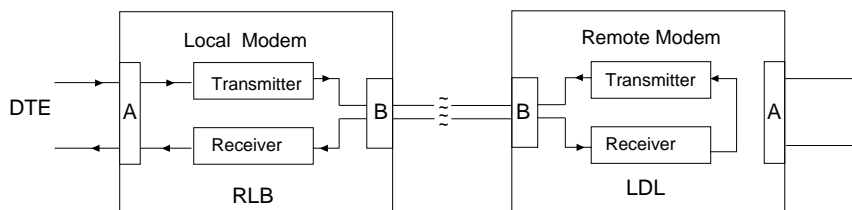
This test can be initiated by the local modem when the modems are on-line.



## 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, and 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. The Control Level field of the LCD screen of the initiating modem will indicate RLB, and that of the accepting modem will indicate LDL. The Elite 2864 modems will have the TST LED indicator ON during the test.

This test can be initiated by either modem when the modems are on-line.

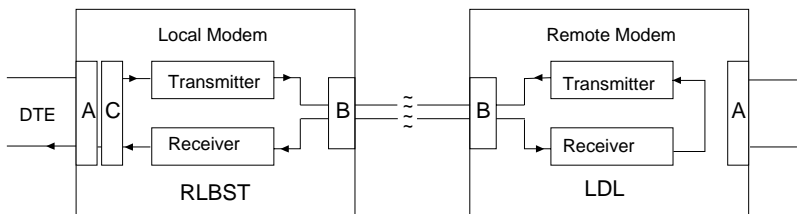


## Remote Digital Loopback with Self-test (AT&T7)

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. On the Elite model, the TST LED flashes for any bit error. On the Omni 288 models, the EC LED flashes for any bit error. This test is applicable when the remote and the lo-

cal modem both provide V.54 Remote Digital Loopback capability. The Control Level field of the LCD screen of the initiating modem will indicate RLBST, and that of the accepting modem will indicate LDL.

This test can be initiated by either modem when the modems are on-line.



## Line Condition Status Display

The screen displays of this section only apply to the LCD models.

Regarding data being transmitted over telephone line circuits, there are many kinds of line impairments that can affect the data being received by the remote modem.

The 2864 modem can measure four major line impairments. From the impairment readings, you can understand the current line condition. The 2864 also logs line events over a long period, so you know what the line condition has been. We will describe these readings and logs as follows:

```
<< SN= 26.7  RX=-25.1 >>
PJ= 0.4    FO=-0.6
```

**Note:** The readings displayed are just for reference and not to be taken for measurements.

### Signal to Noise Ratio (S/N)

This reading is expressed in 0.1 dB resolution. The higher the speed, the higher the S/N ratio required. The modem measures the S/N ratio by measuring the distance between the demodulated signal point and the ideal signal point. For V.32/V.32bis, the modem-measured S/N ratio is generally about 2 dB higher than what is actually on the line because the modem rejects some of the out-of-band noise. For V.22/22bis, the difference can be as high as 8 dB because the modem only uses part of the 3 KHz bandwidth and rejects more than half of the voice band noise.

### Received Signal Power Level (RX)

This reading is expressed in 0.1 dBm resolution. The modem-measured receiving signal power is generally within 1-2 dBm of the actual value with relative accuracy. The receiver sensitivity specification for the 2864 is -43 dBm. Strong signal power could cause signal saturation in the channel and degrade the data validity. To avoid this situation, decrease the transmission power of the remote modem. For increased line operability, the 2864's transmission power level on a leased-line operation could be adjusted from 0 dBm to -27 dBm. The default value is -9 dBm.

### Phase Jitter (PJ)

This reading is expressed in peak-to-peak degrees for phase jitter in the 20 to 300 Hz frequency range in 0.1 degree resolution.

### Frequency Offset (FO)

Frequency offset is expressed in 0.1 Hz resolution. It is the difference between the transmitted carrier frequency and the received carrier frequency.

In the ON-LINE SCREEN 3 there are four counters recording the action or reaction the modem took when the line condition changed.

<< RG=	0	RT=	0 >>
ED=	28	CL=	0

### Retrain Granted (RG)

The count of the granting of the remote modem's retrain requests. Each request is an indicator of bad receiving conditions.

### Retrain Requested (RT)

The count of the local modem's requests for the remote modem to retrain when the signal quality is poor.

### Round Trip Echo Delay (ED)

Measured in T (1/2400 sec.). Will be re-measured in every retrain action.

### Carrier Loss Counter (CL)

When operated over a leased line, it is the count of the carrier's temporary drop-out, if there is any.

ON-LINE SCREEN 4 also has four counters recording the modem's actions and reactions.

<< FG=	0	FR=	0
BR=	0	FE =	0

FRN (Fast Rate Negotitation) Granted (FG)

The count of the granting of the remote modem's change rate (FRN) requests. Each request is an indicator of a changed receiving condition.

