Comet 3356

User's Manual

Version 1.0

ZyXEL

ACCESSING THE INTERNET AND INTRANET

Limited Warranty

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

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

Acknowledgments

FCC Part 15 Information

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

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

This equipment has been tested and found to comply with the limits for a CLASS B digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio/television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Shielded RS-232 cables are required to be used to ensure compliance with FCC Part 15, and it is the responsibility of the user to provide and use shielded RS-232 cables.

FCC Requirements

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

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

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

If your equipment causes harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance. But if advance notice isn't practical, you will be notified as soon as possible. You will be informed of your right to file a complaint with the FCC.

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

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

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

The user is not authorized to repair or modify the equipment.

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

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

The modem is connected to a public switched line using a USOC (Universal Service Order Code) RJ-11C modular jack.

Contacting ZyXEL

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

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

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

- **Fax**: ZyXEL in North America: (714) 693-8811 or Taiwan: +886-3-5782439.
- **E-mail**:
  - **Sales inquiries**: sales@zyxel.com in North America. sales@zyxel.hinet.net outside North America.
  - **Technical support**: support@zyxel.com in North America. support@zyxel.hinet.net outside North America.
- **Product information**: Visit our site on the World Wide Web: http://www.zyxel.com.
- **FTP**: Information , such as ZyXEL software and ROM updates for North America can be found at this FTP address: ftp.zyxel.com

  For European versions and related files, use the address: ftp.zyxel.co.at
- **Postal Service**: You can send written communications at the following address:

  ZyXEL Communications Corporation

  6, Innovation Road II, Science-Based Industrial Park

  Hsinchu, Taiwan 300, ROC

  or

  ZyXEL Communications Inc.

  4920 E. La Palma Avenue

  Anaheim, CA92807, USA

Table of Contents

1 Introduction

Congratulations on the purchase of your Comet 3356 modem - one of ZyXEL's premier high-performance products. The Comet is world renown for its ability to maintain ultra high speeds and clear, quality connections while communicating around the globe.

Unpacking Your Modem

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

- One (1) Comet 3356 modem
- One (1) AC power adapter (external model)
- One (1) RJ-11 modular telephone cable
- One (1) Comet 3356 User's Manual
- One (1) ZyXEL modem driver diskette with Windows 95 INF file and Comet 3356 User's Manual
- One (1) Data/Fax software for Windows environments
- One (1) warranty/registration card
- One (1) ZyCD
- One (1) standard RS-232 cable

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

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

Becoming a Registered Owner

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

2 Installation

This chapter covers the steps required to install your modem and install and configure the Windows 95 driver.

1. Turn off your computer.
2. Open the rear panel on the back of your modem.
3. Connect the power adapter. Plug one end of the power adapter to the round POWER JACK on the back of the modem. Plug the other end to an AC wall outlet. You can leave the power adapter plugged in when you are not using the modem. To prevent power surges from damaging your modem and computer, it is recommended that you connect the power adapter to a surge protector.
4. Connect the serial cable. Plug one end of the serial cable into the SERIAL PORT connector on the back of the modem. Plug the other end of the serial cable to the back of your computer. Your Comet comes with a high-speed serial interface capable of reaching DTE speeds of 115.2Kbps. Be sure that your PC serial port has a high-speed 16550 compatible Universal Asynchronous Receiver Transmitter (UART).
5. Connect the telephone cord. Plug one end of the supplied telephone (RJ-11) cord into the LINE jack on the back of the modem. Plug the other end into a telephone wall jack, just as you would a standard telephone.
6. Turn the Comet on by raising the blue power switch. The PWR LED should come on and the modem performs a self-test procedure.
7. Turn the computer back on.

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

Note: Many older computers use a slow 16450 UART. This UART was not designed for high-speed communications and will significantly impede the performance of the Comet. To check whether your computer has a 16550 compatible UART, use a utility such as Microsoft Diagnostics (MSD) to verify the type of UART installed in your computer. If your computer has a 16450 UART, either replace it with a 16550 UART or add a serial card with a 16550 UART to your system.

