

ZyXEL

U-1496 Series Modems

User's Manual

Chapter One - INTRODUCTION

THE U-1496 SERIES UNIVERSAL MODEMS

The U-1496 series of high-speed modems feature five base models. They are:

U-1496

External stand alone model with 20 x 2 LCD display and menu control.

Also called U-1496S. Includes 2/4-wire leased line support.

U-1496E

External stand alone model with LED status indicators. 2-wire application only.

U-1496B

PC internal card version.

U-1496R

Rack mount modem card version. Up to 16

U-1496Rs can be housed in

a RS-1600 rack with central panel control and 20 x 4 LCD display.

U-1496P

A portable model, particularly suitable for cellular data communications.

There are also models with a plus (+) suffix, such as U-1496E+, U-1496R+, and U-1496B+. These plus versions have a faster processor and more memory space to support the ZyXEL 19200 bps high-speed mode, advanced voice capability, and future updates with more enhanced features.

The basic features, functions, and operation of the plus versions are the same as those of the normal version. We do not specifically mention the plus version in this manual unless there are functional or operational differences. The U-1496 LCD model is always a plus version.

HOW TO USE THIS MANUAL

This manual describes the use of all models in the U-1496 series, the U-1496, U-1496E, U-1496B, U-1496P, and U-1496R. Usually, this manual describes the operation of the U-1496, the model with the largest set of functions. If a description does not apply to a certain model, you may skip the description.

The manual is structured into roughly 5 sections.

The first section comprises chapters 1 through 3. It gives a

basic overview of the U-1496 series modems' features, introduces some basics of modem operation for novice users, and explains the installation of the different models of the U-1496 series including the U-1496B PC-card. Please note that the COM port and interrupt number must be properly chosen, before the U-1496B can be installed.

The panel operation of the U-1496 is described in Chapter 4 and 5. The U-1496 has an LCD display menu control panel. The rack system has a central menu control panel similar to that of the U-1496. Users of the other models should consult the equivalent AT command sections listed for each of the panel operations.

The third section, chapters 6 through 8, provides an overview of the settings and commands which are available in the U-1496 series.

Section four comprises chapters 9 through 17 and describes many special functions of the U-1496 series modems in detail, including data compression, synchronous and lease line operation, remote configuration, caller ID, cellular mode, fax send and receive, voice mail, network management, and diagnostic features.

Section five is the trouble-shooting and special advice section. Here you find additional information on how to use a U-1496 series modem with your computer, and some hints and tips relating to a number of communication software applications.

A glossary, several appendices with technical details and information on standards, and a thorough index complete this manual.

The RS-1600 rack system comes with a supplemental User's Guide describing the use and installation of the rack system. The Network Management System comes with a separate manual detailing its installation and usage.

Compatibility

ZyXEL U-1496 series modems are high performance universal modems capable of transmission speeds up to 19.2 Kbps full-duplex on a 2-wire dial-up line. Universal compatibility covers a broad range of CCITT and BELL standards, and provides data compression and error free transmission.

Various operation modes that can be achieved are as follows:

Bit rate (+/-0.01%) bps	Baud rate (+/-0.01%) baud	Modulation Hz	Carrier Freq	
ZyX19200	19,200	2743	256TCM	1800
ZyX16800	16,800	2400	256TCM	1800
V.33	14,400	2400	128-TCM	1800

V.33 12,000 2400 64-TCM 1800
V.32bis 14,400 2400 128-TCM 1800
V.32bis 12,000 2400 64-TCM 1800
V.32bis 7,200 2400 16-TCM 1800
V.32 9,600 2400 32-TCM 1800
V.32 uncoded 9,600 2400 16-QAM 1800
V.32 4,800 2400 4-DPSK 1800
V.29 9,600 2400 16-QAM 1700
V.29 7,200 2400 8-QAM 1700
V.29 4,800 2400 4-DPSK 1700
V.27ter 4800 1600 8-PSK 1800
V.27ter 2400 1200 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
2400 bps speed range.

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

Note: V.33, V.29, V.27bis, V.27ter and V.26bis are only available in
models U-1496 and U-1496R for 4-wire leased line operation. The
other operation modes are common to all models.

THE U-1496 SERIES STANDARD FEATURES

Synchronous/Asynchronous operations for external stand alone
models and rack mount model.

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 feature.

Extended AT command set.

V.25bis async/sync command set.

Operate on 2-wire dial-up line or 2/4-wire leased line. (4-wire
leased line on U-1496 and U-1496R only.)

Auto-dial/answer and manual originate/answer.

Tone/Pulse dialing.

Dial tone, busy, and ringback detection.

Programmable speaker volume control.

Non-volatile memory storage.

Remote configuration.

Security call back.

Caller ID detection.

Distinctive ring detection.

Extensive Status reports.

Diagnostics available for:

- Modem full self test
- Analog loopback (w/ self test)
- Remote digital loopback (w/ self test)
- Digital loopback

XON/XOFF or CTS/RTS flow control.

Line status monitoring available for: (U-1496 and U-1496R)

- Signal-to-noise ratio
- Receive 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 in error

20 X 2 LCD display and directional keypads. (On U-1496 model only, 20 x 4 on rack panel.)

G3 Fax send and receive capability with speeds up to 14400 bps.

Fax-Polling / Fax-Grouping.

Automatic detection of data or fax call.

Digitized voice capability with speech compression.

Special cellular modes for data communications through cellular link.

Full two-year warranty.

BEFORE YOU GET STARTED

Before you proceed further, please check to see if you have all the necessary materials from the shipping package and make sure nothing is missing. The complete package should include:

- one (1) U-1496 series universal modem
- one (1) power adapter pack (stand alone model only)
- one (1) RJ11 telephone cable
- one (1) JM8 leased line cable (U-1496 only)
- one (1) U-1496 series user's manual
- one (1) ZFAX 3.5" floppy disk
- 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. After you unpack the modem, please check for shipping damages. If you find any damage, contact the shipping agency immediately.

Please retain the shipping carton 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 factory with address listed on your warranty card.

HOW TO BECOME A REGISTERED OWNER

Simply 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 need the following equipment to operate your modem:

Computer/Terminal with communication software (e.g., PC with Windows Terminal).

RS-232 serial cable (not supplied with modem).

Note: If you bought the internal PC card, you don't need a serial cable.

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. For most cases in the PC environment, the modem is used in an asynchronous mode and the software controls the modem by the 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 "modem data file" to tell it which commands and features the modem supports. The floppy disk included with your modem package features sample data files for some popular communication software packages.

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 modem) into the socket on the phone, then plug the other end of the cable to the rear panel of the modem labeled "DIAL-UP LINE" or "WALL". Finish by plugging in your phone cable to the rear panel of the modem labeled "PHONE". Please refer to the illustration in Fig. 3-3.

DIAL-UP OR LEASED LINE

The U-1496E and U-1496B can connect to 2-wire dial-up or leased lines only. The U-1496 and U-1496R offer you a choice of connecting to 2-wire dial-up line (more commonly known as public lines) and 2/4-wire leased lines. To use the U-1496 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 must be configured for originate mode and the other for answer mode. Both RJ11C and JM8 cables are supplied for your convenience.

Chapter Two - MODEM AND FAX BASICS

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

WHAT IS A 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. A modem translates computer data to analog signals (modulation) that can travel through the

telephone network and reach the other 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.

((*MODE-02*; Modem as used in computer communications))

WHAT ARE 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.

WHAT IS RS-232C OR EIA-232D

RS-232C is the Recommended Standard (RS) by the Electronic Industries Association (EIA) defining the serial communication interface between a DTE and a DCE. The most commonly used revision is the "C" revision. For "D" revision, it changes the prefix to EIA. Except for a few added, but not commonly used signals, there is no practical difference between the "C" and "D" revisions. RS-232C is equivalent to CCITT V.24 and V.28.

WHAT IS A 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 or female connectors.

SERIAL RS-232C CABLE

A serial RS-232C cable is used to connect a DTE port to a DCE port. 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.

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), 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.

WHAT IS UART

UART (Universal Asynchronous Receiver Transmitter) is the device used in a DTE or DCE for asynchronous data reception and transmission. The normal UART device used in PCs is of the NS16450 type. For high-speed serial data receiving (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.

MODEM STANDARDS AND SPEEDS

The CCITT (Comite International Telegraphique et Telephonique, now called ITU-TSS (International Telecommunications Union - Technical Standardization Sector), is the international standard-making body for telecommunication. They draft "recommendations". The recommendations they made for modem applications have a "V" prefix and are called V-series recommendations. The commonly used CCITT standards for 2-wire dial-up line are:

V.32bis 14400/12000/7200 bps
V.32 9600/4800 bps
V.22bis 2400 bps
V.22 1200 bps
V.21 300 bps
V.23 1200/75 bps

Note: bis is the French word for second.

In the USA, Bell Systems used to create the de facto standard such as Bell 212A for 1200 bps modems and Bell 103 for 300 bps modems. Everyone is following the CCITT standard now for newer and higher speed modems.

ZyXEL U-1496 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. Only two wires connect 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 signal 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.

A leased-line phone service is also available from phone companies in a 4-wire form. Here the transmitting and receiving signal each uses 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 case of a 2-wire leased line which is a permanent 2-wire connection.

INTELLIGENT MODEM

In the old days, 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.

An intelligent modem has all its functions, including dialing and answering, controllable by the computer or terminal it is connected to, through the same RS-232 serial interface used for data connection.

An intelligent modem operates in one of two states - the command state and the data state. In command state, the modem interprets data received from the serial interface as "commands" and send 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.

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 (R) 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 else 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.

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 CCITT. V.25bis supports both synchronous and asynchronous data

interfaces and finds most of its use in Europe and 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.

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 blocks are error checked at the remote end and the erroneous block is retransmitted.

The commonly used error correction protocols are MNP (R) 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 commonly used data compression protocols by modems are MNP (R) class 5 and V.42bis.

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

MNP (R) PROTOCOLS

MNP (R) (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 CCITT. V.42bis has a better data compression efficiency than MNP-5 and is a more advanced data compression scheme.

V.42bis is used with V.42 for error correction.

XMODEM, YMODEM, AND ZMODEM

These are file transfer protocols used by the host (e.g., the communications program in the PC). It does error checking and ensures data integrity of the file transferred. Some variations of these protocols also appear, like Xmodem-1k, Ymodem-G, etc..

The "G" flavors 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.

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, 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, normally with a thermal printer on thermal sensitive 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

Normal modems can also be designed to include the fax transmitting and receiving function, as does a fax card, since the modem's interface with the computer is the standard serial RS-232 interface. This interface will be used for both modem and fax operations. With the data throughput of a serial RS-232 interface being limited, only compressed fax image data can 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 an

internal PC plug-in card. External stand alone units can be connected to any computer with a standard RS-232 serial port. This computer need not be a PC.

EIA CLASS 2 FAX COMMAND

The EIA class 2 fax command is 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. The problem is that there are several revisions of this standard. Implementations conforming to different revisions may not work together.

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 CCITT. 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 receiving and printing program to allow a BBS to receive faxes and print them out in the background.

CALLER ID

Normally called Caller Number Delivery (CND), this is a service available from phone companies in several parts of USA and some other countries. With this service, the phone company sends calling party information along with 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.

DISTINCTIVE RING

This is a service available from some phone companies in some areas of the USA and in other countries. 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 requirement. 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 (Advanced Digital Pulse Coded Modulation) algorithm can reduce the speech data rate to 1/2 or 1/3 of the original rate. We call it advanced voice capability when a compression scheme can reduce the speech data rate even further with advanced algorithms like CELP (Code Excited Linear Prediction).

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 has an increasing importance for people on the move.

There are two kinds of phenomenons 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. Instructing a cellular phone to change transmitting power 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.

Communication protocols like MNP10 do not do anything to improve the physical layer of data communication robustness and cannot really help in cellular data communication.

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

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 U-1496 series also offer the ability to do cyclic redials of a set of up to ten different numbers.

MODEM AND LEGAL MATTERS

In some countries the PTT authorities require modems to conform to a set of specific rules, e.g., restricting the behavior of modems during automatic redial. Modems must receive an official approval within those countries to be used legally. ZyXEL already has provided specifically designed models which have received such an approval. Check with your PTT authority to find out about existing restrictions.

Chapter Three - MODEM INSTALLATION

This chapter describes the panel function and installation guide for model U-1496, U-1496E, and U-1496P. The U-1496R comes with its own installation guide. The installation guide for U-1496B is in Chapter 18.

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 slot of your ZyXEL modem located on the sides and bottom should not be covered and should allow free movement of air.

U-1496 FRONT PANEL

Fig. 3-1 shows the front panel of the U-1496. There are 6 LED indicators, a 20 x 2 LCD display, and four key switches.
(MODE-03))

U-1496 FRONT PANEL INDICATORS

LED Indicators

PWR Power ON indicator, lights up when U-1496 is turned ON.

OH Off-Hook indicator, lights up when U-1496 is in data mode or off-hook. It goes out when U-1496 is in talk mode or on-hook.

AA Auto-Answer indicator, lights up when U-1496 is in the Auto Answer Mode; flashes when modem rings. In error control mode, it flashes when retransmitting.

DTR Data Terminal Ready indicator, lights up when your DTE or computer indicates that it is ready to begin communication.

TXD Transmit indicator, ON when your DTE/computer transmits data on the serial port.

RXD Receive indicator, ON when your DTE/computer receives data on the serial port.

U-1496 FRONT PANEL SWITCHES

The four arrow keys are for panel operations. They allow intuitive menu tree operation and status display. Refer to Chapter 4 for the detail of menu key operations.

(MODE-04))

U-1496 REAR PANEL MARKINGS

Fig. 3-2 shows the U-1496 rear panel. The following explains the connectors and switch on the rear panel.

POWER Power switch, turns the modem ON or OFF.

POWER JACK Input terminal for power adapter.

LEASED LINE Leased-line JM8 terminal jack, for connection to a 2/4-wire leased line. **DIAL-UP LINE** Dial-up line RJ11 terminal jack, for connection to a 2-wire dial-up line. **PHONE** Telephone line RJ11 terminal jack, for connection to a telephone set.

EIA-232D Serial port DB25S connector, for connection to the serial port of a DTE (computer/terminal). Pin assignments are listed in Appendix A for your reference.

The signal-pin assignments on RJ11 and JM8 phone jacks are listed in Appendix B.

MODEM CONNECTION

When you connect your U-1496 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 and has a 2-meter cord. Connect the U-1496 as shown in Fig. 3-3. Connect U-1496E in the same way, except there is no Leased Line jack. A 2-wire leased line can be connected to the DIAL-UP LINE jack for U-1496E and U-1496P.

((MODE-05))

If leased line is not used, simply leave the connection out. There are no DIP switches or configuration settings that you need to worry about. The U-1496 comes factory pre-set and allows you to fully configure the modem from the LCD display after you turn the power on. User configurations are also conveniently stored in user selectable non-volatile memories and can be recalled as often as needed.

POWERING UP

Once the U-1496's power switch is turned ON, the U-1496 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 17 Diagnostics.

After performing the diagnostic tests, your U-1496 will display the current modem settings on the front LCD panel as shown in Fig. 3-4. Your U-1496 modem is now ready for use.

((MODE-06))

U-1496E FRONT PANEL

Fig. 3-5 shows the front panel of the U-1496E. There are 12 LED indicators and two switches.

((MODE-07))

U-1496E FRONT PANEL INDICATORS

LED Indicators

HS High Speed indicator, lights up when modem is in V.32 or V.32bis mode. Dialing indicator, flashes one second on and one second off when dialing. Retrain indicator, flashes half second on and half second off when modem is in retrain.

AA Auto-Answer indicator, lights up when modem is in the Auto Answer mode; flashes when modem rings.

CD Carrier Detect indicator, lights up when a valid carrier is present on the line.

OH Off-Hook indicator, lights up when modem is in data mode or off-hook. It goes out when modem is in voice mode or on-hook.

DTR Data Terminal Ready indicator, lights up when the DTE or computer indicates that it is ready for communication.

DSR Data Set Ready indicator, lights up when modem is ready for communication.

CTS Clear To Send indicator, lights up when modem can accept data for transmission.

TXD Transmit Data indicator, lights up when the DTE/ computer is transmitting data on the serial port.

RXD Receive Data indicator, lights up when the DTE/computer is receiving data on the serial port.

EC Error Control indicator, lights up when modem is operated in an error control mode like MNP-4 or V.42. Data compression mode (V.42bis or MNP 5) implies error control mode. Retransmission indicator, lights up 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 error, refer to Chapter 17 for details.

TST Test indicator, lights up when modem is in a test mode.

U-1496E FRONT PANEL SWITCHES

VOICE/DATA

A toggle switch that toggles the modem on-line (off-hook, DATA mode) or off-line (on-hook, VOICE mode, the telephone set is connected to the line). If the S35 bit 4 is set (S35.4=1), pressing this switch will make the modem go off-hook and dial the default number.

ANS/ORG

A locked switch, it determines if the modem is in originate mode or answer mode when the modem goes off-hook by toggling the VOICE/DATA switch. Locked up position means answer mode and locked down position means originate mode.

Note: This switch determines on-line mode only when manual off-hook. ATD or ATA command will automatically determine the mode.

U-1496E REAR PANEL MARKINGS

Fig. 3-6 shows the rear panel of U-1496E. The rear panel markings are the same as those of the U-1496 in Fig. 3-2 except that

U-1496E does not have the leased line jack.
(MODE-37))

Refer to U-1496 rear panel description and modem connection for U-1496E's rear panel explanation.

U-1496P FRONT PANEL

Fig. 3-7 shows the U-1496P front panel. The following explains the connectors and indicator on the front panel.

((Figure 3-7: U-1496P FRONT PANEL - redraw))

POWER Power jack connector for power connection.