FRN Request (FR)

The count of the local modem's requests to change the rate.

Block Retransmitted (BR)

The count of the blocks retransmitted (bad receiving on the remote modem).

FCS (Frame Check Sum) Errors (FE)

The count of the FCS errors received (block errors) (bad receiving on the local modem).

Line Condition Report (AT#E1)

For non-LCD models, with the modem on-line, but in the command state, use the **AT#E1** command to have the modem continuously report the line conditions SN, RX, RG, RT, FG and FR. This provides a convenient way of monitoring the line.

Link Status Report (ATI2)

During a connection, the modem will record information about link operations. You can use the AT command **ATI2** to see the summary, as shown in the sample below:

ZyXEL U-MODEM LINK STATUS REPORT

Chars Sent	2420	Chars Received	2420
Octets Sent	950	Octets Received	950
Blocks Sent	13	Blocks Received	13
Blocks Resent	0	Max Outstanding	8
Max Block Size	256	Retrain Requested	0
Link Duration	1	Retrain Granted	0
T401 Timeouts	0	T402 Timeouts	0
FCS Errors	0	Round Trip Delay	10
Xmitter Underrun	0	Receiver Overrun	0
Last Speed/Protocol	Connect 14400/ARQ/V42b		
Disconnect Reason	Local Hang Up		

**This Link Status Report is very helpful in finding out the link condition and what is wrong with the link, if anything. Following are the explanations for each item and the terminology used in this report.**

**Chars**

**Data characters transmitted between the DTE (computer/terminal) and the modem.**

**Octets**

**Data bytes transmitted between the modems, handled by error control protocol, may be compressed data. Data compression efficiency may be seen from the ratio of chars count to octets count.**

**Block**

**Framed octets transmitted between error control protocols of the two modems.**

**Chars Sent**

**Characters sent from the DTE to the modem for transmission.**

**Chars Received**

**Characters received by the modem from the line and sent to the DTE.**

**Octets Sent**

**Data bytes sent to the remote modem.**

**Octets Received**

**Data bytes received from the remote modem.**

**Blocks Sent**

**Blocks sent to the remote modem.**

**Blocks Received**

**Blocks received from the remote modem.**

**Blocks Resent**

**Number of blocks resent because of error. If there are too many resends, it may be a bad line or protocol incompatibility.**

**Max Outstanding**

**Error control protocol parameter. The maximum allowable number of blocks sent or received without acknowledgement.**

**Max Block Size**

**Error control protocol parameter. The maximum allowable number of octets in a block. Actual block size can be smaller.**

### Retrains Requested

Number of times the local modem has requested a retrain. Each request is an indicator of bad receiving conditions.

### Retrains Granted

Number of times retrains requested by the remote modem were granted.

### Link Duration

Connection time in minutes.

### T401 Timeouts and T402 Timeouts

These are for the manufacturer checking link layer operation. T401 and T402 are timers used in MNP4 or V.42. T402 will count when the modem is connected in the idle state with no data to transmit or receive.

### FCS Errors

Frame CheckSum Errors/number of block errors. A lot of FCS errors indicate a bad line.

### Round Trip Delay

Round trip delay between modems in T (1/2400 sec) units. Normally should be in the range of 0-100. A satellite link will introduce a delay of about 1300 T.

### Xmitter Underrun

Number of times the modem fails to provide data octet in time for transmission.

### Receiver Overrun

Number of times the modem fails to take data octet in time from receiver.

### Last speed/protocol

The speed and protocol of the link before hang-up. It may be different from the initial speed because of retrain and speed fall-back or fall-forward. Speed change is a clue to changing line conditions.

### Disconnect Reason

Possible reasons are:

- Local Hang-up
- Remote Hang-up
- Carrier Lost
- On Line
- Resent Expiration
- Protocol Error
- Break Timeout
- DTR Dropped
- Carrier Lost 1 (No handshaking response)
- Carrier Lost 2 (Remote hang-up, busy tone heard)

## Throughput Display

If the modem is operated in asynchronous operation, we can tell the line quality from the Throughput Display. If the speed displayed is slower than usual or what you expected, check the S/N reading. If it is good, check the configuration of the modem and the computer's serial port setting, particularly the flow control setting, or even the configuration of the remote site.

## 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 (also on the Omni 288), the EC LED will flash to indicate re-transmission.

## Dialing Indicator

On the LED models, 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

On the LED model, 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.

## Firmware Update

Most of the 2864 series modems' functions and features are controlled by the system firmware contained in the flash EPROMs.

ZyXEL has a policy of free distribution of new firmware when it becomes available. New firmware is distributed in a binary file. Dealers and users can download the file and program their modems. Each 2864 series model has a set of different firmware code. The firmware is not exchangeable between different models.

Since flash EPROMs are used in the 2864 series modems, a firmware update is just a simple process of typing an AT command and uploading the firmware file. There is no need to open the modem case or program the EPROM. Please refer to the instructions in Firmware Update/Upgrade on page 4-3 for the firmware update procedure.