Optional Steps for Comet Installation

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

Telephone Jack

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

Microphone

To connect an external microphone, connect it to the modem's MIC jack on the back of the modem.

Speaker

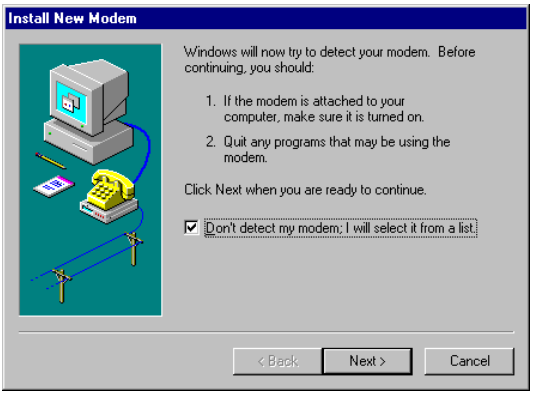
To connect an external speaker, connect it to the modem's SPK jack found on the back of the modem. To connect two speakers, obtain a dual-plug adapter that allows the modem speaker jack to drive both speakers. This adapter can be found at most electronics stores.

Driver and Software Installation

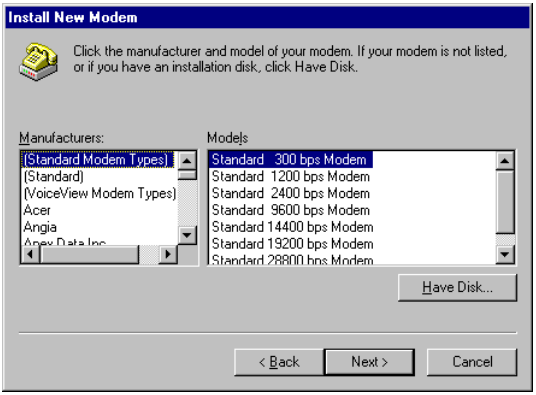
This section contains step by step procedures for installing the Windows 95 and NT drivers, and configuring Dial-up Networking for the Comet.

Windows 95 Driver Installation

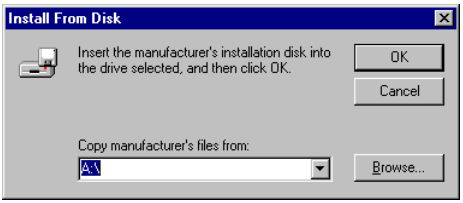
1. From the Windows 95 desk top click the **Start** button, then choose **Settings**, then click **Control Panel**.
2. Double click on the **Modem** icon.
3. From the Modem Properties dialogue box click the **Add** button.