The U-1496P uses a DC 12V power source.

You can use either the attached AC power adaptor or car battery through the cigarette lighter cable as the power source.

LED A dual color LED for status indication,

Green On: indicates power on idle state.

Green flash at

0.5 Hz: indicates dial state

1.0 Hz: indicates handshake state

20 Hz: indicates data state

2 sec ON/4 sec OFF: indicates ringing.

Red ON when in data state: indicates bad signal quality.

Red and Green both FLASH: the number of flashes indicate the error code of power-on selftest.

LINE RJ-11 phone jack for 2-wire dial-up line connector, connect to wall outlet jack or a cellular phone adaptor.

PHONE RJ11 phone jack for connection to a telephone set.

U-1496P REAR PANEL

Fig 3-8 shows the U-1496P rear panel. The following explains the connector on the rear panel.

((Fig 3-8: U-1496P REAR PANEL - redraw))

EIA-232D Serial port DB25S female connector, for connection to the serial port of a DTE (computer/terminal). Pin assignments are listed in Appendix A for your reference. This serial port connector supports both synchronous and asynchronous communication.

MODEM CONNECTION

((Fig 3-9: U-1496P CONNECTION for cellular communication - redraw))

Fig 3-9 shows the modem connection with U-1496P. There are three ways of connecting power to your U-1496P. Select the most

convenient method. The cellular adaptor available from certain vendors will adapt a specific cellular phone unit to a normal 2-wire phone interface for the modem connection. It provides dial tone and ring signal to the modem. Because of the absence of a cellular interface standard, a special cellular adaptor is needed for each specific cellular phone.

((Here we will include the information of chapter 18; U-11496B installation; so that we have all installation procedures in one chapter. This cleans up stuff a little bit.))

Chapter Four - QUICK START

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

This chapter also familiarizes you with the panel operation of the U-1496. This modem comes with a menu driven 20 x 2 LCD display. All functions of the modem are displayed and selectable from this menu. This chapter will also familiarize the user with the menu tree structure. It properly categorizes the modem operations. U-1496E and U-1496B modem users can also consult the U-1496's panel menu operations, but use the equivalent AT command listed in this chapter instead.

LCD PANEL

The U-1496's commands, 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.

Once powered up, the U-1496 goes into the Idle Screen (if not leased line selected). It then waits for commands from a PC/terminal or any key pad operation from the front panel. Refer to Fig. 3-4, there are four ON SCREEN BUTTONS:

- D Dialing menu.
- R Redial last number.
- O Originate mode on-line.
- A Answer mode on-line.

Also, the status and current settings are displayed:

Link Option V.32bis
Link Speed 14400 bps
Error Control V.42 (implied by V.42bis)
Data Compression V.42bis
Line Type Dial-up line
Data Format Asynchronous
DTE Speed 57600 bps

PANEL OPERATION

Four arrow keys manipulate the menu tree:

Left/Right arrow keys used for horizontal item selection and

options 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 CARRIAGE RETURN key or ENTER key on a standard keyboard.

MENU TREE

Fig. 4-1 shows the menu tree structure. There are two main menu trees. One is the CONFIGURATION menu, the other is the DIAGNOSTIC menu. Fig. 4-2 shows the submenus under the CONFIGURATION menu. In Fig. 4-1, there is one idle screen and four data state screens. In data state, screen (1) to (4) can be accessed by pressing the left or right arrow key. A dialing menu can be accessed from the idle screen. 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. Some of the status indicators are better expressed by other screen displays, e.g., a data state screen means DCD is on, and an idle screen means DCD is off; SQ is better explained by S/N ratio and other impairment readings.

ARROW 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 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. 4-1 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 * #
, Pause

; Return to COMMAND STATE
@ 5 second silent wait
! Hook flash
P Pulse dialing
R Reverse dialing
T Tone dialing
W Wait for dial tone
- Digit separator
<bs> backspace

DIAL MEMORY

The first menu of the Dialing Directory is DIAL MEMORY. Pressing the ENTER key will show the following screen:
((MODE-10 (mod.)))

Equivalent AT commands:

AT&Z? View all stored phone numbers.
ATDSn n=0-9, dial stored number.

The first stored number shown on the menu is the default dial number and can be selected from the DEFAULT DIAL menu. By pressing the left or right arrow key, you can view up to ten different numbers stored in memory. Pressing the ENTER key will dial the selected number. 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.

STORE NUMBER

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

((MODE-11 (mod.)))

Equivalent AT commands:

AT&Z? View all stored phone numbers.
AT&Zn=1234567 Store phone number to memory location 0-9.

Just like DIAL MEMORY, ten different numbers can be viewed and selected. If you want to add a number to memory, select an unused memory location and press ENTER. The blinking cursor will change into an underscore and will move to the next right position 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 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 is used when entering numbers, as in the STORE NUMBER operation. After number entry is completed, press the ENTER key to dial the number.

((MODE-12))

Equivalent AT command:

ATD1234567 Dial phone number.

MANUAL DIAL AND DATA/VOICE SWITCHING

Use of a telephone set to make a call, in which 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 command:

ATD Originate on-line.

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 and Answer. Then press the ENTER key to start the modem handshaking sequence.

Equivalent AT commands:

ATD Originate on-line.

ATA Answer on-line.

When you want to switch from modem to voice, 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 communications.

For U-1496E, use the VOICE/DATA toggle switch for data/voice switching and use the ANS/ORG switch to select originate mode or

answer mode on-line. Whenever your modem establishes a connection with another modem, one of the modems must be in answer mode and the other modem must be in originate mode or a connection is not possible.

Equivalent AT commands:

+++ Escape sequence code; causes a modem to return to command mode. Enter escape sequence in data state and wait for the modem to respond.

ATH On-hook; disconnect the modem.

ATD Originate on-line.

ATA Answer on-line.

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:

ATDL Repeat last dial.

A/ Repeat last command once.

A> Repeat last command once, retry the last call up to 9 (depending on the country) times.

AUTO ANSWER

Move to the STATUS REGISTER menu, and change the S0 value to the number of rings until the modem will automatically answer. A value of zero disables auto answer.

Equivalent AT commands:

ATS0=0 Disable auto-answer.

ATS0=n Auto answer on n rings.

DIALING MESSAGE

Dialing from the terminal or front panel will cause the following screen to be displayed on the LCD.

((MODE-13))

Dialed phone number will be displayed on the second line of the 20 X 2 LCD screen. If the number exceeds 20 digits, only the first 20 digits/characters will be displayed. If the phone jack is not plugged in or not attached, the LCD screen will display the following:

((MODE-14))

then the modem will go back to the IDLE STATUS screen. If the line is busy, after 3-5 seconds, the LCD displays:

((MODE-15))

then goes back to 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 interrupt occurs (from the terminal or panel) and breaks in before the connection is made, the screen displays:

((MODE-16))

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

((MODE-17))

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

((MODE-18))

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

((MODE-19 (mod.)))

The ON-LINE STATUS screen 1 shown above means:

Link Option V.32bis
Line Speed 14400 bps
Error Control V.42 (implied by V.42bis)
Data Compression V.42bis
Line Type Dial-up
Data Format Asynchronous
Instant Transmission Throughput 25820 bps (BLANK if synchronous mode was connected) Instant Receiving Throughput 21324 bps (Link speed displayed if synchronous mode was connected)

The ON-LINE STATUS screen 2 shows:

Signal to Noise ratio 26.7 dB
Receiving Signal level -25.1 dBm
Phase Jitter in received signal 0.4 degree
Frequency Offset in received signal -0.6 Hz

The ON-LINE STATUS screen 3 shows:

Retrain Granted 0
Retrain requested 0
Round trip Echo Delay 128 T (1/2400 sec)
Carrier Loss counts 0

The ON-LINE STATUS screen 4 shows:

FRN (Fast Rate reNegotiation) Granted 0
FRN Requested 0
Blocks Retransmitted 0
FCS (Frame CheckSum) 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 three screens. We will discuss the ON-LINE STATUS screen 2, 3, and 4 in more detail in Chapter 17 Diagnostics.

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

((MODE-20))

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; disconnect the modem.

Pressing up 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 screen to revert to the IDLE STATUS screen, awaiting for your next command.

Pressing up in either screen will change your current environment to the CONFIGURATION menu. This will be discussed in the succeeding chapter.

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 value 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 effect in changing or saving settings; panel command execution is also disabled. However, viewing in the panel is not affected.

Chapter Five - MODEM PARAMETER SETTINGS

This chapter explains how to view and set various major modem

parameters using the U-1496 CONFIGURATION menu tree. U-1496E, U-1496P, and U-1496B users can also consult this menu tree for available parameter options, but use the equivalent AT command to set the parameter.

Here we define the various levels of the CONFIGURATION menu tree as:

- CONFIGURATION menu
 - submenus
 - parameter menus
 - parameter selection

where 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 submenus (see also Fig. 4-1):

- TERMINAL OPTIONS
- MODEM OPTIONS
- ERROR CONTROL
- AUDIO OPTIONS
- STATUS REGISTER
- SAVE TO
- RESET

Every submenu screen defines certain parameters of U-1496 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 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 to the other. Pressing the up arrow key 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 '=' sign.

PARAMETER SELECTION

Press the left or right arrow key to view and scroll the available parameters. Only the parameter currently in effect will have the '=' sign before their respective selections, otherwise a ':' sign will appear, meaning that this current parameter is a selectable option. By pressing up to quit from the viewing, the screen will return to parameter menu and the parameter will remain unchanged. Press ENTER to make the selected parameter active.

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

REGISTER'S CONTENT MODIFICATION (STATUS REGISTER)

When you access the STATUS REGISTER submenu in the CONFIGURATION menu, the blinking cursor will be changed into an underscore `_' and the content 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 up will quit the entry procedure, the blinking cursor will reappear, and the content will remain unchanged.

MENU TREE ELEMENTS

For 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 each configuration submenu under which each boldface subtitle is the name of each parameter menu. Under each parameter menu, there are a list of 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. After that is a brief explanation of this parameter. A '+' sign in front of a parameter item means that it is the default parameter setting.

TERMINAL OPTIONS

DATA FORMAT

+ ASYNC AT&M0 Operate as an asynchronous modem with data buffering, may work with data compression and/or error control. Fixed DTE speed with flow control.

SYNC DATA AT&M1 Modem accepts asynchronous command, but changes to synchronous data mode and exchanges data synchronously with remote modem.

DIRECT AT&M2 Direct asynchronous mode without data buffering. DTE speed equals link speed.

SYNC AT&M3 Modem accepts synchronous command (V.25bis) and exchanges data synchronously with a remote modem. You can also dial from the front panel or use a telephone set to make a

connection.

CHARACTER LENGTH

- + 10 AT*C0 10-bit characters.
- 11 AT*C1 11-bit characters.
- 9 AT*C2 9-bit characters.
- 8 AT*C3 8-bit characters.

The character length includes start bit, data bits, parity, and stop bit(s).

COMMAND SET

- + AT AT*I0 Modem accepts asynchronous AT commands.
- V.25bis AT*I1 Modem accepts asynchronous or bit-oriented synchronous V.25bis commands.
- DUMP AT*I2 No command accepted. Modem ignores DTE data in idle state.

Note: Only asynchronous V.25bis available on U-1496B.

DTE RATE

- + FIXED AT&B1 Modem serial port speed is always fixed no matter what link rate (modem speed) is connected. If S44.6=1 and a non-ARQ connection is made, DTE rate follows link rate as if &B0 is set.
- FOLLOWS LINK RATE AT&B0 Modem serial port speed is set in accordance with the link rate. If S44.6=1, the DTE speed is fixed at 19200 bps when the link speed is above 9600, and at 9600 when the link speed is 7200, and at link speed when it is below.

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

DTR OPTIONS

- IGNORED AT&D0 Modem assumes DTR always ON, ignores the changes.
- 108.1 AT&D1 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 AT&D2 Data Terminal Ready, an ON-OFF transition of DTR will disconnect modem from line.
- 108.2 + RST AT&D3 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 such situations arise you must use the IGNORED setting (AT&D0).

DCD OPTIONS

- + TRACKS CARRIER AT&C1 DCD ON when carrier is detected.
(see also S38b3). If S42.7=1, DCD only pulses off for 0.5 sec
when carrier loss happens.
ALWAYS ON AT&C0 Modem forces DCD always ON.

RTS OPTIONS

- + IGNORED AT&R1 Modem assumes RTS always ON, ignores the
changes.
CTS TRACKS RTS AT&R0 Delay before CTS responds to RTS's
change. The delay is set in S26.

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

DSR OPTIONS

- + ALWAYS ON AT&S0 Modem forces DSR always ON.
DATA SET READY AT&S1 According to CCITT. DSR ON during
handshake. If S41.5=1, DSR follows DCD, pulses off for 0.5 sec
for DCD on-off transition. If S44.4=1, DSR follows DTR.

COMMAND ECHO

- + ENABLED ATE1 Modem echoes commands.
DISABLED ATE0 Modem does not echo commands.

RESULT CODE

- + ENABLED ATQ0 Modem returns result code.
DISABLED ATQ1 Modem does not return result code.
ATQ2 If S40.1=1, modem does not return result code in
answer mode.

DTE ASYNC SPEED

76800 Select DTE port asynchronous serial speed.
57600 AT command auto speed detection will override
this selection.
38400
19200
16800
14400
12000
9600
7200
4800
3600
2400
1800

1200
600
300

MODEM OPTIONS

LINK OPTIONS

+ MULTIAUTO AT&N0 Auto handshaking with

ZyX19200 19200
Zyx16800 16800
V.32bis 14400/12000/7200
V.32 9600T/9600/4800
V.22bis 2400/1200
V.22 1200
BELL 212A 1200
G3 Fax 14400/12000/9600/ 7200/4800/2400
(V.17, V.29, V.27ter)
Cellular Modes 14400 to 2400
V.33 14400 AT&N1 V.33 14400/12000
V.33 12000 AT&N2 V.33 12000
V.32 9600T AT&N3 V.32 9600T/9600/7200T/4800
V.32 9600 AT&N4 V.32 9600(non-trellis coded)/7200T/4800
V.32 4800 AT&N5 V.32 4800
V.29 9600 AT&N6 V.29 9600
V.29 7200 AT&N7 V.29 7200
V.29 4800 AT&N8 V.29 4800
V.27b 4800 AT&N9 V.27bis 4800
V.27b 2400 AT&N10 V.27bis 2400
V.26b 2400 AT&N11 V.26bis 2400
V.23 1200 AT&N12 V.23 1200/75
V.23 600 AT&N13 V.23 600/75
V.22b 2400 AT&N14 V.22bis 2400/1200
V.22 1200 AT&N15 V.22 1200
V.21 300 AT&N16 V.21 300
V.32b 14400 AT&N17 V.32bis
14400/12000/9600/7200/4800
V.32b 12000 AT&N18 V.32bis 12000/9600/7200/4800
V.32b 7200 AT&N19 V.32bis 7200/4800
B212A 1200 AT&N24 BELL212A 1200
B103 300 AT&N25 BELL 103 300
V17G3 FAX AT&N32 ZyXEL Fax
14400/12000/9600/7200/4800/2400
(Set S42.4=1 to disable V.17 in calling mode)
ZyX 19200 @ AT&N34 ZyXEL 19200
ZyX 16800 AT&N35 ZyXEL 16800
ZyX 14400 @ AT&N36 ZyXEL 14400
ZyX 12000 @ AT&N37 ZyXEL 12000
ZyX 9600 @ AT&N38 ZyXEL 9600
ZyX 7200 @ AT&N39 ZyXEL 7200
CELL 14400 AT&N42 CELL 14400
CELL 12000 AT&N43 CELL 12000

CELL 9600 AT&N44 CELL 9600
CELL 7200 AT&N45 CELL 7200
CELL 4800T AT&N46 CELL 4800T
CELL 4800C AT&N47 CELL 4800C
CELL 3600C AT&N48 CELL 3600C
CELL 2400C AT&N49 CELL 2400C

Note: @: All ZyX modes except ZyX 16800 are available only on Plus models.

QUALITY ACTION

AUTO RETRAIN AT*Q1 When poor signal quality is detected, automatically retrain. S41.2=1 extends retrain time out to 5 minutes.

+ ADAPTIVE RATE AT*Q2 When poor signal quality is detected, automatically fall-back to next lower speed. When signal quality is improved, automatically fall-forward to next higher speed. Rate range 19200 bps - 4800 bps.

DISCONNECT AT*Q3 When poor signal quality is detected, modem disconnects itself.

NO RESPONSE AT*Q0 No response to poor signal quality.

DEFAULT DIAL

PH0-PH9 AT*D0-9 Default dial pointer. The first phone number displayed in DIAL MEMORY menu (default is PH0). If DTR option 108.1 is active, DTR OFF-ON transition will cause modem to dial the number stored in the memory address selected (memory address 0 to 9).
(See also S35b4).

DIAL BACKUP

+ DISABLED AT*B0 Leased line dial backup disabled.

PH0-PH8 AT*B1-9 When Leased line cannot to 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).

GUARD TONE

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

+ NONE AT&G0 No guard tone provided.

RESERVED AT&G1 Reserved.

1800 HZ AT&G2 1800 Hz guard tone provided.

RDL REQUEST

GRANT AT&T4 Accepts remote digital loopback test request from remote modem. Must be set when remote configuration is needed.

+ DENY AT&T5 Ignores remote digital loopback test request from remote modem.

LLINE ???Spelling okay??? TX POWER

0 to -15 dBm AT*P0-15 Select transmit 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 S35 bit 3 is set.

PHONE JACK

+ SINGLE RJ11 AT&J0 RJ11 permissive telephone jack for dial-up line.

MULTIPLE RJ12/13 AT&J1 Modem supports A/A1 multi-extension telephone.