# Chapter 19

## GENERAL HINTS AND TIPS

### Activating Saved Settings upon Turning-on

Use the command **ATWn** to save a set of parameters into one of the available profiles. Make these settings your current settings by resetting the modem from the profile using the command **ATZn**. The active profile will be used at the next power-on. Refer to chapter 7 for further details.

### Avoiding Low Throughput and Loss of Data

Some computers serve and poll their serial port so slowly that data is lost. You may remedy this situation by using a better equipped computer or by using more efficient terminal software. Please refer to the vendor-specific chapters. Chances are that you will find some tips specifically for your machine.

In some cases, enabling throughput averaging (**ATS42.1=1**) may alleviate the problem. More information on this feature is found in chapter 10.

### Disabling Compression May Yield Faster Transfers

Using MNP5 data compression on files which are already compressed (.ZIP, .LZH, .SIT, .ZOO, .TAR and others) lowers the transfer rate. To disable MNP5, use **ATS38.5=1**. The V.42bis compression scheme is more intelligent than MNP5 and recognizes already compressed files. It does not try to compress them again and thus no speed is lost during a data transfer. More information can be found in chapter 10.

### Avoiding Disconnections during a Handshake on a Leased Line

If data is sent from the DTE to the DCE (computer/terminal to modem) during a handshake attempt on a leased line connect, the modem will abort the handshake and no connection is made. Avoid this by sending **ATS35.1=1** to the modem.

### Avoiding Disconnections when Making a Data Call

The modems of the 2864 series return a **RINGING** message when the remote modem does not answer on the first ring. Some software packages confuse the **RING-**

ING message with the RING message which the modems return when they detect an incoming call. These programs usually interrupt the connection and try to receive the non-existing call. Disable the RINGING message with **ATS42.6=1**.

## Calling from an Extension / Blind Dial

If your modem is connected to a large inhouse telephone system, it may be necessary to disable the modem's dial tone detection since many systems do not provide a standard dial tone. This is done by setting **ATS41.4=1**. Now the modem can initiate a dialing sequence without having detected a dial tone. Let the modem dial the outside line code which provides the regular dial tone to your extension and then wait for a moment before continuing the dial. To wait, insert the w character at the appropriate place in the dial string. The modem will wait for the number of seconds specified in the S-register S6. Example:

```
ATS41.4=1DP9W1234567
```

In some systems, the dial tone is requested not by dialing a number as above, but by sending a flash signal. In this case, insert the exclamation mark (!) into the dial-string:

```
ATS41.4=1DP!W1234567
```

# Chapter 20

## THE FIRST CONNECTION

Telecommunication using computers and modems is a simple task. You need only observe a few - important - parameters. This example shows you how to log into a BBS using the terminal program which is included with Microsoft Windows 3.x. As a Windows component, this simple terminal program has been widely distributed and offers the basic features of a telecommunications package. Many other programs are available which offer many more options. However, even with those programs, the basic steps are the same. Therefore the steps presented here should be helpful to all users. Before you start, make sure that all cables are installed as described in chapter 3. Be sure that your serial cable is not a null-modem cable. Null-modem cables are useful in direct computer to computer serial connections only.

- 1) Start the terminal program. It usually resides in the Applications folder.
- 2) Type **AT** from your keyboard and press the ENTER (or RETURN) key. You should see the characters you just typed in the terminal window along with the modem message OK in the line below.

If you don't see anything, check the connections, reset the modem and try step 2 again. If anything else appears in the terminal window, some parameters in the modem may be misset. Reset the modem and redo step 2. If you still see anything else, some of your terminal program's parameters may be misset. We will show you how to take care of this now.

- 3) From the menu Settings, choose the entry Communications. In the dialog, set the following values:

Baud Rate:	19200
Data Bits:	8
Parity:	None
Flow Control:	Hardware
Stop-Bits:	1
Port:	COM1

If your PC serial port is equipped with a UART 16550, these settings should work fine. If not, you may have to use a lower transfer rate. Please refer to chapter 21 for more solutions to hardware problems, and how to work at high speed.

- 4) From the menu **Settings**, choose **Modem Commands** and in the dialog, choose the parameter set **Hayes**.
- 5) Go to the dialog **Settings - Terminal Emulation** and choose **DEC VT-100 (ANSI)**.
- 6) In the dialog **Settings - Terminal Preferences**, activate **Line Wrap** from the **Terminal Mode** options. Use the **80 characters per line display**. Do not activate the **CR to CR/LF conversion**. The option **Local Echo** should be inactive as well.
- 7) From the menu **Settings**, enter the phone number you wish to call later. You should start with a local BBS and explore your possibilities there before going on to other (more costly) services. Your local computer club should have a list with numbers of BBSs.
- 8) Save the current program settings (menu: **File**; option: **Save**).
- 9) Select the option **Dial** from the menu **Phone**. The modem will start the connection attempt. In the terminal window you will see the commands sent to the modem and its responses.
- 10) If the connection is successfully established, follow the instructions given to you by the remote system. They will be shown in the terminal window. Have fun!