4. Select **Don't connect my modem; I will select it from a list.** Then click **Next**.

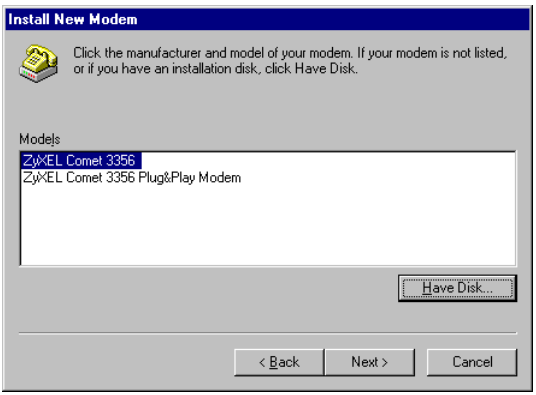


5. Click the **Have Disk** button.

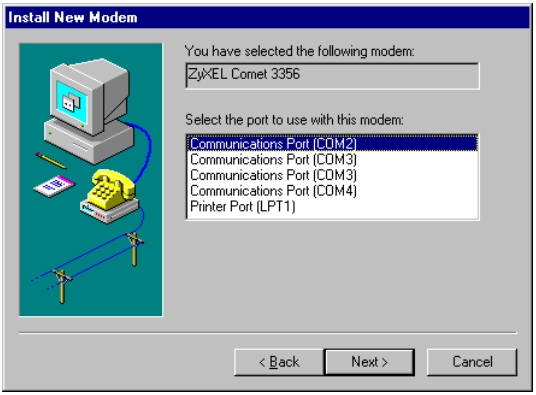


6. Insert the ZyXEL Windows 95 driver disk into your floppy drive and click **OK**.

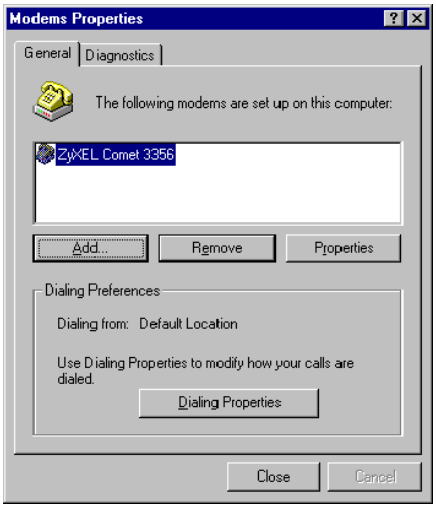
   If you have downloaded an updated INF file from ZyXEL's FTP, Website, or BBS, click the **Browse** button to find the location of the updated .INF file, then click **Open**, Then click **OK**.



7. Select **ZyXEL Comet 3356** from the list. Then click **Next**.



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



9. Click **Close**.

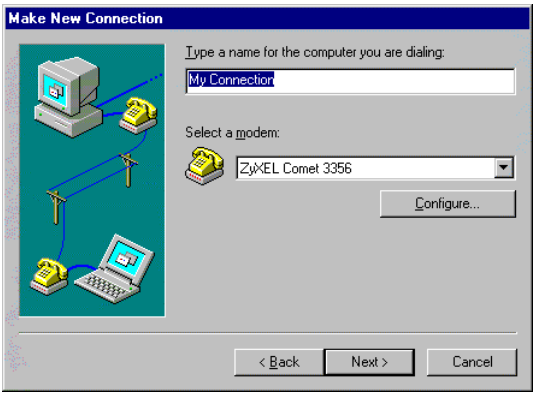
This completes the installation of your Comet modem driver. You may now use programs such as Dial-Up Networking with your ZyXEL modem.

Windows 95 Dial-up Networking

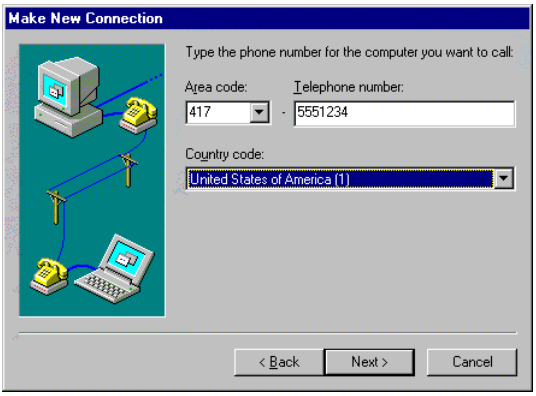
If you have not installed the Dial-Up Networking feature in Windows 95, please install it before you continue.

1. From the Windows 95 desk top click the **Start** button, then click **Programs**, **Accessories**, and **Dial-up Networking**.

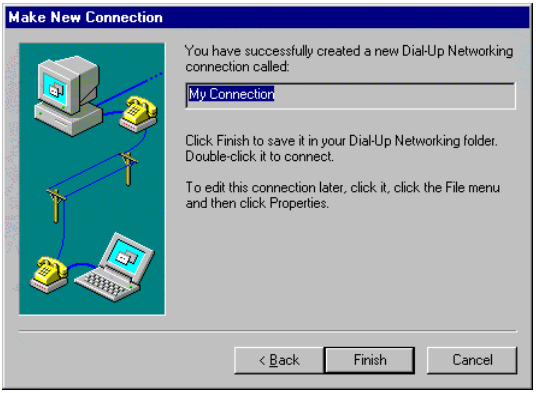
2. From the Welcome to Dial-Up Networking dialogue box click **Next**.