MAKE/BREAK RATIO

+ 39% / 61% AT&P0 For use in USA/Canada and some other countries.

33% / 67% AT&P1 For use in UK and some other countries.

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, for models with N suffix)

+ DISABLED AT*S0 Secondary channel disabled.

ENABLED AT*S1 Secondary channel enabled. 2400 bps or 75-300 bps.

PANEL LOCK

+ UNLOCK AT*LO Panel key operation normal.

LOCK AT*L1 Panel key locked.

Note: With the panel key locked, you can use panel key to view menu items but you cannot 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 AT&X0 Modem provides the transmit clock.

EXTERNAL AT&X1 DTE provides the transmit clock.

SLAVE AT&X2 Modem's receiver clock is used as the transmit clock.

AUTO HANDSHAKE

+ ORIGINATE AT*M0 When operating over a leased line, modem

will handshake in originate mode.

ANSWER AT*M1 When operating over a leased line, modem will handshake in answer mode.

Note: If you need two modems to automatically connect on a leased line when 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 a power-on default profile.

LINE TYPE

+ DIAL-UP AT&L0 Modem is connected to dial-up telephone line.

2W LEASED AT&L1 Modem is connected to 2-wire leased line, phone jack should be plugged into the assigned 'LEASED LINE' receptacle on the rear of the modem.

4W LEASED AT&L2 Modem is connected to 4-wire leased line. Plug the line in the same location as that for the 2W LEASED line.

Note: For wiring information on the leased line, please refer to Appendix B. U-1496E, U-1496P, and U-1496B can only connect a 2-wire leased line to their dial-up jack.

ERROR CONTROL

CONTROL LEVEL

Control Level	Error Control	Data Compression
---------------	---------------	------------------

NONE AT&K0	Disabled	Disabled
------------	----------	----------

MNP4(MNP3) AT&K1	MNP4	Disabled
------------------	------	----------

MNP4+MNP5 AT&K2	MNP4	MNP5
-----------------	------	------

V.42(MNP4) AT&K3	V.42 or MNP4	Disabled
------------------	--------------	----------

+ V.42(b)+MNP4(5) AT&K4	V.42 or MNP4	V.42bis based on V.42 or MNP5 based on MNP4
-------------------------	--------------	---

Note: S38.5=1 disables MNP5 connection.

FLOW CONTROL

DISABLED AT&H0 DTE flow control disabled.

+ CTS/RTS AT&H3 Hardware flow control CTS/RTS enabled.

LOCAL XON/XOFF AT&H4 Local software flow control XON/XOFF enabled.

PASS XON/XOFF AT&H5 Reserved.

NEGOTIA(TION) FALLBACK

+ STAYS ON-LINE AT*E0 If error control negotiation fails, keep the no error control connection.

DISCONNECT AT*E1 If not error control linked, disconnect the line.

BREAK HANDLING

DESTRUCTIVE AT&Y0 Destructive, expedited. Send break, throw away data in buffer.

EXPEDITED AT&Y1 Non-destructive, expedited. Send break first, ahead of data in buffer.

IN SEQUENCE AT&Y2 Non-destructive, non-expedited. Send break in sequence with data.

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

AUDIO OPTIONS

SPEAKER CONTROL

ALWAYS OFF ATM0 Speaker always OFF. Ring is independently controlled by RING VOLUME.

+ ON UNTIL CONNECT ATM1 Speaker ON until carrier detected.

ALWAYS ON ATM2 Speaker always ON.

DIALED TO CONNECT ATM3 Speaker ON after final digit dialed out and speaker OFF when carrier detected. Tone dialing will not be heard.

SPEAKER VOLUME

0-7 ATL0-7 Default is 4. The higher the value, the higher the volume. Speaker volume is set to maximum when in call progress monitoring, if not ATM0.

RING VOLUME

0-7 ATN0-7 Default is 5. The higher the value, the higher the volume. A value of 0 disables the ring function.

Chapter Six - PROFILES

The U-1496 series modems let you save up to 4 sets of configurations, which are called Profiles. You can save the entire modem configuration in the non-volatile EEPROM memory for use as the 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.

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

AT&Wn

There are 5 sets of pre-programmed profiles that come with each U-1496 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 that 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. Following are the commands and their responses. 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

S00=000	S01=000	S02=043	S03=013	S04=010
S05=008	S06=003	S07=050	S08=002	S09=006
S10=007	S11=070	S12=000	S13=000	S14=002
S15=130	S16=000	S17=018	S18=000	S19=000
S20=002	S21=178	S22=000	S23=105	S24=138
S25=000	S26=000	S27=156	S28=068	S29=000
S30=000	S31=017	S32=019	S33=255	S34=030
S35=000	S36=000	S37=000	S38=000	S39=000
S40=000	S41=000	S42=000	S43=000	S44=000
S45=100	S46=028	S47=064	S48=000	S49=000
S50=000	S51=000	S52=000	S53=000	S54=000
S55=000	S56=000	S57=000	S58=000	S59=000

OK

Current settings are the active settings which will take effect on the modem's functions until power is OFF. You can temporarily change the setting and use it, but without saving it.

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

S00=000	S01=000	S02=043	S03=013	S04=010
S05=008	S06=003	S07=050	S08=002	S09=006
S10=007	S11=070	S12=000	S13=000	S14=002
S15=130	S16=000	S17=018	S18=000	S19=000
S20=002	S21=178	S22=000	S23=105	S24=138
S25=000	S26=000	S27=156	S28=068	S29=000
S30=000	S31=017	S32=019	S33=255	S34=030
S35=032	S36=000	S37=000	S38=000	S39=000
S40=000	S41=000	S42=000	S43=000	S44=000
S45=100	S46=028	S47=064	S48=000	S49=000
S50=000	S51=000	S52=000	S53=000	S54=000
S55=000	S56=000	S57=000	S58=000	S59=000

OK

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

DTE speed 38400 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
S00=000	S01=000	S02=043	S03=013	S04=010							
S05=008	S06=003	S07=050	S08=002	S09=006							
S10=007	S11=070	S12=000	S13=000	S14=004							
S15=130	S16=000	S17=018	S18=000	S19=000							
S20=002	S21=050	S22=000	S23=105	S24=138							
S25=000	S26=000	S27=156	S28=068	S29=000							
S30=000	S31=017	S32=019	S33=255	S34=030							
S35=002	S36=000	S37=000	S38=000	S39=000							
S40=000	S41=000	S42=000	S43=000	S44=000							
S45=100	S46=028	S47=064	S48=000	S49=000							
S50=000	S51=000	S52=000	S53=000	S54=000							
S55=000	S56=000	S57=000	S58=000	S59=000							

OK

Profile 1 is set for the needs of asynchronous 2-wire leased line operation. For U-1496B, the default setting for this profile is the same as profile 0.

A summary of this profile is:

DTE speed 38400 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

S00=000	S01=000	S02=043	S03=013	S04=010
S05=008	S06=003	S07=050	S08=002	S09=006
S10=007	S11=070	S12=000	S13=000	S14=192
S15=130	S16=000	S17=018	S18=000	S19=000
S20=002	S21=154	S22=000	S23=105	S24=138
S25=000	S26=000	S27=128	S28=068	S29=000
S30=000	S31=017	S32=019	S33=255	S34=030
S35=032	S36=000	S37=000	S38=000	S39=000
S40=000	S41=000	S42=000	S43=000	S44=000
S45=100	S46=028	S47=064	S48=000	S49=000
S50=000	S51=000	S52=000	S53=000	S54=000
S55=000	S56=000	S57=000	S58=000	S59=000

OK

Profile 2 is set for the needs of synchronous dial-up line operation. For U-1496B, the default setting of this profile is the same as 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
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

S00=000	S01=000	S02=043	S03=013	S04=010
S05=008	S06=003	S07=050	S08=002	S09=006
S10=007	S11=070	S12=000	S13=000	S14=200
S15=130	S16=000	S17=018	S18=000	S19=000
S20=002	S21=018	S22=000	S23=105	S24=138
S25=000	S26=000	S27=128	S28=068	S29=000
S30=000	S31=017	S32=019	S33=255	S34=030
S35=032	S36=000	S37=000	S38=000	S39=000
S40=000	S41=000	S42=000	S43=000	S44=000
S45=100	S46=028	S47=064	S48=000	S49=000
S50=000	S51=000	S52=000	S53=000	S54=000
S55=000	S56=000	S57=000	S58=000	S59=000

OK

Profile 3 is set for the needs of synchronous 4-wire leased line operation. For U-1496E, U-1496P, and U-1496B, the default setting of this profile is the same as profile 0 since they don't have 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

S00=000	S01=000	S02=043	S03=013	S04=010
S05=008	S06=003	S07=060	S08=002	S09=006
S10=007	S11=070	S12=000	S13=000	S14=002
S15=130	S16=000	S17=018	S18=000	S19=000
S20=002	S21=178	S22=000	S23=105	S24=138
S25=000	S26=000	S27=156	S28=068	S29=000
S30=000	S31=017	S32=019	S33=255	S34=030
S35=000	S36=000	S37=000	S38=000	S39=000
S40=000	S41=000	S42=000	S43=000	S44=000
S45=100	S46=028	S47=064	S48=000	S49=000

S50=000 S51=000 S52=000 S53=000 S54=000
S55=000 S56=000 S57=000 S58=000 S59=000

OK

Factory default setting is stored in ROM, ZyXEL presets User Profile 0 the same as the factory default.

RESET 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 U-1496, or by issuing commands from your terminal.

On RESET submenu screen, the profile that follows the equal sign '=' means that the profile is the one that will be loaded upon power-up. This setting also affects the SAVE TO submenu default profile (see next section).

((MODE-21))

PROFILE 0 ATZ0 Reset modem and load user profile 0.
PROFILE 1 ATZ1 Reset modem and load user profile 1.
PROFILE 2 ATZ2 Reset modem and load user profile 2.
PROFILE 3 ATZ3 Reset modem and load user profile 3.
FACTORY DEFAULT ATZ4 Reset modem and load 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.

SAVE 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 AT 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 which case profile 0 is the SAVE TO default.

((MODE-22))

PROFILE 0 AT&W0 Save current settings to user profile 0 (EEPROM).
PROFILE 1 AT&W1 Save current settings to user profile 1 (EEPROM).
PROFILE 2 AT&W2 Save current settings to user profile 2 (EEPROM).
PROFILE 3 AT&W3 Save current settings to user profile 3 (EEPROM).

PROFILE PROTECTION

If S35.6 of profile 0 is set, this file is protected. A save operation using AT&W0 will prompt supervisory password entry. Using the SAVE TO menu to save to profile 0 will have no effect.

Setting S35.6 in profile 0 will also protect the supervisory password. If this bit is set, the supervisory password cannot be reset to the default "ZyXEL" by modem hardware reset (see Chapter 12). Remember your password before setting this bit.

RESET PROFILES

After you have changed the user profile settings, if you wish, you can reset all four user profiles to factory preset values. This is done by holding the ENTER key down while you power-on the modem. Remember that by doing this, all of your user profile settings are lost. Unless you have set bit 6 in S-register 35 of profile 0, this will also reset the supervisory password to "ZyXEL" (see last section).

On U-1496E, holding the VOICE/DATA switch down while powering on the modem will reset the modem. On U-1496B, shorting the jumper TS2 and then turning on the power will reset the modem.

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 is also doing continuous self testing after this reset (see Chapter 17 for details). Turn off power to stop testing.

Chapter Seven - 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 with the same effect as you do from terminal commands, or through the modem's panel controls.

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 the profile that is currently inactive, you will have to recall the profile to make it active (see Chapter 6).

The U-1496 series modems have 60 S-Registers from S0 to S59. S0 to S11 are standard AT S-Registers; and S13 to S49 are mostly bit-map configured. Changes in the bit-map configuration can also have the same effect as issuing commands. However, typing in the commands is recommended.

READ AND SET S-REGISTERS

See Register's Content Modification section in Chapter 5 for reading and setting S-Registers using the U-1496's LCD panel. When using AT commands, use

ATSr ?

to display the value stored in S-Register `r'; use

ATSr = n (0 <= r <= 59; 0 < n <= 255)

to set S-Register `r' to value `n'; use

ATSr.b = n (0 <= r <= 59; 0 <= b <= 7; 0 <= n <= 1)

to set only bit 'b' of S-Register 'r' to value 'n' 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 the bits. For example, if you want to set S38 bit 3 to 1 for a specific application:

Do an $ATS38 = ?$ to find the original value.

Convert it to binary:

Bit	Binary Value	Decimal Value	Sedecimal Value	We Use
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 a bit to '1', do a logic OR with the value:

	10001000	136	\$88	01000000	64	\$40
OR	00001000	8	\$08	00001000	8	\$08
	10001000	136	\$88	01001000	72	\$48

To set a bit to '0', do a logic NOT AND with the value:

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 decimal value, do an $ATS38 = n$ to set the register.

Using $ATS38.3 = 1$ to do the same is much easier.

Note: If you enter values from the U-1496 front panel, use the sedecimal (hex) values.

S-REGISTER DESCRIPTIONS

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

- S0 Default= 0; Sets the number of rings on which the modem will answer automatically. S0=0 disables autoanswer. The range of rings is 0 to 255. (Country specific)
- S1 Default=0; Counts the incoming rings and stores the value to this register. User can read but should not change this value.
- S2 Default=43; S2 holds the ASCII decimal value for Escape Sequence character. Default character is "+". A value of 128-255 disables the escape code.
- S3 Default=13; Holds the ASCII decimal value of Carriage Return character.
- S4 Default=10; Holds the ASCII decimal value of Line Feed character.

- S5 Default=8; Holds the ASCII decimal value of Backspace character. A value of 128-255 disables the Backspace key's delete function.
- S6 Default=3; 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, modem will dial as soon as it detects a dial tone. This S-Register also sets the time-out interval for `W' dial modifier to wait for the dial tone. Range is 1 to 255 seconds. (See also S41b4.)
- S7 Default=60; Sets the number of seconds the modem waits for a carrier. If the modem does not detect a carrier within this time, it hangs up and returns the NO CARRIER result code.
- S8 Default=2; Sets the duration of delay generated by comma (,) dial modifier. Also sets the pause between command re-execution for Repeat (>>) command.
- S9 Default=6; 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 Default=7; Sets the duration, in tenths of a second, that the modem waits after loss of carrier before hanging up. This guard time allows the modem to distinguish between a line hit, or other cause that momentarily breaks the connection, and a true disconnection (hanging up) by the remote modem.
- S11 Default=70; Sets the duration and spacing, in milliseconds, in touch-tone dialing.

Note: The number values of ASCII codes are always given as decimals. If you enter values from the U-1496 front panel you must convert these values to sedecimal (hex) values.

S12 Reserved.

S13 Bit-map register, default=0

(1) = 1; Capture modem manufacturer information during V.42 handshake. Can be displayed at AT12 "Last Speed/Protocol" line if available.

S14 Bit-mapped register, default = 2

- | | | | |
|-----|-------|-----|--|
| &Mn | (7,6) | =0; | Asynchronous, buffered. |
| | | =1; | Async command, sync data. |
| | | =2; | Direct asynchronous, no buffer. |
| | | =3; | Synchronous. |
| &Xn | (5,4) | =0; | Internal clock. |
| | | =1; | External clock. |
| | | =2; | Remote clock. |
| &Ln | (3,2) | =0; | Dial-up line. |
| | | =1; | 2W leased line. |
| | | =2; | 4W leased line. |
| &T4 | (1) | =0; | Grant remote digital loopback test request. |
| &T5 | | =1; | Deny remote digital loopback test request. |
| *Mn | (0) | =0; | Auto-handshake on originate mode in leased line operation. |
| | | =1; | Auto-handshake on answer mode in leased line operation. |

S15 Bit-mapped register, default = 130

- | | | | |
|-----|---------|-------|--|
| Zn | (7,6,5) | =0-4; | Profile as active settings after power on. |
| *Cn | (4,3) | =0; | 10-bit character length. |
| | | =1; | 11-bit character length. |
| | | =2; | 9-bit character length. |
| | | =3; | 8-bit character length. |

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

- | | | |
|-----|-----|-------------|
| (2) | =0; | 1 stop bit. |
|-----|-----|-------------|

=1; 2 stop bits.
 (1,0) =0; Even parity.
 =1; Odd parity.
 =2; No parity.

S16 Test status register, default = 0

=0; No test in progress. (Default)
 =1; Analog loopback test in progress.
 =2; Reserved.
 =3; Local digital loopback test in progress.
 =6; Remote digital loopback test in progress.
 =7; Remote digital loopback with self-test in progress.
 =8; Analog loopback with self-test in progress.

S17 Bit-mapped register, default = 18

*In (7,6) =0; AT command set.
 =1; V.25bis command set.
 =2; Dumb model
 D (5) =0; Normal dial
 DR =1; Reverse dial, answer mode on line
 *Pn (4,3,2,1) =0-15; Set leased line transmission power level. (See also S35b3)
 *Sn (0) =0; Disable secondary channel.
 =1; Enable secondary channel. (See also S42b0)

S18 Same value format as S20. If non-zero, 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

&Nn =0; Multi-Auto, auto negotiate highest possible link rate. (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.17FAX 14400/12000/9600/7200, V.29FAX 9600/7200, V.27terFAX 4800/2400, cellular modes)
 =1; V.33 14400/12000.
 =2; V.33 12000.
 =3; V.32 9600T/9600/7200T/4800.
 =4; V.32 9600/7200T/4800.
 =5; V.32 4800.
 =6; V.29 9600.
 =7; V.29 7200.
 =8; V.29 4800.
 =9; V.27bis 4800.
 =10; V.27bis 2400.
 =11; V.26bis 2400.
 =12; V.23 1200/75.
 =13; V.23 600/75.
 =14; V.22bis 2400/1200.
 =15; V.22 1200.
 =16; V.21 300.
 =17; V.32bis 14400/12000/9600/7200/4800.
 =18; V.32bis 12000/9600/7200/4800.
 =19; V.32bis 7200/4800.
 =24; Bell 212A 1200.
 =25; Bell 103 300.