---

Note:	You should be able to establish a reliable connection with most BBSs using the parameters given above. In some instances, however, it may be necessary to use 7 data bits and even parity (e.g., many CompuServe nodes). Change these settings in the dialog box <b>Communications</b> if necessary.
-------	--

---

Note:	Contacting your distributors or dealers for application drivers. Your distributor's BBS (mailbox) or Internet system normally will have the latest drivers for many communication packages, not only for DOS and Windows, but also for UNIX, OS/2, Macintosh, Windows NT and other operating systems. If you need further assistance, please contact ZyXEL technical support.
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# Chapter 21

## ZyXEL MODEMS AND A PC

All of the modems of the 2864 series may be used with a PC. If you install the internal PC card model, you don't need a serial cable. The modem's standard profiles should be just fine with most applications. If you are connecting to the modem's parallel port, make sure that you have a bidirectional PC parallel port and use a 25-wire cable to make the connection. The ZyXEL serial/parallel adapter card provides you with a special high-speed PC-modem communication advantage when working with a 2864 series modem.

### Serial Cable

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.

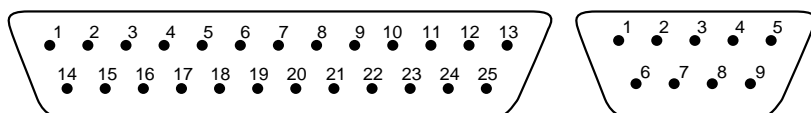


Fig. 21.1: 25-pin and 9-pin male connectors usually found in PCs.

To connect a PC to the modem, you need the following 9-wire cable:

Computer 9-pin	25-pin	Signal	Modem
1	8	CD	8
2	3	RXD	3
3	2	TXD	2
4	20	DTR	20
5	7	Signal Ground	7
6	6	DSR	6
7	4	RTS	4
8	5	CTS	5
9	22	RI	22

For high speed serial connections at 230.4Kbps or 460.8Kbps, use a low-capacitance cable. Also, keep the cable as short as possible.

## Parallel Cable

Use a 25-wire cable with a male connector at one end and a female connector at the other end to connect the PC's parallel port to the modem's parallel port. Keep this cable as short as possible. This cable may also be used to make the 25-pin serial connection.

## Using the Windows 3.1 Terminal Program

You will not be able to use a transfer rate of more than 19.2Kbps with this program. With a special comm driver, you may be able to run the serial port at a higher speed. Please consider this when you set up your modem's DTE to DCE speed. If you are using a ZyXEL 2864 modem's parallel port for PC-modem communication, setting the DTE speed has no actual physical meaning. The actual speed depends on how fast and efficient the Windows program can run. The parallel connection guarantees no data loss, no matter how fast or slow the Windows program runs. Fast 286, 386, 486 and Pentium PCs allow you to lock the serial port at speeds above 38.4Kbps. Check whether your PC and software allow this. Refer to the ZyXEL Serial/Parallel I/O Adapter Card section in this chapter for information about high-speed connections.

## Hardware Hints

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. Among other programs, the shareware terminal program Terminate allows you to determine which type of UART(s) is/are installed in your system without opening the computer.

If you run Windows, OS/2 or another multi-tasking operating system, you should set your serial port speed to 38400 bps or less. In these environments, the serial port is usually served slower than in a single task environment.

Another option in multi-tasking environments is to increase the priority of your serial port. If you use Windows, read the file SYSINI.WRI. This file is placed into the

WINDOWS folder during the installation of Windows. Increasing the serial port priority in Windows may degrade the performance of other programs.

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.

## ZyXEL Serial/Parallel I/O Adapter Card

For high-speed PC to 2864 modem communication, ZyXEL produces the special I/O adapter card SP110AT. This card includes a serial port and a parallel port, each with special features, particularly when working with a ZyXEL 2864 series 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 2864 series 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 receive FIFO to increase any comm program's efficiency.
- The parallel port can be used as a normal bidirectional parallel port. In addition, it has the following two modes for high-speed interfacing to a ZyXEL 2864 series modem through the modem's parallel port:

### 1) ZyXEL special parallel port mode:

With special drivers, this parallel port mode is more efficient in data transfer between the PC and the modem than using the normal parallel port mode.

### 2) Emulated serial port mode:

Although the connection is established using the parallel port (with the above special parallel port mode efficiency), a PC's serial port is emulated which looks exactly like a serial port from the PC's point of view. This emulated port does not need any special driver to operate and it will work with existing comm software packages.

The SP110AT I10 adapter card fits into an AT ISA bus slot. It can be set to any IRQ number available on the AT bus. Please refer to the card's manual for details. Check your distributor/dealer for availability of this card.