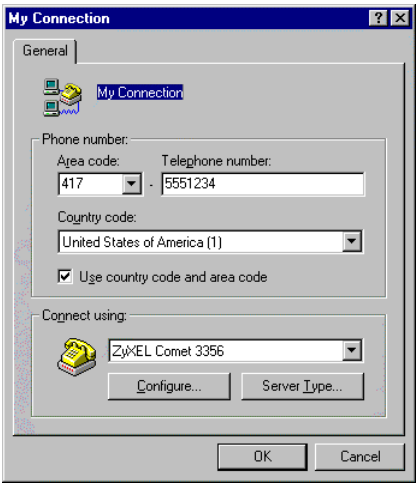
3. Choose a name for your connection and select your modem type from the drop down window. Then click on the **Next** button.



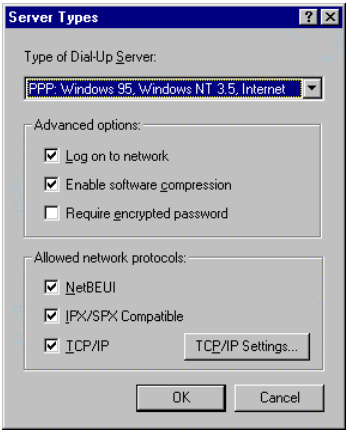
4. Enter the phone number to your ISP or whatever host you are calling. Then click the **Next** button.



5. Click on the **Finish** button. A new icon is created in the Dial-up Networking folder.
6. Right click on the new icon. Then select **Properties** from the menu.



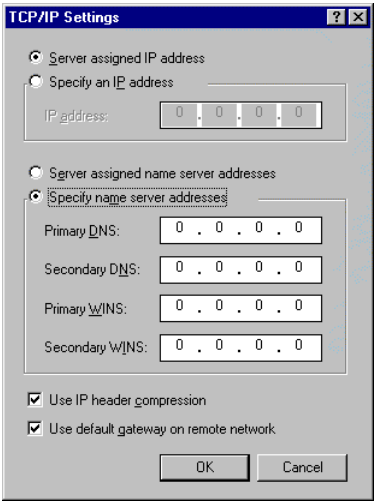
7. Make sure your Comet modem appears in the Connect Using field. Then click on the **Server Type** Tab.



These options are mostly host or server specific.

- If you are using PPP, use the default settings shown above.
- If you are logging on to an Internet connection, then select **TCP/IP**.
- If you are connecting to a LAN, then select **Log on to network**.
- If you are logging on to a Microsoft Windows network, select **NetBEUI**.
- If you are logging on to a Novell network, then select **IPX/SPX** Compatible.

Once complete click on TCP/IP Settings.



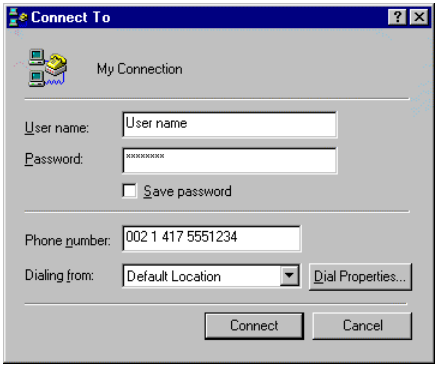
If your host requires you to specify an IP address (Static IP), then click on the **Specify and IP address** option button and enter your IP address. If your host

assigns an IP when you log in (Dynamic IP), then leave the **Server assigned IP address** option button checked. Most servers assign an IP to you when you log in.