=32;	V.17FAX	14400/12000/9600/7200,
	V.29FAX	9600/7200,
	V.27terFAX	4800/2400.
=34;	ZyX 19200	19200
=35;	ZyX 16800	16800
=36;	ZyX 14400	14400
=37;	ZyX 12000	12000
=38;	ZyX 9600	9600
=39;	ZyX 7200	7200
=42;	CELL 14400	14400
=43;	CELL 12000	12000
=44;	CELL 9600	9600
=45;	CELL 7200	7200T
=46;	CELL 4800	4800T
=47;	CELL 4800	4800C
=48;	CELL 3600	3600C
=49;	CELL 3600	2400C

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

S20 DTE speed, default=2
(Auto detected from AT command)

=0;	76.8 Kbps.
=1;	57.6 Kbps.
=2;	38.4 Kbps.
=3;	19.2 Kbps.
=4;	16.8 Kbps.
=5;	14.4 Kbps.
=6;	12.0 Kbps.
=7;	9.6 Kbps.
=8;	7.2 Kbps.
=9;	4.8 Kbps.
=10;	3.6 Kbps.
=11;	2.4 Kbps.
=12;	1.8 Kbps.
=13;	1.2 Kbps.
=14;	600 bps.
=15;	300 bps.

S21 Bit-mapped register, default =178

&Dn	(7,6)	=0;	Modem ignores DTR signal, assumes DTR always ON.
		=1;	108.1, DTR OFF-ON transition causes dial of the default number. DTR OFF causes hang-up.
		=2;	108.2, Data Terminal Ready, DTR OFF causes the modem to hang up and return to command state.
		=3;	108.2, DTR off causes the modem to hang up and reset the modem to profile 0.
&Rn	(5)	=0;	CTS follows RTS in synchronous mode. Response delay set in S26.
		=1;	Ignore RTS (CTS always ON) in synchronous mode.
&Cn	(4)	=0;	CD always ON.
		=1;	CD tracks presence of data carrier. (See also S38b3)
&Sn	(3)	=0;	Modem forces DSR always ON.
		=1;	According to CCITT. (See also S44b4, S41b5)

Mn (2,1) =0; Speaker always OFF.
 =1; Speaker ON until carrier is detected.
 =2; Speaker always ON.
 =3; Speaker ON after last digit is dialed out until carrier detected.
 *En (0) =0; Maintain non-error control connection when error control handshake fails.
 =1; Drop connection when error control handshake fails.

S22 Reserved.

S23 Bit-mapped register, default = 105

Qn (7) =0; Modem returns result code.
 =1; Modem does not return result code. (See also S40b1)
 Vn (6) =0; Display result code in numeric format. (See S35b7)
 =1; Display result code in verbose format.
 Xn (5,4,3) =0; Basic result code (0-4). (See result code table for ATXn)
 =1; Result code (0-5, 10-21).
 =2; Result code (0-6, 10-21).
 =3; Result code (0-5, 7-21).
 =4; Result code (0-21).
 =5; Error control result code enabled.
 =6; Error control result code enabled.
 =7; Error control result code enabled.
 &Pn (2) =0; Pulse dial make/break ratio=39%/61%.
 =1; Pulse dial make/break ratio=33%/67%.
 T (1) =0; Tone dial.
 P =1; Pulse dial.
 En (0) =0; Command echo disabled.
 =1; Command echo enabled.

S24 Bit-mapped register, default = 138

Ln (7,6,5) =0-7; Speaker volume control.
 Nn (3,2,1) =0-7; Ring volume control.

S25 Reserved.

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

*Qn (7,6) =0; No response to poor signal quality.
 =1; Initiate retrain to poor signal quality. (See also S41b2)
 =2; Adaptive rate (auto fall-back and fall-forward) when signal quality changes.
 =3; Disconnect when signal quality is poor.
 &Hn (5,4,3) =0; Flow control disabled.
 =1; Reserved.
 =2; Reserved.
 =3; Hardware CTS/RTS flow control.
 =4; Software XON/XOFF flow control.
 =5; Reserved.
 &Kn (2,1,0) =0; No error control.
 =1; MNP4 (includes MNP3, see also S41b0).

- =2; MNP4 + MNP5. (See also S41b0, S38b5)
- =3; V.42 +MNP4.
- =4; V.42 + V.42bis (compatible with &K2, see also S38b5).

S28 Bit-mapped register, default = 068,
 Bn (7) =0; Select V.22 for 1200 bps communication.
 =1; Select Bell 212A for 1200 bps communication.
 &Bn (6) =0; DTE/DCE rate follows link rate. (See also S18, S44b6)
 =1; DTE/DCE rate fixed at DTE setting, range from 300 to 76.8

Kbps. (See also S44b6)

- &Gn (5,4) =0; No guard tone.
 =1; Reserved.
 =2; 1800 Hz guard tone.
- Yn (3,2) =0; Destructive, expedited break.
 =1; Non-destructive, expedited break.
 =2; Non-destructive, un-expedited break.
- *Ln (1) =0; Panel key normal.
 =1; Panel key locked.
- &Jn (0) =0; Single phone line, RJ11 phone jack.
 =1; Multiple phone/modem line, RJ12/RJ13 phone jack.

S29 Default dial phone number pointer, default = 000. Use AT&Zn = S to store phone numbers.

*Dn =n; Set default dial phone number pointer at location n (n=0-9) in the phone directory stored in EEPROM.

S30 Dial-backup phone number pointer, default = 000.

*Bn =0; Disable dial backup.
 =n; Enable dial backup and set dial backup phone number pointer at location n-1 (n=1-9) in the EEPROM. (See also S44b2).

Note: When the leased line has become unoperational, 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 ring if dial backup is enabled (a non-zero number is selected).

S31 Default=17;
 Holds the ASCII decimal value of the XON character.

S32 Default=19;
 Holds 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 will automatically "lookback" to determine whether the leased line is again operational. This timer will disconnect current dial-up line and attempt to connect on the original leased line. If it is still unavailable, the dial-up line will continue to be used.

S35 Bit-mapped register, default = 000,
 (7) =1; Enable extended numerical result code 30 - 39 when an error

control connection is made, used with ATV0 (S23b6), see result code table.

(6) =1; Enable password protection to profile saving. When AT&W0 is issued and profile 0 in the EEPROM has this bit set, supervisory password will be requested.

(5) =1; Enable Selective Reject in V.42

(4) =1; Effective only on the U-1496E and U-1496R. When Data/Voice switch is pressed, modem will dial the default number. (See *Dn, S29).

(3) =1; Add 12dBm attenuation to the leased line transmission power. (See *Pn, S17b1, S49b0).

(2) =1; V.26bis alternative A.

(1) =1; Disable aborting from terminal during modem handshaking.

(0) =1;* Use CELL 4800T trellis coded 4800 for V.32 4800.

Note: Available with cellular mode, otherwise this feature is reserved.

S36 Bit-mapped register, default = 000

Security function control

*Gn (7,6,5) =0; Disable security function
=1; Enable type 1* security, with password check.
=2; Enable type 1 security, with password check and call back.
=3; Enable type 2* security, with password check.
=4; Enable type 2 security, with password check and call back.
=5; Enable type 2 security, with password check and call back,

remote site enters the call-back number.

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

Remote configuration control

*Wab (1) =0; Write from local profile to remote profile.
*Rab =1; Read from remote profile to local profile.
*Fn (0) =0; Deny remote request for configuration.
=1; Grant remote request for configuration.

S37 Bit-mapped register, default = 000. For remote configuration using panel menu control. (See *Wab, *Rab)

(7,6,5,4) =0-5; Local profile number.

(3,2,1,0) =0-5; Remote profile number.

Note: When using U-1496 panel for remote configuration, set S36 bit 1 and S37 first, then activate it in DIAGNOSTIC menu.

S38 Bit-mapped register, default = 000

(7,6) Reserved.

(5) =1; Disable MNP5 negotiation regardless of error control setting.

(4) =1; Disable FAX answering in MULTI-AUTO mode. Hang up if a FAX call is received..

(3) =0; CD tracks carrier.

=1; CD on/off sequence follows UNIX standard, CD On before connect message is sent. CD Off after last DCE response is sent. (UNIX system needs CD On to enable serial port receiving.) (See &C1, S21b4.)

(2,1) Reserved.

(0) =1; Enable repeat dialing of the default number if not connected.

(See *Dn, S29)

S39 Bit-mapped register, default = 000
 (7) =0; Does not include resync information in recorded voice data.
 =1; Includes resync information in recorded ADPCM file.

Note: When the resync function is enabled, the modem sends a resync symbol - <DLE><DC2>(hex 10 and 12) every 50 ms. ADPCM data can be edited without losing sync if enabled.

(6) =0; DTMF detection is enabled only in voice PLAY or RECORD mode.
 =1; DTMF detection is enabled when command "AT+VLS=2" is received.

Note: AT auto baud detection is disabled when DTMF detection is enabled.

(5) =1; Disables scrambler/descrambler in V.26bis mode. Enables compatibility with older modems which have no V.25bis scrambler/descrambler unit.
 (4) =1; Class 2 fax with DTE speed shifting; +FCON at current DTE rate and shift to 19200 at next phase
 (3) =1; Class 2 fax with Bitfax compatibility; +FCON at 2400 and shift to 19200 at next phase.
 (2) =1; Reverse Answer; answer in originate mode.
 (1,0) Reserved.

S40 Bit-mapped register, default = 000
 (7) Reserved.
 (6) =1; Enable type 4 ring detection.
 (5) =1; Enable type 3 ring detection.
 (4) =1; Enable type 2 ring detection.
 (3) =1; Enable type 1 ring detection.
 (2) =1; Enable caller ID detection. (See also S24b2, *T)
 Q2 (1) =1; ATQ2, modem does not return result code in 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 0's enable ring detection on any ring longer than 100ms.

S41 Bit-mapped register, default = 000
 (7) =1; Ignore calling tone. Not to be used as fax detection.
 (6) =1; Do not answer on the first ring, force S0=2.
 (5) =1; DSR follows DCD, off for 0.5 sec on DCD on-off transition. (See &Sn).
 (4) =1; In X2-X7 setting, modem waits for S6 seconds before dialing and ignores dial tone detection.
 (3) =1; Enable CCITT signals 140 and 141 on EIA-232D interface.
 (2) =1; Extend the retrain time-out timer to 5 minutes. (See *Qn, S27b6).
 (1) =0; Flag idle in V.25bis HDLC. (See *I1, S17b6)
 =1; Mark idle in V.25bis HDLC.
 (0) =1; Special MNP compatibility (See also &Kn, S27b0, S38b5).

S42 Bit-mapped register, default = 000
 (7) =1; DCD pulses off for 0.5 sec at carrier loss, always on otherwise.

- (6) =1; Disable "RINGING" result code. (See ATXn).
- (5) =1; button.
- (4) =1; V.17 fax in calling mode, no effect on answering mode (See &N0 and &N32).
- (3) =1; Disable escape sequence code in answer mode.
- (2) =1; CND message will be forced on even if ATQ2 is set. (See S40b1).
- (1) =1; Enable throughput averaging.
- (0) =0; secondary channel, 75-2400 bps
- =1; Select 2400 bps secondary channel.

Note: Secondary channel is available only on network management capable models, i.e., U-1496RN and U-1496SN.

- S43 Bit mapped register, default = 000
- (7,6,5,4,) Reserved
 - (3) =1; Disable cellular mode.
 - (2) =1; Disable cellular mode Auto Transmit Power Adjustment. Use S49b0-3 to set transmit power.
 - (1) =1; Disable ZyXEL 19200 bps in Multi-Auto mode.
 - (0) =1; Disable ZyXEL 16800 bps in Multi-Auto mode.

- S44 Bit-mapped register, default = 000,
- (6) =1; When selected with &B0, DTE speed fixed at 19200 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 &B1, DTE speed fixed at current rate when an ARQ connection is made; when a non-ARQ connection is made; DTE speed follows link rate.
 - (5) =1; Enable V.13 half-duplex simulation in synchronous mode.
 - (4) =1; DSR follows DTR (See also S41b5).
 - (3) =1; Enable cyclic dial with ATDSn.
 - (2) =1; Semi-auto dial back-up, modem will wait for user's confirmation from front panel before dialing to back up.

S45 Delay during which the CND silence detection is disabled. Unit is 20ms; default 087. (See also S46).

S46 Silence detection. To process the CND signal, silence must be detected for the specified amount of time. Unit is 20 ms; default = 003.

S47 CND attenuation. Attenuation while processing the CND signal. 1 is the highest attenuation.

S48 Bit-mapped register, default=000

- (0) =1; Causes CND information to be reported in raw data format.

S49 Bit-mapped register, default = 000

- (7) =0; For cellular mode only, modem is installed in office.
- =1; For cellular mode only, modem is in mobile use.
- (6,5,4) Reserved.
- (3,2,1,0) =0-15; Set cellular mode transmit power -9 to -24 dBm. (See also S43b2.)

S50 Inactivity timer in 10-second units. Counts when there is no data flow in or out of the RS-232 serial port.

Chapter Eight - AT COMMAND SET SUMMARY

An AT command is a command issued by the computer/terminal to the modem through the RS232 serial port in asynchronous data format when the modem is in command state. An `AT' command prefix (ATtention) precedes each command line, except in the case of `A/', `A>>', and `+++'. The `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 characters. Up to 40 commands can be entered in a single command line with a single AT prefix.

`+++' is the escape sequence code that is entered in data state and the modem will return to command state.

BASIC AT COMMAND SET

Following is a list of the basic AT command set. Each command should be entered following an AT prefix. A `+' mark placed before an AT command in the list indicates that it is a default setting.

- A Answer mode on-line. (See also S39b2).
- + B0 Select CCITT V.22 for 1200 bps communication (Default).
- B1 Select Bell 212A for 1200 bps communication.
- D Enter originate mode, dial number that follows, attempt to go on-line.

Digits and modifiers that can be used with the D command:

- 0-9,#,* Digits for dialing.
- P Pulse dial.
- T Tone dial.
- W Wait for second dial tone.
- R Originate a call in answer mode. Entered as the last digit.
- , Pause for a time designated by S8.
- ; Return to command state after dialing.
- @ Wait for a 5-second silence before proceeding, otherwise return `NO

ANSWER'.

- ! Hook flash (call transfer).
- DL Dial the last-dialed number.
- DSn Dial number stored in EEPROM at location n(0-9). S44.3=1 enables cyclic dial.

If the first dial is not successful, it will cycle dial through all the numbers stored in memory.

- + E0 Disable character echo in command state.
- E1 Enable character echo in command state (Default).
- H0 Go on-hook (hang-up). Same as ATH.
- H1 Go off-hook.

I0 Display product code <197> "1496" for U-1496 series modems. Same as ATI.
I1 Display ROM checksum and product information.
I2 Display link diagnostic status report.

L0-7 Speaker volume control. The higher the value, the higher the volume (Default is L4).

+ M0 Speaker always OFF.
M1 Speaker ON until carrier detected (Default).
M2 Speaker always ON.
M3 Speaker ON after last digit is dialed out and OFF when carrier is detected. Tone dialing is not heard.

N0-7 Ring volume control. When a call comes in, speaker will ring to indicate an incoming call. N0 will disable the ring function (Default is N5).

O Return to on-line state.

P Pulse dial.

+ Q0 Modem returns result code (Default).
Q1 Modem does not return result code.
Q2 Modem returns result code but quiet after answering on a RING. (See also S42b2).

Sr=n Set S-Register `r' to value `n', n must be a decimal number between 0-255.
Sr? Display value stored in S-Register `r'.
Sr.b=n Set bit 'b' of S-Regis 'r' to value n (0 or 1).
Sr.b? Display value of bit 'b' of S-Register 'r'.

+ T Tone dial (Default).

V0 Display result code in numeric form. (See also S35b7 and the result code table of ATXn.)
+ V1 Display result code in verbose form (Default).

Xn Result code and call progress monitor options (Default is X5).

ATV0	ATV1	Result codes.								
		X0	X1	X2	X3	X4	X5	X6	X7	
0	OK	0	0	0	0	0	0	0	0	
1	CONNECT	0	0	0	0	0	0	+	+	+
2	RING**	0	0	0	0	0	0	0	0	
3	NO CARRIER	0	0	0	0	0	0	0	0	0
4	ERROR	0	0	0	0	0	0	0	0	0
5	CONNECT 1200			0	0	0	0	0	+	+
+										
6	NO DIAL TONE			0		0	0	0	0	0
7	BUSY			0	0	0	0	0	0	
8	NO ANSWER				0	0	0	0	0	
9	RINGING***					0	0	0	0	
10	CONNECT 2400			0	0	0	0	0	+	+
+										
11	CONNECT 4800			0	0	0	0	0	+	+

+	12	CONNECT 9600	0	0	0	0	+	+
+	14	CONNECT 19200	0	0	0	0	+	+
+	15	CONNECT 7200	0	0	0	0	+	+
+	16	CONNECT 12000	0	0	0	0	+	+
+	17	CONNECT 14400	0	0	0	0	+	+
+	18	CONNECT 16800	0	0	0	0	+	+
+	19	CONNECT 38400	0	0	0	0	+	-
-	20	CONNECT 57600	0	0	0	0	+	-
-	21	CONNECT 76800	0	0	0	0	+	-
-								

Notes:

+ : If error control result codes enabled (X5, X6, or X7), the result message will be formatted as:

CONNECT DTE speed/Link speed/*Error control level - X5

CONNECT Link speed/ARQ - X6

CONNECT Link speed/ARQ/*Error control level - X7

where ARQ means Automatic Retransmission reQuest type of error control is enabled.