# Chapter 22

## ZyXEL MODEMS AND UNIX

### Hints for Unix Setups

#### 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.

#### Installation

##### Modem settings

Unix environments usually don't like modem responses or echoing of commands. Therefore you should set `ATEOQ1`. If you plan to install a dial-in line, don't forget to set the S-register `S0` to a value other than 0 (e.g. `ATS0=2`) for auto-answer. Depending on your kind of Unix, the cable and software used, you may have to disable carrier detection using `AT&C0`.

##### Unix system files

If you wish to use your modem for dial-out connections, you only need appropriate software, but no changes to system files are necessary. You need to generate information or activate entries in at least two system files. If you wish to use your modem for dial-in connections, these files are `/etc/inittab` and `/etc/gettydefs`.

In `/etc/inittab`, you define which `getty` to use along with some parameters. The final parameter on the definition line is a tag which points to an entry in the file `/etc/gettydefs` discussed next. An example for your entry in `/etc/inittab` might be:

```
s1:45:respawn:/usr/lib/uucp/uugetty -mt60 -r- ttys01 MMULTI
```

The parameter `ttys01` should be replaced by the actual name of the used serial port.

Your `/etc/gettydefs` should contain a number of definitions appropriate for your purpose. Choose or create one for a multi-speed modem with hardware-handshaking (if your cable supports this).

Remember that the name tag must be the same as in `/etc/initttab`. A possible entry in `/etc/gettydefs` might be:

```
MMULTI# B38400 CS8 CRTSCTS # B38400 SANE -ISTRIP HUP HUPCL
CRTSCTS #@S login: #38400
```

(The above two lines are a single entry.)

## 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's special features such as voice, special gettys such as `mgetty` or `vgetty` are needed. These programs are available from several ftp-sites. Some archives also contain source files.

You should suppress the modem's result codes (`ATQ2`) from the 2864 series modems because some applications may be irritated by them.

Disabling throughput averaging (`ATS42.1=0`) may speed up connections with powerful workstations.

# Chapter 23

## ZyXEL MODEMS AND APPLE MACINTOSH

The external models of the 2864 series modems may be connected to an Apple Macintosh computer. You may use the standard modem settings, with one exception: use **AT&D0**.

### Connector

When you connect a ZyXEL 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 provide hardware handshaking. The serial port on these (very outdated) models is provided as a 9-pin connector similar to that of a PC. We will not discuss it here.

The serial port on all other Macintosh models is a Mini-8 connector.

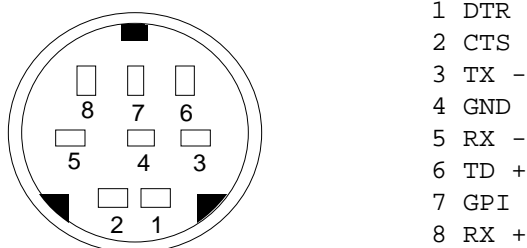


Fig. 23.1: Serial port of an Apple Macintosh

### Apple Macintosh Particularities

The Apple Macintosh serial port supports up to 57600 bps in interrupt mode starting with the SE model. The modem port (A) also allows synchronous transfers. The type of transfer is controlled through pin 7 of the serial port. This pin is connected to the CD (Carrier Detect) line and the Receive/Send clock lines of the SCC circuit (the serial port driver - comparable to, but more flexible than a PC UART). The

state of bit 3 (vsync) of the V1A1 chip's data register A determines which transfer method is used. If the bit is low, the serial port is used in asynchronous mode. If it is high, synchronous transfers are possible. You need special software which handles this bit. The standard drivers of the Communication Toolbox (part of Apple's system software) do not support this feature.

In many of the low-end models (i.e., Classic, Classic II, LC and LC II), pin 7 is not connected. These models do not offer synchronous transfer.

According to Apple, loss of data is possible in certain models when the serial port speed is set to more than 2400 bps and Appletalk is active at the same time. With the newer models you should never encounter any problems, even when you run speeds of 9600 bps or above.

You should not lock the serial port at more than 19200 bps if you do not dedicate your Macintosh computer to data transfer. However, if you own a Quadra or a Mac IIfx, you may be able to use multi-tasking at even higher speeds on the serial port.

A number of NuBUS cards are available which provide serial capabilities with all of the above restrictions removed.

## Cable

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

Mac	Modem	Description *
Din 8	DB 25	
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

- \*. With the cable described above, no DTR signal is available. To use this signal, you need a special cable with the appropriate software for your Macintosh. With the described cable, the modem must ignore the Data Terminal Ready signal. Set **AT&D0**.

## Software for the Apple Macintosh

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 idle 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 ZyXEL modems' voice features. This software is licensed and distributed by ZyXEL, USA.

Other fax and voice software packages are available in the public domain, as shareware or as commercial software.