8. Click the **Specify name server addresses** option button and enter your primary and secondary DNS (Domain Name Server) IP.

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

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



If the User name and Password are incorrect or missing, type them in. Click on the Connect button and your Comet will dial the number and establish a connection to your Internet Service Provider.

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

Setup for DOS Fax/Modem Software

After installing the Comet, use the following procedures to verify your modem connections.

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

2. Select the following communication settings:

Setting	Value
Baud rate	115,200bps
Data bits	8
Parity	None
Stop bits	1
Flow control	Hardware
Initialization string	AT&F
Port	COM*n**

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

4. Place your communications software in terminal or direct connect mode (your communications software manual will explain how).
5. Look at the modem's front panel and verify the TR LED is ON. If this LED is OFF, your communications software is not addressing your modem at the correct COM port. Make sure your software is set up for the same COM port to which your modem is connected.
6. Type AT and press the Enter key. You should see the AT characters you typed, followed by an OK result code. If you do not see an OK result code, turn the modem off and on, then repeat this step.
7. Type ATDT number and press Enter, where number is your modem's telephone number. You should see a BUSY result code. If you do not see a BUSY result code contact ZyXEL technical support.

3 Basic Modem Operation

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

Understanding AT Commands

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

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

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

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

Using the Windows 95 Hyper Terminal Program

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

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

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

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

The next window sets the COM port settings. The settings used for The Comet should be as follows:

Bits per second:	115200

Data bits:	8
Parity:	None
Stop bits:	1
Flow Control:	Hardware

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

You are now ready to start entering AT commands.

In the terminal window, type:

```
AT<Enter>
```

Comet responds

```
OK
```

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

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

Type:

```
ATA<Enter>
```

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

Dialing and Answering Techniques

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

Dialing using the ATD Command

Touch Tone Dialing:	ATD**T** 555 1212
Pulse Dialing:	ATD**P** 555 1212
Tone and Pulse Dialing:	ATD**P** 555 1212 W**T** 24
Pausing During Dialing:	ATDT 9**,,**555 1212
Dialing Without Waiting for Dial Tone:	AT**X0**D, 555 1212
Originating a call using an Answer Tone:	ATDT 555 1212,,,,,,**R**

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

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

123456,1 714 555 1212

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

Auto-Answer and Hook Controls

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

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

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

Manually Answering a Call: AT**A**

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

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

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

Making Your First Connection

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

Start the terminal program by double-clicking the **Test Connection** icon. When the terminal window appears, enter the dial command with ZyXEL's BBS (`+88635776274`) as the phone number.

Type:

```
ATDT<Phone number> <enter>
```

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

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

Quick Tips when issuing AT Commands

- The ENTER or RETURN key must be pressed to execute a command.
- Multiple AT commands can be combined into one line. For example, AT&D2 and AT&K0 can be combined into one line AT&D2&K0.

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

- If you see duplicated characters for each one you type, your Comet and software both have their "echo" feature turned. The Comet command echo state is switched off using ATE0 and on using ATE1 (default). To eliminate the double characters, turn off the software's command echo rather than using the ATE0 command. If you see no characters in your terminal window when you type, the modem's echo setting is probably set to off. In this case, issue the ATE1 command.
- When a command is successfully issued and accepted, a modem responds with what is called a "Result Code." The Comet supports both "verbose" result codes (i.e. "OK"), and "numerical" result codes (i.e. "0").

You can use the ATV command to set it one way or the other as follows:

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

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

Command	Description
A/	Repeats the last issued AT command once
<any key>	Terminates the current connection attempt, if pressed while modem is handshaking.
+++	Escape code sequence. Entered while the modem is in Data Mode. Returns modem to Command Mode.

Modem Result Codes

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

The Comet also provides result codes that show:

- Whether or not a Dial Tone was detected when the modem originated a call.
- If a busy signal was detected when the modem originated a call.
- The speed, protocol, and error control/data compression method used.
- If your modem has detected an incoming ring.