*: Data Compression included. /SREJ is appended if V.42 with selective reject is connected.

** : 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:

For X5 - CONNECT 38400/V.32 9600T/MNP5

CONNECT 57600/V.32b 14400/V.42b

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

For X6 - CONNECT 9600/ARQ

CONNECT 14400/ARQ

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

For X7 - CONNECT 9600/ARQ/MNP5

CONNECT 14400/ARQ/V.42b

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

ATV0	Connect Speed	Result Code	With Error Control
30	CONNECT		
31	CONNECT 1200		
32	CONNECT 2400		
33	CONNECT 4800		

- 34 CONNECT 7200
- 35 CONNECT 9600
- 36 CONNECT 12000
- 37 CONNECT 14400
- 38 CONNECT 16800
- 39 CONNECT 19200

- 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 Reset modem and load factory settings, also set 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 DTE/DCE rate fixed at DTE setting, range from 300 to 76.8Kbps (Default). (See also S18, S20, S44b6.)

- + &C0 Assume that the carrier is always present (force CD always ON).
- + &C1 CD tracks presence of carrier (Default). (See also S38b3, S42b7.)

&D0 Ignore DTR signal, assume DTR always 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 and reset from profile 0.

&F Load factory settings to RAM as active configuration.

+ &G0 No guard tone (within USA, Canada) (Default).

&G1 Reserved.

&G2 1800 Hz guard tone.

&H0 Flow control disabled.

&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 lines RJ12/RJ13 phone jack.

- &K0 No error control.
- &K1 MNP4 (includes MNP3).
- &K2 MNP4 + MNP5. (See also S38b5, S41b0.)
- &K3 V.42 +MNP4.
- + &K4 V.42 + V.42bis, compatible with &K2 (Default). (See also S38b5.)

- + &L0 Normal 2-wire dial-up line (Default).
- &L1 2-wire leased line.
- &L2 4-wire leased line.

- +&M0 Asynchronous mode, buffered data (Default).
- &M1 Asynchronous command, synchronous data.
- &M2 Direct asynchronous mode, no buffering.
- &M3 Synchronous mode.

- + &N0 Multi-Auto, auto negotiate highest possible link rate (ZyX19200, ZyX16800, 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, and cellular modes 14400 - 2400) (Default).
- &N1 V.33 14400/12000.
- &N2 V.33 12000.
- &N3 V.32 9600T/9600/7200T/4800.
- &N4 V.32 9600/7200T/4800.
- &N5 V.32 4800.
- &N6 V.29 9600.
- &N7 V.29 7200.
- &N8 V.29 4800.
- &N9 V.27bis 4800.
- &N10 V.27bis 2400.
- &N11 V.26bis 2400.
- &N12 V.23 1200/75.
- &N13 V.23 600/75.
- &N14 V.22bis 2400/1200.
- &N15 V.22 1200.
- &N16 V.21 300.
- &N17 V.32bis 14400/12000/9600/7200/4800.
- &N18 V.32bis 12000/9600/7200/4800.
- &N19 V.32bis 7200/4800.
- &N24 Bell 212A 1200.
- &N25 Bell 103 300.
- &N32 V.17 FAX 14400/12000/9600/7200,
V.29 FAX 9600/7200,
V.27ter FAX 4800/2400.
- &N34 ZyXEL 19200
- &N35 ZyXEL 16800.
- &N36 ZyXEL 14400.
- &N37 ZyXEL 12000
- &N38 ZyXEL 9600
- &N39 ZyXEL 7200
- &N42 CELL 14400

&N43 CELL 12000
&N44CELL 9600
&N45 CELL 7200
&N46 CELL 4800T
&N47 CELL 4800C
&N48 CELL 3866C
&N49 CELL 2400C

Note: All speeds over 9600 bps are trellis coded except V.29; V.32bis 7200 is also trellis coded. Not all modes available in all models. Check the compatibility table. All ZyXEL modes except ZyXEL 16800 are available only with Plus models.

- + &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 Modem assumes RTS always ON, ignores the changes (Default). (&Rn controls the synchronous mode operation only, in asynchronous mode RCTS/RTS are used for flow control.)

- + &S0 Modem forces DSR always ON (Default).
- &S1 DSR according to CCITT. If S44b4=1, DSR follows DTR. If S41b5=1, DSR always on but follows DCD off for 0.5 second.

- &T0 Terminate test in progress.
- &T1 Initiate Analog LoopBack (ALB) test.
- &T2 Reserved.
- &T3 Initiate Local Digital Loopback (LDL) test.
- &T4 Grant Remote Digital Loopback request from remote modem.
- &T5 Deny Remote Digital Loopback request from remote modem (Default).
- &T6 Initiate Remote Digital Loopback (RDL) test.
- &T7 Initiate Remote Digital Loopback with self test (RDL + ST).
- &T8 Initiate Analog LoopBack with self test (ALB+ST).

- &V0 View current active settings.
- &V1 View user profile 0 settings.
- &V2 View user profile 1 settings.
- &V3 View user profile 2 settings.
- &V4 View user profile 3 settings.
- &V5 View factory default settings.

- &W0 Save current settings to user profile 0. (See also S35b6).
- &W1 Save current settings to user profile 1.
- &W2 Save current settings to user profile 2.
- &W3 Save current settings to user profile 3.

- + &X0 Modem provides synchronous transmit clock signal (Internal clock to pin 15 of EIA-232D) (Default).
- &X1 Terminal provides synchronous transmit clock signal (External clock, from pin 24 of EIA-232D).
- &X2 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 Store the dial string (s) to EEPROM at location n (n=0-9).
- &Z? Display all the phone numbers stored in EEPROM.

EXTENDED AT* COMMAND SET

- + *B0 Disable dial-backup (Default).
- *Bn Enable dial-backup and set 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 Set default dial pointer at phone directory location n. (See also S35b4, S38b0, &Zn, &D1.)

- + *E0 If error control negotiation fails, keep the no error control connection (Default).
- *E1 If error control negotiation fails, disconnect the call (hang up).

- + *F0 Deny remote configuration (Default).
- *F1 Accept remote configuration (and Remote Digital Loopback must be granted---AT&T4).

- + *G0 Disable security function (Default).
- *G1 Enable type 1 security, with password check.
- *G2 Enable type 1 security, with password check and call back.
- *G3 Enable type 2 security, with password check.
- *G4 Enable type 2 security, with password check and call back.
- *G5 Enable type 2 security, with password check and call back, remote site enters the call-back number.

Notes:

1. The command *Gn needs supervisory 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 modem.
4. Modem can store 10 sets (0-9) of telephone numbers. If call back security is disabled, modem will search the password table to check the remote modem's password. If they match, modem will keep the connection, otherwise modem will hangup. If call back security is enabled, modem will complete password checking. If no match, modem will disconnect the line, otherwise modem will disconnect the line, find the corresponding phone number and call back immediately. Remote modem should be set to auto answer the call and response.

*HS Modify supervisory password.

Note: The default supervisory password is "ZyXEL".

*Hn Modify user password table at location n (n=0-9).

Note: These commands *Hn and *HS need supervisory password checking. 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.
- *I2 Dumb mode.

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

- + *L0 Panel key normal (Default).
- *L1 Panel key locked.

- + *M0 Leased line auto-handshake on originate mode (Default).
- *M1 Leased line auto-handshake on answer mode.

*P0-15 Set leased line transmission power level, range from 0 dBm to -15dBm (Default = -9dBm). Range from -12dBm to -27dBm if S35 bit 3 is set.

- *Q0 No response to poor signal quality.
- *Q1 Retrain action taken if signal quality is poor.
- + *Q2 Adaptive rate; auto fall-back or fall-forward (Default).
- *Q3 Disconnect for poor signal quality.

*Rab 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.

Note: The command *Rab only works when modem is on-line, no matter what kind of connection.

- + *S0 Secondary channel disabled (Default).
- *S1 Secondary channel enabled.

- *T Display last caller ID message.

- *V View password table.

Note: The command *V needs supervisory password checking.

*Wab Write local configuration profile a to remote user profile b and reset 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.

Note: The command *Wab only works when modem is on-line, no matter what kind of connection.

Chapter Nine - ERROR CONTROL AND DATA COMPRESSION

ERROR CONTROL

Error Control keeps the modem data link error free by detecting and retransmitting the data in error. 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 - the international telecommunications standard making organization. V.42 supports both LAPM (Link Access Procedure for Modem), and MNP4. V.42 handshake will try an LAPM connection first, if not successful, it will try MNP4.

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

1. Asynchronous to Synchronous Conversion

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. Modem converts asynchronous characters to synchronous data stream. 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 U-1496 series is 256 bytes. The maximum number of outstanding blocks without acknowledgements 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 number. If it is the same as 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 acknowledge for block 15 is received in a given time, this block must have been damaged. Acknowledgments of blocks 16 through 18 are ignored. Blocks 15 through 18 are resent.

4. ARQ Error Correction with Selective Reject

ZyXEL modems support V.42 error control with selective reject. Using this feature, the mode only resends the data block(s) in error, not all the data blocks starting from the one in error (just block 15 in above example). This saves retransmission time, greatly improving efficiency in high error rate conditions.

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

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.

U-1496 series modems support both V.42bis and MNP5 data compression protocols. Data compression needs an error-free data link 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 a little bit higher. In general, it is about 50% better in efficiency.

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. Total number of available tokens is 256, of which only the first 32 tokens are smaller than 8 bits, so random data will take 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. U-1496 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 U-1496 series of modems, the error control and data compression option can be enabled from the front panel or terminal.

CONTROL LEVEL	ERROR CONTROL	DATA COMPRESSION
None AT&K0	Disabled	Disabled
MNP4(MNP3) AT&K1	MNP4	Disabled
MNP4+MNP5 AT&K2	MNP4	MNP5
V.42(MNP4) AT&K3	V.42 or MNP4	Disabled.
V.42(b)+MNP4(5) AT&K4	V.42 or MNP4	V.42bis or MNP5

&4K 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 S38 bit 5 will disable MNP5 protocol negotiation regardless of 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 U-1496 series modems use the powerful 68000 processor that do not slow down during bidirectional file transfers.

NEGOTIATION FAIL FALL-BACK

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

STAYS ON-LINE AT*E0 If error control negotiation fails, keep the no error control connection (Default).
DISCONNECT AT*E1 If not error control linked, disconnect the line.

No matter what control level is enabled, DTE speed can always be set different 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 from the speed the modem is linked to. The DTE speed options range from 300 bps to 76800 bps. What DTE speed is optimized for your application depends on how fast your computer and communication software can process the serial port data. U-1496 series modems use some controls and commands to make the modem optimize its performance.

ADAPTIVE BLOCK SIZE

Depending on the line condition, ZyXEL U-1496 series modems will automatically adjust the block size to minimize the error rate and re-transmission time.

AVERAGING THROUGHPUT

At high DTE speeds, slow computers tend to lose characters. Even though most software programs offer protocols with error correction capability, it will still take time to recover the errors. The U-1496 averages the throughput before sending characters to DTE. This will decrease the probability of the computer to lose 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 is less of a problem now. 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 S42 bit 1 to 1.

HINT 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.

On some computers, a change of resolution or of the number of colors may result in higher speeds, because less time is used to transfer data to the video buffer.

Choice of an efficient assembly coded communication software is also very important. When using communication software, use a simple protocol without error control (modem has done 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 transmit and receive data buffers. Flow control is necessary so that a device (computer or modem) does not receive more data than it can handle. The U-1496 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 RS-232 signals which must be available on your computer. When the modem's transmit buffer is almost full, the modem will drop CTS to signal DTE that it cannot take any more data. Turn ON the CTS to notify DTE that it can keep sending data to the modem. At the computer software side, when the receive buffer of the software is almost full, it will drop RTS to signal the modem to stop sending data to DTE. Turn ON the RTS and the modem will start sending data again to DTE. In asynchronous full-duplex applications, the U-1496 always responds to the RTS signal as a flow control signal. The U-1496 defaults automatically to this hardware flow control setting and it is a better choice.

Software XON/XOFF Flow Control

It is a bidirectional flow control. XON and XOFF character defaults are decimal 17 and 19. These can be changed by modifying S-Registers 31 and 32. Both modems and 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 Ten - SYNCHRONOUS OPERATION

This chapter gets you started using the U-1496 series modem for synchronous operation. Use the U-1496 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 the non-FSK modes that the modem is supplied with.

The U-1496, U-1496E, U-1496P, and U-1496R stand alone, portable, and rack mountable models support synchronous mode operation, but the U-1496B has a built-in PC asynchronous serial port and can only be used in asynchronous mode.

Before you start to send and receive data synchronously, 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 modem and the modem 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. Generally, there are three types of transmitting synchronous clock sources you can choose from. Internal clock is the one that suits most applications and is the default. Here, the clock signal is generated by the sending modem. Slave clock is used when in remote digital loopback mode. External clock is a signal which is generated by the sending DTE.

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

RTS OPTIONS

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

- + IGNORED AT&R1 Modem ignores RTS, assumes RTS always ON. (Default).
- CTS TRACKS
- RTS AT&R0 Delay before CTS responds to RTS's change. The delay is set in S26 register.

Half-Duplex Operation

For a half-duplex modem, the carrier only exists in one direction at any specific time. The carrier, local CTS signal, and remote CD signal will follow the RTS signal in a certain manner. Some communication software written for half-duplex modems rely on the 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, V.13 protocol is provided to have the local CD signal follow 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 to define how the modem will operate in the command state.

SYNC DATA AT&M1 Modem accepts asynchronous command in command state, but exchanges data synchronously in data state.

SYNC AT&M3 Modem accepts synchronous command (V.25bis) and exchanges data synchronously with a remote modem.

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

DIAL FROM SYNCHRONOUS MODE

- 1) Dial from terminal using asynchronous command

Set &M1 and use asynchronous AT command to dial the number. After the modem is connected, the modem will enter synchronous operation.

- 2) Dial through the computer using V.25bis commands

Some communication software on the synchronous computer can dial using V.25bis synchronous commands. In this case, set &M3 and *I1 and modem will accept the synchronous V.25bis dialing command 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 asynchronous command &Zn=. Use 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 U-1496E, with S35 bit 4 set, pressing DATA/VOICE switch will also cause dialing of the default number.

- 4) Dial from panel

This is available only with U-1496 or U-1496R's LCD panel. Set 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 modem to synchronous mode (&M1 or &M3), then dial a number from a telephone set. When you hear the answer tone, type ATD (if set &M1) or press `O' on the IDLE SCREEN menu from the panel. On the U-1496E, press the VOICE/DATA switch with the ANS/ORG switch set to ORG. 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 S-Register S0 equal the number of rings to auto-answer. This can be set from the terminal (if set &M1) 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 set &M1) or press `A' on the IDLE SCREEN menu from the front panel. On the U-1496E, press the VOICE/DATA switch with the ANS/ORG switch set to ANS.

CHANGE FROM SYNCHRONOUS MODE TO ASYNCHRONOUS MODE

Set the modem to asynchronous mode from the panel, or just reset from an asynchronous profile. On the U-1496E, pressing the DATA/VOICE button while turning on the power will reset all profiles to their factory presets. The active setting is factory default, which is asynchronous.

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

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

Chapter Eleven - 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 U-1496 and U-1496R support 4-wire and 2-wire leased lines. 4-wire leased lines use a pair of wires to transmit data and the second pair to receive. 2-wire leased lines transmit and receive on the same pair of wires.

In some countries, a distinction is made between different kinds of leased lines:

Kind	CCITT-Norm	Description
Standard	M1040	This is a line with specifications similar to standard telephone lines. Attenuation in the frequency band 300 - 1700 Hz is smaller than from 1700 Hz to 3400 Hz.
Advanced	M1025	The DCE uses a higher amplification for the 1700 Hz to 3400 Hz range than for the 300 Hz to 1700 Hz range.
Special	M1020	The same attenuation is used for the whole band width.

The U-1496 and U-1496R have a separate jack/terminal for leased line connection. U-1496E and U-1496B have only a phone jack for dial-up line connection. You can only connect to the 2-wire leased line on the same jack.

LEASED LINE CONFIGURATION

For the U-1496, 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 labelled 'LEASED LINE' (located at the rear of the modem) for leased line operation. You can set the U-1496 for leased line operation by typing commands from the terminal or by selecting it from the front panel. Leased line phone jack pin assignments are shown in Appendix B.

The U-1496R has both dial-up and leased line terminal connectors at the rear panel of the rack it is housed in.

LINE TYPE

2W LEASED AT&L1 Modem connected to 2-wire leased line, the line plug should be plugged into the jack assigned 'LEASED LINE' on the rear panel.

4W LEASED AT&L2 Modem connected to 4-wire leased line. Plug the line into the 'LEASED LINE' jack.

For U-1496E, U-1496P, and U-1496B, only 2-wire leased lines can be used and the same phone jack is used for both dial-up and leased line connections. Dial backup feature is not available in this case.

POWER LEVEL

The leased line mode transmit power level of the U-1496 and U-1496R can be adjusted from 0 dBm to -27 dBm in 1 dBm increments.

LLINE TX POWER AT*P0-15 The default is -9 dBm. Adjustable range is 0 to -15dBm. Effective in leased line operation only. If bit 3 of S35 is set, this range will change to -12 to -27 dBm.

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 the call immediately.

In a leased line connection, the communication circuit between two modems is always connected. Dialing and waiting for rings do not happen in this situation. If these two modems want to establish a data link, one must be designated the originator and the other the answerer. You can set this manually or automatically.

MANUAL CONNECTION

Set the modem to leased line mode. Type 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 U-1496E, press the VOICE/DATA switch to make the modem go off-hook and on-line. Use the ANS/ORG switch to select originate or answer mode.