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



# Chapter 24

## ZyXEL MODEMS AND ATARIS

All external models of the ZyXEL 2864 series may be connected to Atari computers. The factory settings should work just fine with your Atari computer.

### Cable

The standard Atari ST, Mega ST and Falcon 030 models provide just a single serial port, while the Mega STE and TT are equipped with 3 or 4 serial ports. Not all ports provide all of the signals which are needed for truly reliable communication. On the Atari ST, the port is a male 25-pin connector. On the other models, it is a male 9-pin connector.

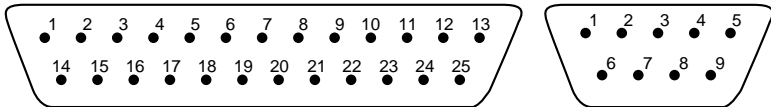


Fig. 24.1: Serial connectors of the Atari computers

To connect an Atari to your modem, you need a 9-wire cable:

Atari					Signal	ZyXEL
ST	TT	STE/TT/ Falcon	STE/TT	STE/TT		
25-pin	Serial 1 9-pin	Serial 2 9-pin	Modem1 9-pin	Modem2 9-pin		
8	1	1	1	–	CD	8
3	2	2	2	2	RXD	3
2	3	3	3	3	TXD	2
20	4	4	4	4 (on)	DTR	20
7	5	5	5	5	Ground	7
6	6	6	–	–	DSR	6
4	7	7	7	7 (on)	RTS	4
5	8	8	8	–	CTS	5
22	–	9	9	–	RI	22

## Hardware Tips

While the 25-pin connector of the ST is 100% compatible with a PC connector and standard cables may be used, the maximum data rate on this port is restricted to 19200 bps.

Kits are available which allow speeds of up to 57600 bps. If you want to use your Atari ST as an answering machine and use the ADPCM mode of your ZyXEL modem, you must install one of these extensions. More information on these kits and projects may be found in Fidonet or in Internet groups about the Ataris.

Regarding the ports on Mega STE and TT, we must note that the port labeled Modem1 has a restriction on the maximum transfer rate. Some signals are missing on the Modem2 port and DTR and RTS are always active.

If a TT or Mega STE is connected to a local area network through the 8-pin LAN port, the ports Serial2 and Serial1 are disconnected. If no LAN is connected, these ports allow high data rates.

The LAN port available on some of the Atari models is currently not supported by the system software.

## Software Tips

A large number of telecommunication packages is available for Atari computers. Even fax and voice software is available as shareware.

### Using TeleOffice

Older versions of this fax-software produced errors when used with ZyXEL modems. The current version works nicely. If you have problems, get the current version.

### Using the Mailer Binkley 3.0x

In the automatic mailer mode, only the port Modem1 or the single ST port may be used. If you use the software in the dumb terminal mode, the settings from the extended control panel (XCONTROL) are used, letting you choose which port to use from the accessory. Releases of this software dating later than October 1993 use any serial port in mailer mode.

### Using STalker

With this software, you should use the port Serial2 if possible. This port allows the highest data rates.



### Using Rufus

Some very old versions are irritated by the `RINGING` message during a dial-up if the `RUFUS` dial directory is used to initiate a call. Disable the `RINGING` message (`ATS42.6=1`) or even better, get a current version.

### Using Connect

The shareware terminal software `Connect` makes use of the `ZyXEL` voice features. Make sure you use version 2.20 or later. Earlier versions are incompatible with the current `ZyXEL` firmware. The format of `Connect` voice data files is not compatible with the `ZyXEL ZFAX (PC)` program. Therefore you must record voice data messages using your telephone or a microphone.

### Using TELL IT

This fax software uses a `ZFAX` compatible file format. You just need to rename the `*.ZVD` files to `*.PCM`. However, `Tell IT` saves additional information in extra files.



# Chapter 25

## ZyXEL MODEMS AND AMIGA

You may connect any of the external models of the ZyXEL 2864 series to an Amiga computer. The default modem settings should work fine in most instances.

### Cable

Among the Amiga computers, two versions of the serial port exist. The Amiga 1000 has a female 25-pin connector, the other models a male 25-pin connector.

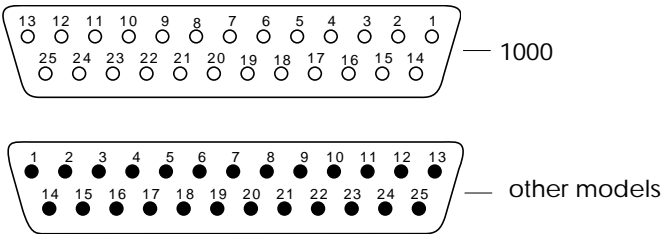


Fig. 25.1: Female and male connectors of Amiga computers

Use standard serial cables with 9 wires. For the models with a female connector, you need a gender changer to fit the plug into the socket. Under no circumstances should any other pin be connected than those described in the table below. Depending on the model of your Amiga computer, you may damage your modem if other pins are connected! Some Amiga models carry non-standard voltages on their connectors.

Amiga			Modem
Pin	1000	other	Pin
1	Protective Ground		1
2	TXD	TXD	2
3	RXD	RXD	3
4	RTS	RTS	4
5	CTS	CTS	5

Amiga			Modem
Pin	1000	other	Pin
6	DSR	DSR	6
7	Signal Ground		7
8	DCD	DCD	8
20	DTR	DTR	20
22	NC*	RI	22

\*. not connected

## Software Tips

A number of PD and shareware telecommunication packages, fax and voice software are available in BBSs and from the major online services.

## Hardware Tips

Amiga computers run under a multi-tasking environment. Therefore you should lock the serial port, but do not lock it to baud-rates higher than 38400 bps on the low-end models. To lock the baud-rate on the modem, use the command **AT&B1**.

If you are still using a Kickstart version prior to 2.0, you should upgrade your Kickstart version. Kickstart 2.x and 3.x are now available.

# 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 Macintoshes, 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.

**Backup dial:** ZyXEL modems can establish a backup dial-up connection when a leased-line connection is disrupted and cannot be reestablished.

**Baudrate:** Unit of the symbol speed. Baudot was 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  $2^8$  (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 the bit rate; 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.

**CEPT:** Commission Européenne Postale et Telephonique. This organization regulates the data exchange 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 character 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:** Also called a mouse's piano. Perfectly suited to break finger nails and pencils. DIP switches are abundant in the world of electronic equipment. They are used to set certain parameters on a printer, modem or 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:** Name of an ASCII code (see table in appendix E). This control code is used in voice mode to separate data segments and control 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  $20 \times 2$  liquid crystal display (LCD).

**FSK:** Frequency Shift Keying – a frequency modulation scheme.

**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.

**Highspeed 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, the unit of frequencies.

**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.

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:

**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.

**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 processed 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.

**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 synchronously 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.

# Appendix A

## EIA-232D INTERFACE

Signal pin	ITU-TSS Signal name	EIA Signal name	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.	←



# Appendix B

## PHONE JACK PIN ASSIGNMENTS

Most models of the ZyXEL 2864 modem series feature two RJ11 phone jacks, one for the dial-up line connection (LINE) and one for an optional connection to a telephone set (PHONE). The signals on these pins are:

1	A
2	RING
3	TIP
4	A1

The signals A and A1 are used with the KTS (Key Telephone System). They may or may not be supported depending on the jumper option in the modem. For the rack-mount model, the line terminals are located on the backplane of the rack chassis. The model 2864L also features a leased-line jack. This jack is an 8-pin JM8 type jack. The signals on its pins are:

1	Transmit Signal (R1)
2	Transmit Signal(T1)
3	not connected
4	not connected
5	not connected
6	not connected
7	Receive Signal(T)
8	Receive Signal(R)

A 4-wire leased-line connection uses pins 1 and 2 for transmission and pins 7 and 8 for reception. 2-wire leased-line connections use pins 1 and 2 for both transmission and reception.





# Appendix C

## ZyXEL PARALLEL PORT INTERFACE

Signal pin	Signal name	Description	Direction Adapter - Printer
1	-STROBE	Strobe pulse	→
2	DATA 0	Data signal: bit 0.	↔
3	DATA 1	Data signal: bit 1.	↔
4	DATA 2	Data signal: bit 2.	↔
5	DATA 3	Data signal: bit 3.	↔
6	DATA 4	Data signal: bit 4.	↔
7	DATA 5	Data signal: bit 5.	↔
8	DATA 6	Data signal: bit 6.	↔
9	DATA 7	Data signal: bit 7.	↔
10	-ACKNLG	Acknowledge signal; data has been received by the printer and the printer is ready to accept further data.	←
11	BUSY	Busy signal; printer is not ready to receive data.	←
12	PE	Paper end	←
13	SLCT	Printer is in the selected state; printer is on-line.	←
14	-ATFD	Auto-feed; paper is auto-fed by one line after every printed line.	→
15	-ERROR	Printer is in error state.	←
16	-INIT	Resets printer to initial state.	→
17	-SLCT IN	Enables printer for data entry.	→
18	GND	Ground	
19	---	Not connected	
20	GND	Ground	
21	GND	Ground	
22	GND	Ground	
23	---	Not connected	
24	GND	Ground	
25	GND	Ground	

---

Note: "Direction" column refers to the direction of the signal flow. When the 2864 ISDN or modem's parallel port is connected to a PC parallel port, it emulates the printer side; when the ISDN/modem's parallel port is connected to a printer, it emulates the adapter side.

# Appendix D

## V.25bis COMMAND SET

Syntax	Command with Parameters <sup>1</sup>	Description
CRN	CRN <dialstring> <sup>2</sup>	Call request with number provided.
CRS	CRS n	Call request with number from memory, $0 \leq n \leq 49$ ; n is the memory location.
PRN	PRN n; <number>	Saves <number> to address n ( $0 \leq n \leq 49$ ).
RLN	RLN <sup>3</sup>	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.