AUTO-HANDSHAKE

If you want handshaking to automatically occur upon power-up, you have to save the leased line configuration to the power-up profile. How to designate a profile to be a power-up profile is described in Chapter 6: Profiles. 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 AT*M0 When operating over a leased line, modem will handshake in originate mode (Default).

ANSWER AT*M1 When operating over a leased line, modem will handshake in answer mode.

The U-1496, U-1496R, U-1496P, and U-1496E support both asynchronous and synchronous leased line operation. Choose a suitable modem link mode. If the signal to noise ratio of your leased line is guaranteed above 25 dB, V.32bis 14400 is a better choice. V.32bis 14400 is also compatible with V.32bis 12000/7200 and V.32 9600T/9600/4800. You can use ZyX 16800 or ZyX 19200 mode if the S/N ratio is better than 27 or 28dB.

LEASED LINE DIAL-BACKUP

When a leased line connection fails, some actions may be taken by the U-1496 or U-1496R.

1. Retry to connect on the leased line indefinitely if dial back-up option is disabled.
2. If dial backup is enabled, the originating modem attempts to dial a pre-stored telephone number to backup the connection; the answering modem will retry to connect on the leased line and monitor the dial-up line for rings. Only U-1496 and U-1496R have the dial backup function and capability. They have separate dial-up and leased line phone jacks/connectors.

DIAL BACKUP

The dial backup option can be set by issuing an asynchronous AT command from the terminal, or by using the front panel control.

+ DISABLED AT*B0 Leased line dial backup disabled (Default).
 PH0-PH8 AT*B1-9 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 timer timeout happens. 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 dial backup connection before going back to check the leased line.

S34=0; Keep using dial backup line indefinitely.

S34=n; Retry leased line after `n' minutes (n=1-25, default is 30). If the leased line has still not 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 connection when the line is not in use, e.g., non-business hours.

ABORT FROM LEASED LINE

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 IDLE SCREEN.

DISCONNECT LEASED LINE

Disconnecting (manually) the leased line will force the U-1496 to switch to the IDLE STATUS screen. Either manually on-line 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.

On the U-1496E, pressing the VOICE/DATA switch will toggle the modem on/off the connected leased line.

Chapter Twelve - SPECIAL FUNCTIONS

This chapter describes the special features of U-1496 series modems, their functions and uses.

SECURITY FUNCTION

The U-1496 series modems provide a security function. When enabled, an unauthorized user cannot dial in and make a connection. Two types of security functions are provided. Type 1 security is used when the remote modem is also a U-1496 series modem; type 2 security function is used when the remote modem is any other brand modem. In the type 1 connection, the dial-in (remote) modem will send in its supervisory password for checking at the initial connection handshaking, and the local modem will check this password against its pre-stored acceptable password list. In 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. In level 1 security, the local modem will maintain the connection if the password checking is OK, otherwise the line is disconnected. In level 2 security, if the password is found in local modem's pre-stored acceptable list, it will disconnect the line, dial back at the phone number corresponding to the dial-in password. The line is simply disconnected if the password does not match.

There can be 10 user passwords, the corresponding 10 dial back numbers are common to the modem's 10 stored phone numbers. Any character (0-255) can be used in the password, the maximum password length is 8 characters.

Security function is only accessible through AT command in terminal mode. Any access attempt will be prompted to enter the supervisory password, the attempt will be rejected if the entered password is not correct. The default supervisory password is "ZyXEL" when modem is shipped out from the factory. This supervisory password is also the password sent for automatic password checking in type 1 connection. To modify the supervisory password, use

AT*HS

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

Password: (Enter supervisory password)

Password: (Enter new supervisory password)

Verify: (Enter the new supervisory password again)
OK

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

The command AT*V will list the 10 user passwords and the supervisory password on the screen for viewing. Again, you will be prompted to enter supervisory password first.

The following commands will enable different type and level of security functions:

- *G0 Disable security function
- *G1 Enable type 1 and level 1 security, with password check.
- *G2 Enable type 1 and level 2 security, with password check and call back.
- *G3 Enable type 2 and level 1 security, with password check.
- *G4 Enable type 2 and level 2 security, with password check and call back.
- *G5 Enable type 2 and level 2 security, with password check and call back, remote site enter the call back number.

*Gn command needs supervisory password checking. 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 U-1496 series modems provide the remote configuration capability that a local modem can configure the remote modem and reconnect at the new configuration. Remote configuration is provided at a profile to profile batch mode. The line connection does not need to be always maintained during remote configuration modification.

When on line, the remote modem's configuration or one of its profiles can be read into one of local modem's user profiles. This profile can be modified locally and the line can be disconnected during this time. Local profile modification is done by loading this profile as active settings and then modifying and saving the active settings back to the profile. Reading a remote profile `b' into a local profile `a' is done by the command

```
AT*Rab
```

where

- a=0-3 which is the local user profile number and
- b=0-3 which is the remote user profile number or
- b=4 for remote current configuration or
- b=5 for remote factory default.

Make the modems on-line again, the local modem can download (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
```

where

- a=0-3 which is the local user profile number or
- a=4 for local active configuration or
- a=5 for local factory default and

b=0-3 which is the remote user profile number.

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

Remote configuration can also be activated from U-1496 or U-1496R's LCD panel. The remote modem is set to grant remote configuration by setting S36 bit 0 to 1. For the local modem, set S36 bit 1 to 1 for read operation or 0 for write operation. Set S37 bit 0-3 to the remote profile number and bit 4-7 to the local profile number. After the S-Register settings are done, activate the remote configuration operation by going to DIAGNOSTIC menu and activating the REMOTE CONFIGURATION submenu.

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

CALLER NUMBER DELIVERY (CND)

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

With CND service, the phone company central office will send the coded caller information to the called station. This information is sent once between the first and second ring. U-1496 series modems are equipped with the capability to 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 command AT*T.

There are two kinds of caller information message formats sent by the phone company. One is the single message format which includes date, time, and caller ID; the other is the multiple message format which also includes the caller name as registered with the phone company.

S-Register S40 bit 2 is used to enable (1) or disable (0) the caller ID detection function. The default is disable. 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.

For a single message format, the modem will present a ring message to the terminal as

```
RING  
MM-DD hh:mm <Caller_ID>  
RING
```

where 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.

Following is an example:

RING
04-28 12:30 7135551414
RING

For a 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: Michael 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 have the modem send the last CND message.

Setting S48.0=1 will cause the modem to report CND information in its raw data format. The DTE software is responsible in explaining the data. Please refer to Bellcore Technical Advisory AT-NWT-000030 document for data format.

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 called by distinguishing which type of ring is received.

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

Ring signal is a repeated on and off of ring. Different type of ring usually corresponds to a

different composition of the `ON' part of the ring. The U-1496 series modems can distinguish up to four types of ring signals and can be commanded to answer or not answer to 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 between the ring types is on the 2-second ON part of the ring signal. It comprises a long, double short, or triple short ring.

Type 1: 1.2S or 2S on; 4S off.

Type 2: 0.8S on, 0.4S off, 0.8S on; 4S off.

Type 3: 0.4S on, 0.2S off, 0.4S on, 0.2 S off, 0.8S on; 4S off.

Type 4: 0.3S on, 0.2S off, 1 S on, 0.2 S off, 0.3S on; 4S off.

S-Register S40 bit 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 and a ring message sent to the terminal even if it is not counted as an accepted ring by the modem. The control relationships between bits in S40 and different ring types are:

Bit 3 - Ring type 1

Bit 4 - Ring type 2

Bit 5 - Ring type 3

Bit 6 - Ring type 4

If all of these bits are `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.

V.25bis COMMAND SET

V.25bis is a dialing command set standard defined by CCITT. 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 dialing. However, AT command only supports 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 communication is used. It is supported by the communication software on the computer.

The U-1496 series modems supports both asynchronous and synchronous V.25bis dialing. However, the internal card supports only 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 is used in most synchronous communication links. Appendix C lists the supported V.25bis commands/indications and their formats.

Use AT*I1 to enable V.25bis commands. For synchronous applications, normally the modem is permanently used for 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 powered on. The V.25bis command set is also selectable through the U-1496'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 Thirteen - CELLULAR MODE OPERATION

ZyXEL U-1496 series modems are equipped with a special communication mode - cellular mode - which enables the modem to perform reliable high speed data transmissions over a cellular phone link. Although all ZyXEL U-1496 series modems provide the cellular mode, the U-1496P portable modem is specially designed for portable use. It is portable in size and capable of using the DC12V car battery power. A power cable to plug into the cigarette lighter is provided with the modem.

This chapter explains cellular mode usage and gives background information on cellular data communications.

CELLULAR PHONE SYSTEM

Here we talk about 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 talking cellular phone 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 a hand-off.

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

CELLULAR IMPAIRMENTS

In the process of 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 transmitting 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 hand-off will happen.

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 each signal path, there is an interference pattern that, depending on location, means the received signal combination may be strong, weak or totally vanished. A moving cellular phone will experience a periodical signal drop and this is called multipath fading. Fading will cause data error because the carrier is lost. It will also interfere with a modem's adaptive operation and affect the modem's data that is received later.

The analog cellular phone system was designed for voice communications. It employs companding (concatenated from compressing and expanding; a special data-saving method) and pre-emphasis which are good for voice, but not suited for a modem signal. A modem signal, if too strong, may saturate the cellular link and cause distortion. A modem signal power that is too weak will result in lower signal-to-noise ratio at the receiving end. There is an optimum transmitting power in cellular data communications but it is different in each case.

CELLULAR MODEMS

A real cellular modem must be able to conquer the cellular impairments and maintain a reliable data link with reasonable data throughput through a cellular channel. Most modems claiming cellular compatibility today lack most of this capability.

Link layer protocol like MNP10 responds slowly to a fast changing cellular line condition. Most importantly, it does not do anything to enhance modem data pump performance or physical communication robustness. It does little to help conquer cellular impairments.

ZyXEL CELLULAR TECHNOLOGY

ZyXEL developed special technologies for cellular data communications to provide reliable, high throughput data links over a cellular channel.

A summary of these technologies includes:

FRS: Fast Re-Synchronization of the modem after cell hand-off and power level change.

CFEC: Cellular Forward Error Correction to correct fading errors.

DCSS: Dynamic Cellular Speed Selection to dynamically select the best operating speed and mode in order to minimize error and maximize throughput.

ATPA: Automatic Transmit Power Adjustment selects the optimum transmit power so as not to saturate the cellular channel.

RHE: Reliable Handshake Enhancements. It ensures reliable connection set-up even in very noisy line conditions. It also ensures reliable V.42 error control set-up. Other modems may retry many times to make a successful handshake.

Besides physical layer enhancements, ZyXEL also does V.42 link layer enhancements.

ZyXEL CELLULAR MODES

In addition to normal modem, fax, and voice operation modes, the following cellular modes are offered in the U-1496 series modems:

Mode Speed

Multi-Auto	ZyX modes/V.32bis/V.32/V.22bis/G3 FAX/Cellular Modes
CELL 14400	14400/12000/9600/7200/4800/3600/2400
CELL 12000	12000/9600/7200/4800/3600/2400
CELL 9600	9600/7200/4800/3600/2400
CELL 7200	7200/4800/3600/2400
CELL 4800T	4800/3600/2400
CELL 4800C	4800/3600/2400
CELL 3600C	3600/2400
CELL 2400C	2400

CELL 14400 will connect with the other modem with 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.

CELL 4800C uses forward error correction to get a low error rate at 4800 bps net link speed.

CELL 3600C and CELL 2400C also use forward error correction to get a net speed of 3600 bps and 2400 bps. They are more robust than the CELL 4800C mode. Forward error correction mode is used when there is a high number of errors.

The modem will automatically and dynamically select the best speed and mode to operate (DCSS). Selecting one of the above cellular modes only limits the maximum speed at which the modem will operate. It automatically chooses and adjusts to the best operating speed and mode under the maximum speed.

The multi-auto mode will automatically adapt to the other side's capability and request and connect at 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 cellular mode connection. Multi-auto is the default mode.

CELLULAR MODE USAGE

Cellular mode is recommended rather than using a cellular link for modem connection. It can also be used on other bad line conditions such as a line with frequent impulse noise. Cellular mode is more noise resistant, impairment resistant, and error resistant.

It is simple to use the cellular modes. 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 all others.

S49b7 is to tell the modem where the modem is installed. If S49b7=0, the modem is installed in an office connected to a normal telephone line; if S49b7=1, it means the modem is installed in a mobile 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 the 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 regular modem, the connection will automatically be a regular modem mode.

If a manual transmit power setting is desired, set S43b2=1 to disable auto transmit power adjustment and use S49 bit 0-3 to set transmit power at -9 to -24 dBm.

If cellular mode connection is never desired, setting S43b3=1 will disable the cellular mode connection. The default is enabled.

CELLULAR MODEM INSTALLATION

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

Assume using a cellular phone data interface adapter, the following figures illustrate three installation examples. Fig 13-1 is an example of a mobile phone that has a handset cradle and separate transceiver and handset. Fig. 13-2 is an example of a mobile phone that has a separate transceiver and handset. Fig. 13-3 is an example of a one-piece hand-held mobile phone.

Chapter Fourteen - FAX OPERATION

The U-1496 series universal modem supports the Group 3 send and receive facsimile function. You must connect the modem to a computer, usually a PC, in order to use this fax function. The computer is the input/output device for the fax function. The interface between the modem and the computer is the normal RS-232 serial connection. It uses the same interface for both data and fax applications. In fax operation, the modem does the function of protocol handshaking and image data transfer, and the computer does the job of image data creation, capturing, conversion, compression, decompression, retrieving, and storing.

On the disk a fax program for PCs is always included. The documentation for this program can be found in a file on the disk. Please refer to that documentation for the latest developments. Some distributors and dealers also include other software with the modem. Refer to the accompanying documentation - printed or on disk.

In the following sections, we will describe the CCITT T.30 fax protocol, the fax commands, status report result codes, flow control protocol, and fax applications. The instructions for using the accompanying modem/fax/voice utility program are contained in the document file in the software disk. Please refer to the updated document disk file for software usage instructions.

THE CCITT T.30 FAX PROTOCOL

The CCITT T.30 fax protocol describes the G3 fax handshake signals and procedures. The U-1496 series modem takes full control of this protocol, initiates and terminates fax calls, manages the communication session, and transports the image data. The modem shields the computer fax software from the T.30 protocol handling.

Along with T.30, the U-1496 series modem provides the highest fax speed up to 14400 bps using the new fax transmission standard V.17. When connecting to an existing non-V.17 fax device, the modem provides a highest speed of 9600 bps and will automatically fall back to 7200, 4800, and 2400 bps if the line quality is not good enough. When connecting to a higher speed and better performance V.17 machine, 14400 bps transmission speed can be achieved. It will fall back to 12000, 9600, or 7200 bps if the line quality is not good enough.

THE FAX COMMAND SETS

The U-1496 series universal modem supports two command sets for the fax function, the EIA PN 2388 Class 2 command set, and the Extended Fax AT command set. We will briefly describe the supported Class 2 commands here. Please refer to the EIA document for detailed explanation. All of the following sections are related to Extended FAX AT commands.

THE CLASS 2 COMMAND SET

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

Command Style

+<command>=<value> Execute a command or set a parameter
 +<command>? Read possible settings
 +<command>=? Read current setting

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

+FAA=n Auto answer mode parameter
 n=0 DCE to answer as set by +FCLASS
 n=1 DCE can answer and auto. determine calling type
 +FCLASS=n Service class selection
 n=0 Set to modem mode
 n=2 Set to Class 2 mode
 n=6 Set to ZFAX mode
 n=8 Set to Voice mode
 +FBOR=n Phase C data bit order
 n=0 Select direct bit order
 n=1 Select reversed bit order in receiving mode
 +FICG="string" Local fax station ID string, for polling Rx.
 +FCON DCE response, Fax connection made
 +FCR=n Capability to receive parameter
 n=0 DCE will not receive message data or poll a remote
 +FDCC=vr,br,wd,ln,df,ec,bf,st DCE capabilities parameters
 vr=0 Vertical resolution: Normal; 98 lpi
 vr=1 Vertical resolution: Fine; 196 lpi
 br=0 Bit rate: 2400 bit/s; V.27ter
 br=1 Bit rate: 4800 bit/s; V.27ter
 br=2 Bit rate: 7200 bit/s; V.29 or V.17
 br=3 Bit rate: 9600 bit/s; V.29 or V.17
 br=4 Bit rate: 12000 bit/s; V.17
 br=5 Bit rate: 14400 bit/s; V.17
 wd=0 Page Width: 1728 pixels in 215mm
 wd=1 Page Width: 2048 pixels in 255mm
 wd=2 Page Width: 2432 pixels in 303mm
 ln=0 Page length: A4; 297mm
 ln=1 Page length: B4; 364mm
 ln=2 Page length: unlimited length
 df=0 Data compression format: 1-D; modified Huffman
 df=1 Data compression format: 2-D; modified Read
 ec=0 Error correction disabled
 bf=0 Disable Binary file transfer
 st=0 Minimum scan time/line 0 ms
 st=1 Minimum scan time/line 5 ms
 st=2 10 ms (normal); 5 ms (fine)
 st=3 Minimum scan time/line 10ms
 st=4 20 ms (normal); 10ms (fine)
 st=5 Minimum scan time/line 20ms
 st=6 40 ms (normal); 20ms (fine)
 st=7 Minimum scan time/line 40ms
 +FDCCS=vr,br,wd,ln,df,ec,bf,st Current session parameter; refer to +FDCC command
 +FDIS=vr,br,wd,ln,df,ec,bf,st Current session negotiation parameter; refer to +FDCC
 command
 +FDR Receive phase C data command; initiates document reception
 +FDT=df,vr,wd,ln Transmit phase C data command; releases the DCE to proceed
 with negotiation

+FET=n		End the page or document command
	n=0	More pages; same document
	n=1	End of document; another document follows
	n=2	No more pages or documents
	n=4	Procedure interrupt: another page follows
	n=5	Procedure interrupt: end of document, another document follows
	n=6	Procedure interrupt: end of document
+FLID="string"		Local ID string parameter
+FLPL=n		Document for polling command
	n=0	Indicate that the DTE has no document for polling
	n=1	Indicate document available for polling
+FMDL?		Request DCE model
+FMFR?		Request DCE manufacturer
+FPTS=n		Page transfer status
	n=1	Received page good
	n=2	Page bad; retrain requested
	n=3	Page good; retrain requested
	n=4	Page bad; procedure interrupt requested
	n=5	Page good; procedure interrupt requested
+FNS="<string of Hex>"		Non-standard frame FIF octet string
+FREV?		Request DCE revision
+FSPL=n		Enable polling command
	n=0	Disable polling
	n=1	Enable polling

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

The Class 2 Command Responses

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

The 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 flow control (RTS/CTS) and software flow control (XON/XOFF) are enabled.

Extended FAX AT Commands

These commands are unique to the U-1496 series modems. The computer controls the modem through a set of extended fax AT commands and the modem responds with a set of status report result codes. During data state, compressed fax image data is flowing between the modem and computer. The default serial connection speed is 19200 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 modem mode and fax parameters. Besides the extended fax AT commands, the modem accepts all the other AT commands described in Chapter 8. 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 Setting

#F

Set the modem into 'V17G3 FAX' mode, same function as the extended AT command 'AT&N32'.

#B0

Set fax receiving mode. The connection parameters and received fax data are sent to DTE continuously following the connect message. (Default).

#B1

Set fax receiving mode. The connect messages are separated from the received fax data. The modem sends "CONNECT FAX" and "ZyXEL" first, then it waits for the DC2 character (hex18) to send the fax data. When the modem receives a DC2 from the DTE, it starts to send the fax connection parameters "/SnnnnVnTnRnLnCnP <string><CR><LF>" then the received fax data. In this mode, the modem will wait for DC2 at the beginning of every page. The DTE software should detect the page separator "RTC" then sends the DC2 to receive the next page of fax data. This mode is used with BBS receiving fax.

#B2

This mode is for the polling feature of the modem. In this mode, the modem will send a polling signal to the remote fax device to ask to receive a fax from the remote fax device. The received fax data will be sent to the DTE continuously following the connect message.

Parameter Setting

#V0 Set to normal vertical resolution.

#V1 Set to high vertical resolution.

#T0 Set to one dimensional coding scheme.

#T1 Set to two dimensional coding scheme.

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

STATUS REPORT RESULT CODES

When the 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).

Following are the possible result codes:

NO DIAL TONE

Try to dial but no dial tone is detected.

NO CARRIER

Handshake fail or no carrier detected or timeout.

BUSY

The other party's phone line is busy.

NO ANSWER

Expected quiet answer is not detected before timeout.

CONNECT FAX/SnnnnVnTnRnLnCnP <string>

This report informs DTE of the connecting status which includes the connection speed and the fax parameters after handshaking with the remote facsimile.

Snnnn Fax connection speed; nnnn is a 4-digit number representing the connection speed.
nnnn=1440, 1200, 9600, 7200, etc., where 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 (computer):

DISCONNECTnP <string> This result code informs DTE of the disconnecting status.

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

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

FLOW CONTROL

In extended FAX AT command mode, the modem always uses hardware (CTS/RTS) flow control. The following flow control signaling is used during sending a fax:

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 hangs up the phone. After hanging up, the modem sends a status report result code to the DTE.

If you want to send a multi-page fax, you need only 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 during receiving a fax:

CTS is not used when receiving fax.

RTS is used to inform the modem that the computer cannot accept data at this moment. The modem will not pass any received data to 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 RECEIVE 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. Following is the setup procedure.

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. Power on the DTE terminal and set S38 bit 4 of the modem to 1 by sending the command "ATS38.4=1" to the modem. This will disable the modem from receiving a fax.
4. Set the modem autoanswer ring number to be the same as your fax machine. For example, if you have set your fax machine to answer an incoming call after 2 rings, then you need to set the modem with the same ring number by sending the command "ATS0=2" to the modem.

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

RECEIVE FAX IN THE BBS SYSTEM

The ZyXEL modem has the unique feature of automatic detection of data and fax calls, and can make the BBS receive a fax 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 connect 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 connect message as:

((MODE-32))

Set external mail as:

((MODE-38))

The following is a sample setting in the "binkley.cfg" file for a Binkley system.

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

Chapter Fifteen - 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 the modem can playback the recorded digitized voice either off-line for local message listening or on-line for a message announcement. For interactive voice applications, DTMF tone detection capability is important so a computer can react according to the remote caller's touch tone input.

VOICE DATA COMPRESSION

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

The U-1496 series modems support three voice digitization schemes. Two schemes use the ADPCM algorithm and one uses the advanced CELP (Code Excited Linear Prediction) algorithm to achieve near-phone-quality voice at a 9.6 kbps speech data rate. A summary of these three schemes is listed below:

Digitization Scheme	Speech Compression Algorithm	Data Rate
CELP	Code Excited Linear Prediction	9600 bps
2-ADPCM	ADPCM, 2 bits/sample	19200 bps
3-ADPCM	ADPCM, 3 bits/sample	28800 bps

where the sampling rate used is 9600 samples per second.

The ADPCM voice modes are supported on all U-1496 series modems. However, the advanced CELP scheme is supported only on the plus models, including the U-1496 LCD model.

Silence detection is implemented to eliminate voice data coding in silent periods.

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 calls, fax, or data calls. A common method to do this detection and switch is the use of a human voice announcement as the first step in the answer process. The calling party is instructed to push one number in the push-button pad for fax calling and 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. The modem can decide 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 automatic detection of voice, fax, and data. New capabilities or enhancements will be released in future versions of its firmware.

VOICE AT COMMANDS

The U-1496 series modems support a set of voice AT commands. These commands are basically consistent with the TIA TR29.2 committee PN-2986 document. ZyXEL is continuously enhancing its modem's voice capability and voice command implementation. Please refer to the manual amendment or firmware release notes for updated details.

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

COMMAND SYNTAX

AT is used as the command line prefix. The voice command takes one of the following forms:

```
+V<CM>?          read current setting
+V<CM>=?         read permissible setting
+V<CM>=<single value> set single-value parameter
+V<CM>=<value string> set compound parameter
```

where <CM> represents a two-letter command syntax. A value string consists of values separated by a comma or semicolon. The first two command forms are for read actions, the last two are for write actions. A command may have both action types or be just read or write type only.

RESPONSE SYNTAX

For each command line received, the modem issues 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 final response is " OK " if all the commands in the command line have been successfully executed, otherwise it is "ERROR".

FLOW CONTROL

Software XON/XOFF flow control is used.

SUPPORTED COMMANDS FOR VOICE MODE OPERATION

AT+FCLASS=<mode>

This command selects a DCE mode as follows:

<mode> = 0 (Default), Data mode.

<mode> = 2, Fax mode.

<mode> = 8, Voice mode.

Result codes:

OK: The DCE issues this result code if DCE accepts this command.

ERROR: The DCE issues this result code if <mode> is not permitted.

AT+FCLASS?

DCE will return current mode setting, followed by the OK result code.

AT+FCLASS=?

DCE will return permitted modes. The response is:

0,2,8

OK

with <CR><LF> between each line.

ATA (with AT+FCLASS=8)

This command causes DCE to answer the phone. DCE will return the VCON result code immediately.

ATD (with AT+FCLASS=8)

This command causes the DCE to dial a phone number.

Result codes:

VCON: The DCE issues this result code when the DCE has determined that the remote station is off hook.

NO CARRIER: The DCE issues this result code when the DCE has continuously detected ringbacks for the amount of time specified in S7.

BUSY: The DCE issues this result code when the DCE detects a busy tone.

RINGING: The DCE issues this result code when the DCE detects a ringback signal.

ATH (with AT+FCLASS=8)

This command causes the DCE to hang up the phone with the following considerations for a hang up while in voice mode:

- Force the command AT+FCLASS=0, but do not destroy any of the voice parameters.
- Force voice I/O device to Telco line.

AT+VNH=<value>

This command causes the DCE to disable or enable automatic hang-ups to a varying degree in the DATA and FAX modes.

<value> = 0 (Default), the DCE shall not disable automatic hang-ups.

<Value> = 1, the DCE shall disable automatic hang-ups. This behavior shall persist until the DTE issues ATH, ATZ, or AT+VIP command, or DTR drop. The DCE shall perform on hook on an ATH command.

<Value> = 2, the DCE will disable automatic hang-ups. This behavior will persist until the DTE issues ATH, ATZ, or AT+VIP command, or DTR drop. The DCE shall not perform on hook on an ATH command.

AT+VNH?

DCE will return current hang up setting, followed by the OK result code.

AT+VNH=?

DCE will return permitted hang-up modes. The response is:

0,1,2
OK

with <CR><LF> between each line.

ATZ (with AT+FCLASS=8)

This command causes the DCE to enter DATA MODE (AT+FCLASS=0) and set all of the voice related parameters to their default values.

VOICE MODE COMMANDS

AT+VBT=<value>

This command causes the DCE to set the default DTMF/tone generation duration used in conjunction with AT+VTS command.

The range of the <value> is from 1 to 255. The units are 0.1 seconds.

Result codes:

OK: The DCE issues this result code if DCE accepts this command.
ERROR: The DCE issues this result code if <value> parameter is out of range.

AT+VBT?

DCE will return current beep duration setting, followed by the OK result code.

AT+VBT=?

DCE will return permitted values of beep duration. The response is:

1-255
OK

with <CR><LF> between each line.

AT+VIP

This command causes the DCE to initialize all the voice parameters to the default settings as follows:

Parameter:	Value: see also	
Compression method:	2-bit ADPCM	+VSM
Silence threshold:	16	+VSD
Activity Timer:	7 sec.	
Silence interval:	7 sec.	+VSD
Ringback goes away timer:	7 sec.	+VRA
Ringback never appeared timer:	5.7 sec.	+VRN
Default beep tone duration:	1 sec.	+VBT/+VTS

Result codes:

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

AT+VLS=<device>

This command causes the DCE to select a voice I/O device.

The permitted <device> is as follows:

0: disconnect all I/O devices
2: Telco line
8: External Mic. (Connect a microphone or telephone set to the dial-up line RJ11 jack.)
16: Internal speaker

Result codes:

OK: The DCE issues this result code if DCE accepts this command.
ERROR: The DCE issues this result code if <device> is not permitted.

AT+VLS?

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

AT+VLS=?

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

0,2,8,16
OK

with <CR><LF> between each line.

AT+VRA=<value>

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 the <value> is from 0 to 255. The units are 0.1 second. A value of zero forces the DCE to return VCON immediately after the ATD command is received.

Result codes:

OK: The DCE issues this result code if DCE accepts this command.
ERROR: The DCE issues this result code if <value> is out of range.

AT+VRA?

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

AT+VRA=?

DCE will return permitted interval of Ringback Goes Away Timer.

The response is:

0-255
OK

with <CR><LF> between each line.

AT+VRN=<value>

This command sets the amount of time the DCE will wait looking for ringback. If the DCE does not detect a ringback in this time period, the DCE shall assume that the remote station has gone off hook.

The range of the <value> is from 0 to 255. The units are 0.1 second. A value of zero forces the DCE to return VCON immediately after the ATD command is received.

Result codes:

OK: The DCE issues this result code if DCE accepts this command.
ERROR: The DCE issues this result code if <value> is out of range.

AT+VRN?

DCE will return current Ringback Never Appeared Timer, followed by the OK result code.

AT+VRN=?

DCE will return permitted interval of Ringback Never Appeared Timer.

The response is:

0-255
OK

with <CR><LF> between each line.

AT+VRX

This command causes the DCE to start the voice reception process.

The DCE begins the voice receive mode by returning the CONNECT result code to the DTE. After this report, the DCE sends <DLE> shielded voice data to the DTE.

The DTE can abort the voice receive state by sending a character other than <XON> and <XOFF>. On termination of the voice receive state, the DCE will append a <DLE><ETX> character pair, followed by the VCON result code.

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 either with the QUIET or SILENCE <DLE> shielded code.

See the description of the <DLE> shielded code for the difference between the SILENCE and QUIET report.

The range of the sensitivity <sds> is from 0 to 31. The higher the value, the higher the sensitivity threshold level. The magnitude difference in sensitivity level has a unit of dB. <sds> = 0 means silence detection is disabled or not supported. The range of the interval <sdi> is from 0 to 255 in units of 0.1 second.

Result codes:

OK: The DCE issues this result code if DCE accepts this command.
ERROR: The DCE issues this result code if the <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

with <CR><LF> between each line.

AT+VSD=?

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

(0-31),(0-255)
OK

with <CR><LF> between each line.

AT+VSM=<cml>

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

<cml> = 1, 9.6 Kbps CELP (Code Excited Linear Prediction)
<cml> = 2 (Default), 19.2 Kbps 2-bit ADPCM
<cml> = 3, 28.8 Kbps 3-bit ADPCM

Note: Only PLUS models support CELP mode.

AT+VSM?

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

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

with <CR><LF> between each line. Where

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

AT+VSM=?

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

1;CELP;1;0;(9600)
2;ADPCM;2;0;(9600)
3;ADPCM;3;0;(9600)
OK

with <CR><LF> between each line.

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

AT+VTS=<string>

This command causes the DCE to produce DTMF and other tones.

The tone generation string shall consist of elements in a list with each element separated by commas. Each element can be:

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

2) Three numbers separated by commas and enclosed in square brackets. The DCE shall interpret the first and the second number as the frequencies of the dual tone, and the third one as the duration of the tone.

The frequency range is from 200 Hz to 3300 Hz, a frequency of zero means silence. The range of the duration is from 0 to 255 in units of 0.1 second.

3) A single ASCII character and a number, separated by commas and enclosed in curly braces. The DCE should interpret the ASCII character as a DTMF digit, and the number as the duration of the tone.

AT+VTS=?

This command causes the DCE to report the allowable tone string elements. The response is as follows:

```
(0,200-3300),(0,200-3300),0-9,A-D,*,#  
OK
```

with <CR><LF> between each line.

AT+VTX

This command causes the DCE to start the voice transmission process.

The DCE begins the voice transmit 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 can abort the voice transmit state by sending a <DLE><ETX> character pair to the DCE. On termination of the voice transmit state, the DCE will send the VCON result code.

<DLE> SHIELDED CODES

In voice transmit/receive mode, BYSYNC protocol should be applied to the data stream to/from DCE. During this period, commands and responses will be in <DLE> shielded form. The supported <DLE> shielded codes are as follows (all <DLE> shield codes are case sensitive):

Commands:

<DLE><ETX>: terminate transmission process.

Responses:

<DLE>0: DTMF '0' received

<DLE>1: DTMF '1' received
<DLE>2: DTMF '2' received
<DLE>3: DTMF '3' received
<DLE>4: DTMF '4' received
<DLE>5: DTMF '5' received
<DLE>6: DTMF '6' received
<DLE>7: DTMF '7' received
<DLE>8: DTMF '8' received
<DLE>9: DTMF '9' received
<DLE>#: DTMF '#' received
<DLE>*: DTMF '*' received
<DLE>c: T.30 fax calling tone received
<DLE>b: Busy tone received
<DLE>q: Quiet detected. The DCE has determined that there was voice energy present at the beginning of the voice recording session followed by a period of silence greater than the amount of time selected by the AT+VSD command.
<DLE>s: Silence detected. The DCE has determined that there was no voice energy present at the beginning of the voice recording session followed by a period of silence greater than the amount of time selected by AT+VSD command.

DTMF DETECTION

DTMF detection is reported by the above <DLE> shielded code. When the detection is enabled, it is controlled by the setting of S39b6.

S39b6

= 0; DTMF detection is enabled only in PLAY and RECORD mode.

= 1; DTMF detection is enabled as soon as the AT+VLS=2 command is sent.

Note: AT auto DTE speed detection is disabled when DTMF detection is enabled.

VOICE DATA FORMAT

The voice data file format is described in the ZFAX document on the software diskette. 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 ADPCM voice data at 50ms intervals. The ADPCM coder is reset with every resync symbol, thus ADPCM voice data will not depend on too long a 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). Resync generation is controlled by the setting of S39b7.

S39b7

= 0; No resync generation.

= 1; ADPCM voice data includes resync generation.

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

EXAMPLES OF VOICE MODE OPERATION

1. Greeting message recording (Connect a microphone or telephone set to dial-up line RJ11C jack).

DTE		DCE	comments
-----		-----	-----
AT+FCLASS=8	--->		Switch to voice mode
	<---	OK	
AT+VSM=?	--->		
		1;CELP;1;0;(9600)	
		2;ADPCM;2;0;(9600)	
		3;ADPCM;3;0;(9600)	
	<---	OK	
AT+VSM=1	--->		Select CELP compression method
	<---	OK	
AT+VLS=8	--->		Activate external microphone or telephone set on LINE Jack
	<---	VCON	
AT+VRX	--->		Start to record
	<---	CONNECT	
	<---	<DATA>	
AT	--->		Stop recording
	<---	<DATA>	
	<---	<DLE><ETX>	
	<---	VCON	Return to command state
AT+VLS=0	--->		Deactivate external microphone or telephone set on LINE Jack
	<---	OK	
AT+FCLASS=0	--->		Return to data mode
	<---	OK	

2. Voice file playing via internal speaker.

DTE		DCE	comments
-----		-----	-----
AT+FCLASS=8	--->		Switch to voice mode
	<---	OK	
AT+VSM=?	--->		
		1;CELP;1;0;(9600)	
		2;ADPCM;2;0;(9600)	
		3;ADPCM;3;0;(9600)	
	<---	OK	
AT+VSM=1	--->		Select CELP compression method
	<---	OK	
AT+VLS=16	--->		Activate internal speaker
	<---	VCON	

AT+VTX	--->		Start to play
	<---	CONNECT	
<DATA>	--->		
<DLE><ETX>	--->		
	<---	VCON	Return to command state
AT+VLS=0	--->		Deactivate internal speaker
	<---	OK	
AT+FCLASS=0	--->		Return to data mode
	<---	OK	

3. Voice file playing via line.

DTE		DCE	comments
-----		-----	-----
AT+FCLASS=8	--->		Switch to voice mode
	<---	OK	
AT+VSM=?	--->		
		1;CELP;1;0;(9600)	
		2;ADPCM;2;0;(9600)	
		3;ADPCM;3;0;(9600)	
	<---	OK	
AT+VSM=1	--->		Select CELP compression method
	<---	OK	
AT+VLS=2	--->		Connect to line
	<---	VCON	
AT+VTX	--->		Start to play
	<---	CONNECT	
<DATA>	--->		
<DLE><ETX>	--->		
	<---	VCON	Return to command state
AT+VLS=0	--->		Deactivate line connection
	<---	OK	
AT+FCLASS=0	--->		Return to data mode
	<---	OK	

4. Answering machine (Voice call).

DTE		DCE	comments
-----		-----	-----
AT+FCLASS=8	--->		Switch to voice mode
	<---		OK
AT+VSM=?	--->		