Note:

- (1) Commands and parameters may be separated by spaces.
- (2) Dial modifiers: See the ATD command.
- (3) RLN is answered with several LSN displays.  
Every LSN corresponds to a memory location.



# Appendix E

## STANDARDS

### ASCII Control Characters

Oct	Dec.	Hex	Character	Key	Description
000	0	0x00	NUL	CTRL-@	NUL character
001	1	0x01	SOH	CTRL-A	Header start
002	2	0x02	STX	CTRL-B	Text start
003	3	0x03	ETX	CTRL-C	Text end
004	4	0x04	EOT	CTRL-D	End of transmission
005	5	0x05	ENQ	CTRL-E	Enquiry
006	6	0x06	ACK	CTRL-F	Positive Acknowledgement
007	7	0x07	BEL	CTRL-G	Bell
010	8	0x08	BS	CTRL-H	Backspace
011	9	0x09	HT	CTRL-I	Horizontal TAB
012	10	0x0A	LF	CTRL-J	Line feed
013	11	0x0B	VT	CTRL-K	Vertical TAB
014	12	0x0C	FF	CTRL-L	Form feed
015	13	0x0D	CR	CTRL-M	Carriage Return
016	14	0x0E	SO	CTRL-N	Shift Out
017	15	0x0F	SI	CTRL-O	Shift In
020	16	0x10	DLE	CTRL-P	Data Link Escape
021	17	0x11	DC1	CTRL-Q	Device control 1 (XON)
022	18	0x12	DC2	CTRL-R	Device control 2 (start tape)
023	19	0x13	DC3	CTRL-S	Device control 3 (XOFF)
024	20	0x14	DC4	CTRL-T	Device control 4 (stop tape)
025	21	0x15	NAK	CTRL-U	Negative Acknowledge
026	22	0x16	SYN	CTRL-V	Synchronization

Oct	Dec.	Hex	Character	Key	Description
027	23	0x17	ETB	CTRL-W	End of transmission block
030	24	0x18	CAN	CTRL-X	Cancel
031	25	0x19	EM	CTRL-Y	End of (tape) media
032	26	0x1A	SUB	CTRL-Z	Substitute
033	27	0x1B	ESC	ESC	Escape
034	28	0x1C	FS		Form separator
035	29	0x1D	GS		Group separator
036	30	0x1E	RS		Record separator
037	31	0x1F	US		Unit separator

## Selection of ITU-T standards

- X.1-X.15**                      **Services and features.**
- X.1**                      **International classes for users in public data networks.**
- X.15**                      **Definitions regarding public data networks.**
- X.20-X.32**                      **Interfaces.**
- X.25**                      **DTE/DCE interface for terminal equipment used in public networks working in packet mode.**
- X.31**                      **Support for packet-oriented terminal equipment in ISDN.**
- X.32**                      **DTE/DCE interface for packet-oriented terminal equipment which accesses a public PAD through public phone lines.**
- X.40-X.87**                      **Transmission, identification and mediating.**
- X.50**                      **Basic multiplex scheme for an international interface between synchronous data networks.**
- X.87**                      **Basic standards and methods for the realization of international features for users and of network features in public data networks.**
- X.200-X.244**                      **Open communication systems.**
- X.200**                      **Reference model for open communication systems for ITU-T applications.**
- X.250**                      **Description methods for systems.**
- X.300-X.310**                      **Interaction between networks.**
- X.350-X.353**                      **Mobile telecommunication systems.**

X.400-X.430	Message transmission systems.
X.400	Layer model - Service elements of the layers.
X.430	Access protocols for terminals.

## Data transmission through telephone networks (V.1 -V.110)

V.1-V.7	General.
V.10-V.34	Interfaces and Modems in the telephone bandwidth.
V.21	300 bps modems for use in public telephone networks.
V.22	1200 bps duplex modems for use in public telephone networks and on leased lines.
V.22bis	2400/1200 bps duplex modem for use in public telephone networks and on leased lines.
V.23	600/1200 bps modem for use in public telephone networks.
V.32	Duplex modem family with up to 9600 bps for public telephone networks and leased lines.
V.32bis	Duplex modem family with up to 14400 bps for public telephone networks and leased lines.
V.34	This standard allows modem connections at up to 28800 bps. This standard has very many optional features, including, but not limited to various baud rates and modulation schemes.
V.35-V.37	Wide band modems.
V.10, V.41-V.42	Error control protocols.
V.10	Error display in electromechanical devices.
V.41	Code independent error protection system.
V.42	Error protection through LAPM and MNP4.
V.42bis	Data compression using string tables.
V.50-V.110	Transmission quality and support.
V.54	Loopback tests for modems.
V.57	Sensing device for high-speed transmission.





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