```

1;CELP;1;0;(9600)
2;ADPCM;2;0;(9600)
3;ADPCM;3;0;(9600)
<---OK

AT+VSM=1    --->          Select CELP compression method
            <---  OK

AT+VLS=2    --->          Connect to line
            <---  VCON

AT+VTX      --->          Start to play greeting message
            <---  CONNECT

<DATA>      --->
<DLE><ETX>  --->
            <---  VCON          return to command state

AT+VRX      --->  Start to record
            <---  CONNECT
            <---  <DATA>
            <---  <DLE>b      DCE detects busy tone
                        or
            <---  <DLE>q      or
                                long period of quiet

AT          --->          Stop recording
            <---  <DATA>      DCE deliver remaining data
            <---  <DLE><ETX>
            <---  VCON          Return to command state

AT+VLS=0    --->          Deactivate line connection
            <---  OK

AT+FCLASS=0 --->          Return to data mode
            <---  OK

```

5. Answering machine (Fax call).

DTE	DCE	comments
-----	-----	-----
AT+FCLASS=8	---> <--- OK	Switch to voice mode
AT+VSM=?	---> 1;CELP;1;0;(9600) 2;ADPCM;2;0;(9600) 3;ADPCM;3;0;(9600) <--- OK	
AT+VSM=1	---> <--- OK	Select CELP compression method
AT+VLS=2	---> <--- VCON	Connect to line

AT+VTX	--->		Start to play greeting message
	<--->	CONNECT	
<DATA>	--->		
	<--->	<DLE>c	T.30 fax calling tone detected
		or	or
		<DLE>5	DTMF digit '5' detected
<DATA>	--->		
<DLE><ETX>	--->		
	<--->	VCON	Return to command state
AT+FCLASS=2	--->	Try to handshake Fax mode	
	<--->	OK	
ATA	--->		Switch to fax mode and answer fax call ...

6. Answering machine (Data call).

DTE		DCE	comments
-----		-----	-----
AT+FCLASS=8	--->		Switch to voice mode
	<--->	OK	
AT+VSM=?	--->		
		1;CELP;1;0;(9600)	
		2;ADPCM;2;0;(9600)	
		3;ADPCM;3;0;(9600)	
	<--->	OK	
AT+VSM=1	--->		Select CELP compression method
	<--->	OK	
AT+VLS=2	--->		Connect to line
	<--->	VCON	
AT+VTX	--->		Start to play greeting message
	<--->	CONNECT	
<DATA>	--->		
<DLE><ETX>	--->		
	<--->	VCON	Return to command state
AT+VRX	--->		Start to record
	<--->	CONNECT	
	<--->	<DATA>	
	<--->	<DLE>s	DCE detects silence
AT	--->		Stop recording
	<--->	<DATA>	DCE deliver remaining data
	<--->	<DLE><ETX>	
	<--->	VCON	return to command state (DTE delete this
silence file)			
AT+FCLASS=0	--->		

<--- OK

ATA --->
mode and answer data call...

Try to handshake data mode. Switch to data

CONNECT A PHONE HANDSET TO THE MODEM'S RJ11C LINE JACK

If you have a telephone with a handset that has a cable with an RJ11C connector plugged into the phone set base unit, you can unplug the handset and plug it into the modem LINE Jack and then use the handset as both a microphone and a speaker.

The two central wires in the LINE Jack are the signal wires to be connected to the phone company. If you connect the handset to this LINE Jack, normally the earphone in the handset will be connected to the modem's two-wire line terminals. You can hear the voice when the modem is in playback mode and you can speak to the earphone (remember "earphone") while recording. In recording mode, the earphone is used as a microphone.

CAUTION: Never plug the handset into the modem's PHONE Jack because it will be connected to the phone line when modem is on-hook and it will be damaged by the phone line's DC voltage and current.

CONNECT A TELEPHONE SET TO THE MODEM'S RJ11C LINE JACK

A normal telephone set cannot be connected to the modem's LINE jack and 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 PABX.

A specially designed "Switch Box" can be used to interface the telephone set to the modem. On one side of the Switch Box it connects to the phone line and telephone set; on the other side it connects to the modem's LINE and PHONE jacks. In normal conditions, the modem's LINE and PHONE jacks connect to the phone line and telephone set through this Switch Box. When the switch on the Switch Box is pressed down, the telephone set is connected to the modem's LINE jack and the Switch Box provides a DC voltage to it. The other connections are cut off. The telephone set can then be used as a recording input or a playback output for the modem's voice function. If a facsimile is connected to the PHONE SET terminal of the Switch Box, it can be used as a scanner or printer for the computer connected to the modem.

Chapter Sixteen - NETWORK MANAGEMENT CAPABILITY

When there are many modems installed at different places forming a modem network, it is desirable to monitor and control all 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 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 detailed description, please refer to the rack's user manual and the NMS software ZyView'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 the modem cards in the rack and interfaces to central NMS control station. A simple twisted pair wiring can be used to link all 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 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 pass 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 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 links between 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 using a secondary channel. Two sites with many racks each can link their NMS in this way.

NMS CAPABLE MODELS

All ZyXEL rack models are NMS capable but only the model with a "N" suffix (i.e., U-1496RN) 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 U-1496SN is the U-1496 with a secondary channel. It can be put on the end node of a hierarchical modem network and is remote controllable.

Chapter Seventeen - DIAGNOSTICS

The U-1496 series modems provide several diagnostic capabilities:

- Power-Up 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
- Eye Pattern Display
- Re-transmission Indicator
- Throughput Display
- Link Status Report
- Modem Reset

All these capabilities can apply to 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

Each time the modem is powered-up or receives the reset command from panel, the modem will test the ROM code checksum, system RAM memory, DSP code checksum, DSP RAM memory, EEPROM, digital circuits, and analog circuit calibrations.

On the U-1496 panel, the LCD will display the results of the power-on self-test:

- (0) 'SYSTEM TESTING....' Self-test start indicator, if no error occurs, this message will continue up to the end of the test.
- (1) 'ROM TEST FAIL....' ROM code checksum error.
- (2) 'RAM TEST FAIL....' System RAM fail.
- (3) 'XROM CHKSUM ERROR....' EEPROM checksum error, program will download the factory default settings to EEPROM and re-initialize the self-test. This is not a real error.
- (4) 'DSP A RAM FAIL....' The testing of DSP A RAM fails.
- (5) 'DSP B RAM FAIL....' The testing of DSP B RAM fails.
- (6) 'V0 CALIBRATION FAIL....' Analog circuit calibration error.
- (7) 'VR CALIBRATION FAIL....' Analog circuit calibration error.
- (8) 'FR CALIBRATION FAIL....' Analog circuit calibration error.
- (9) 'DSP A COMM FAIL....' Communications between controller and DSP A fail.
- (10) 'DSP B COMM FAIL....' Communications between controller and DSP B fail.

The reset command from the panel will restart the power-on self-test. If an error message is displayed on the LCD screen, turn off the modem, wait for more than 10 seconds, turn the power on again. If the modem continues to display an error message, 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 U-1496E has only LED indicators. The TST LED will be ON during power-on self-test, and OFF after the test if the test is OK. The SQ LED will flash if the test fails. The number of flashes indicates the error number corresponding to the above error message.

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

ANALOG LOOPBACK TEST (AT&T1)

This test can check almost every part of the modem and 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 whatever data you have sent to the modem. Also, the Control Level field of the LCD screen will be indicated as `ALB'. The U-1496E will have the TST LED ON during the test. This test can only be initiated when the modem is off-line.

((MODE-23))

ANALOG LOOPBACK WITH SELF-TEST (AT&T8)

This test generates data from the modem itself instead of input data from an RS-232 cable. The data will go through the same path as the Analog Loopback Test does. In asynchronous mode, the pattern is printable ASCII characters. You can see the result on the screen. In synchronous mode, the pattern is 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 U-1496E TST LED flashes for any bit error. The Control Level field of the U-1496 LCD screen will be indicated as 'ALBST', which stands for ALB with self-test.

This test can only be initiated when 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.

((MODE-24))

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 be indicated as 'LDL'. The U-1496E TST LED indicator will be ON.

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

((MODE-25))

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 received data back, and the local terminal or computer will receive all 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 for the initiating modem will be indicated as 'RLB', and for accepting modem will be indicated as 'LDL'. The U-1496E will have the TST LED indicator ON during the test.

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

((MODE-26))

REMOTE DIGITAL LOOPBACK WITH SELF-TEST (AT&T7)

This test generates data from the modem itself instead of input data from the RS-232 cable. The data will go through the same path as the Remote Digital Loopback Test does. In asynchronous mode, the pattern is printable ASCII characters. You can see the result on the screen. In synchronous mode, the pattern is 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 U-1496E, the TST LED flashes for any bit error. 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 for initiated modem will be indicated as 'RLBST', and for accepted modem will be indicated as 'LDL'.

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

((MODE-27))

LINE CONDITION STATUS DISPLAY

The LCD screen display of this section only applies to the U-1496 and U-1496R models.

Regarding data being transmitted on telephone line circuits, there are a lot of factors that can affect the data in transit. The U-1496 can measure four major line impairments. From the impairment readings, you can understand the current line condition. The U-1496 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:

Note: The readings displayed are just for reference and not to be taken for measurements.

((MODE-28))

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. 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 modems only use part of the 3KHz bandwidth and rejects more than half of the voice band noise.

Receiving 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 and with relative accuracy. The receiver sensitivity specification for the U-1496 is -43 dBm. Strong signal power could cause signal saturation in the channel and degrade the data validity. To avoid this situation, decrease the transmitting power of the remote modem. For increased line operability, the U-1496's transmitting 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 ON-LINE SCREEN 3 there are four counters for recording the action or reaction the modem takes when a line condition is changed.

((MODE-29))

Retrain Granted (RG)

The count of remote modem's retrain request. Each request is a bad receiving indication.

Retrain Requested (RT)

The count of U-1496's request for remote modem to retrain when 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 down modem's actions and reactions.

((draw new))

FRN (Fast Rate re-Negotiation) Granted (FG)

The count 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 U-1496's requests to change rate.

Block Retransmitted (BR)

The count of blocks retransmitted (Bad receiving on the remote modem).

FCS (Frame Check Sum) Errors (FE)

The count of FCS errors received (block errors) (Bad receiving on local modem).

LINK STATUS REPORT (AT12)

During a connection, the modem will record information about link operations. You can use an AT command (AT12) to see the summary, as in the following sample:

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	110
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 terminology used in this report.

Chars

Data characters transmitted between DTE (computer/terminal) and 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 DTE to modem for transmission.

Chars Received

Characters received by modem from line and sent to DTE.

Octets Sent

Data bytes sent to remote modem.

Octets Received

Data bytes received from remote modem.

Blocks Sent

Blocks sent to remote modem.

Blocks Received

Blocks received from remote modem.

Blocks Resent

Number of blocks resent because of error. If there are too many resents, 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.

Retrans Requested

Number of times the local modem has requested retrain. Each request is a bad receiving indication.

Retrans Granted

Number of times retrans requested by remote modem were granted.

Link Duration

Connection time in minutes.

T401 Timeouts and T402 Timeouts

They are for manufacturer checking link layer operation. T401 and T402 are timers used in MNP4 or V.42. T402 will count when modem is idle connected with no data to transmit or receive.

FCS Errors

Frame Check Sum Errors or number of block errors. Many FCS errors mean a bad line.

Round Trip Delay

Round trip delay between modems in T (1/2400 sec) units. Normally should be in the range of 100-200. A satellite link will introduce a delay of about 1300 T.

Xmitter Underrun

Number of times modem fails to provide data octet in time for transmission.

Receiver Overrun

Number of times 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 of 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 PC serial port setting, particularly the flow control setting, or even the configuration of the remote side.

RE-TRANSMISSION INDICATOR

In error control mode, an error occurring on the link will cause the data to be re-transmitted. At the same time, the AA LED will flash. This is another way to know the quality of the line. On the U-1496E, the EC LED will flash to indicate retransmission.

DIALING INDICATOR

On the U-1496E, the HS LED will flash 1 second on and 1 second off to indicate that the modem is dialing.

HANDSHAKING AND RETRAIN INDICATOR

On the U-1496E, the HS LED will flash 1/2 second on and 1/2 second off to indicate that modem is in handshaking or retrain.

EYE PATTERN GENERATOR

The Eye Pattern Generator (EPG) is a diagnostic tool used with an oscilloscope to evaluate the telephone line or modem receiver performance. The EPG converts the signal received over the telephone line to voltage signals that the oscilloscope displays as an 'eye' pattern or 'constellation' pattern.

Note: EPG is available only on U-1496 upon special request. Commercial model U-1496 product does not include EPG.

You can diagnose telephone line problems by noting if the eye pattern on your oscilloscope is distorted. The quality of the line depends on the area (country), weather, the route of each call, and equipment, etc.. If the modem cannot resist the distortion, it will retrain or fall back to a lower rate if the modem is configured this way.

To see the eye pattern, connect one oscilloscope probe to the X-pin and one probe to the Y-pin on the rear panel of the modem. Connect the ground of each probe to the G-pin. Put the oscilloscope in XY mode. The modem speed standard determines the number of points in the eye pattern.

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 U-1496E and U-1496B, this procedure also makes the modem run a self test. It is a good way to test the modem hardware.

On the U-1496, holding the ENTER key down for a few seconds while powering up will reset the modem.

On the U-1496E, holding the VOICE/DATA key down for a few seconds 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 RS232 port. The HS, CD, DSR, CTS, RXD, EC, SQ, and TST LEDs should be ON. If not, there is a hardware problem. Contact the nearest service center for help. If SQ flashes, the number of flashes indicates the error number corresponding to the error message listed at the beginning of this chapter.

On the U-1496B, short the TS2 jumper with a plug then power up the computer. The modem will be reset and will continuously 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 this chapter.

FIRMWARE UPDATE

Most of the U-1496 series modems' functions and features are controlled by the system firmware contained in two EPROMs. These two EPROMs are labeled in the PCB (Printed Circuit Board) as U24 and U25. You can update/upgrade your modem with new functions and features just by changing the EPROMs.

ZyXEL has a policy of free distribution of new firmware (but not EPROMs) when it becomes available. New firmware is distributed in two binary files. Dealers/users can download them and program EPROMs of their own using an EPROM programmer. Each U-1496 series model has a set of different firmware code. The firmware is not exchangeable between different models.

Firmware files are named with version number, model suffix character, and chip label extension. An example is

```
RM610EP.U24
| | | |
| | | +- socket number
| | |+- type (<none> - Plus - Network)
| | +---- model (B - E - R - S)
| +----- revision
+----- EPROM type (K (512K), M (1M), T (2M))
```

This file name codes for software revision 6.10 for the U-1496E Plus model and for EPROM U24. This firmware is used on 1Mbit EPROM. If a letter T is used instead of M, it means it is used on 2M EPROM. Some new features, such as cellular modes on Plus models, need 2M EPROM. The other suffix character meanings are:

S for U-1496 (stand alone),
B for U-1496B,
R for U-1496R.

Each firmware release is a set of two firmware files with extension U24 and U25.

For U-1496 and U-1496E models, you need to open the case in order to change the EPROM. Following are the case opening procedures:

U-1496:

Remove the rear two rubber pads, unscrew the two screws under the pads, and the case can be opened.

U-1496E:

Press on the side of the upper case and use fingernail or screw driver to bend the locking flap a little to open. Do the same to each locking flap.

Special models with metal case (e.g., U-1496EG+):

Bend the tabs on the front and back panel outward to remove the panels. Unscrew the five screws at the bottom of the case. Pull out the PCB.

Use a small screw driver to lever the EPROM chip out of its socket. Lever up each end a little to avoid bending the IC pins. When you put the new firmware EPROM in, make sure the IC orientation is right. Inserting the EPROM IC in reverse orientation will damage the IC.

ZyXEL is constantly doing firmware enhancements to its modem. The enhancements include new features, performance improvements, bug fixes, and/or higher speeds. ZyXEL will provide free distribution of the new firmware but ZyXEL does not guarantee what the new firmware will

be. ZyXEL only guarantees features listed in the original product description.

New releases of the firmware are released as EPROM files through bulletin board systems and networks.