Result codes can originate from any of eight result code sets. The **ATX*n*** command lets you choose which set of result codes your modem uses. By default, your modem uses result codes equivalent to the **ATX4** command.

Viewing S Register Values

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

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

Changing S Register Values

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

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

Non-Volatile Memory

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

Storing Phone Numbers

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

The '***s***' is a number from 0 to 3 that represents the location in memory that the phone number is to be stored, and the '***n***' is the phone number itself.

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

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

You can store up to 4 telephone numbers.

Dialing Stored Phone Numbers

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

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

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

Saving Settings and User Profiles

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

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

AT&V	Views the settings in profile.
AT&W*n*	Stores the current settings in user profile. *'n'; n*=0 or 1
ATZ*n*	Resets the current settings with the settings in profile. '*n*', *n*=0 or 1
AT&F*n*	Resets the current settings with the factory settings. *n*=0 or 1

Default Modem Settings for PC's

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

AT Command	Description
E1	Echoes command characters
&C1	Carrier detect follows remote carrier
&D2	Modem disconnects on DTR on-to-off transition
%C3	Use both V.42bis and MNP 5 data compression.

4 Advanced Data Communications

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

Front Panel LEDs

The Comet has 9 front panel LEDs. Refer to the following tables for details on the LED status indicators and their meanings.

LED	State	Indicates Status
MR	Modem Ready or Self-Test in progress.	Modem is ready for data communications.
HS	High Speed	Modem is operating at 2400bps or higher
CD	Carrier Detect	Modem has detected a valid carrier signal, or &C0 is set.
OH	Off Hook	Modem is accessing telephone line.
SD	Send Data	Flashes on/off rapidly when data is being transmitted from modem to your computer.
RD	Receive Data	Flashes on/off rapidly when data is being transmitted from computer to your. modem
TR	Terminal Ready	Computer is ready for data communications.
AA	Auto Answer	Modem will automatically answer incoming calls.
PWR	Power	The modem is on and has power to operate.

DTE Interface

DTE and DCE are terms used in data communication. DTE stands for Data Terminal Equipment and DCE stands for Data Communication Equipment. The computer or terminal is the DTE and the modem is the DCE. The DTE interface used by the Comet is an RS-232 with throughput speeds up to 115.2 Kbps.

UART

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

Serial Port

A serial port is the serial data connector together with its internal circuit on the DTE or DCE with electrical and mechanical characteristics according to RS-232C. Since some signals travel from the DTE port to DCE port, and some signals travel in the opposite

direction, the signal pin is a transmitter on one port and a receiver on the other. The DTE serial port is different from the DCE serial port in terms of signals on the connector pins. There are also mechanical differences in terms of male (with pins) or female (with holes) connectors.

Serial RS-232C Cable

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

Communication Protocols and Speeds

The most commonly used ITU-T modem standards for 2-wire dial-up lines are summarized in the chart below:

Standard	Speed (bps)
K56flex*	56,000 ~ 32,000
V.34bis	33,600 / 31,200
V.34	28,800 ~ 2,400
V.32bis	14,400 / 12,000 / 7,200
V.32	9,600 / 4,800
V.22bis	2,400 / 1,200
V.22	1,200
V.21	300
V.23	1,200

* K56flex is upgradable to ITU-T 56Kbps.

In the USA, Bell Systems used to create de facto standards such as Bell 212A for 1200 bps modems and Bell 103 for 300 bps modems. The Comet supports all the above mentioned modem standards and are compatible with existing modems.

Universal Protocol Compatibility

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

Various operation modes that can be achieved are as follows:

Standard	BPS rate (+/-0,01%)	Baud rate (+/-0,01%)	Modulation	Carrier Freq [Hz]
K56flex	56,000 - 32,000	multiple	PCM	multiple
V.34bis	33,600/31,200	2,400	TCM	1,800
V.34	28,800 - 2,400	multiple	multiple	multiple

Standard	BPS rate (+/-0,01%)	Baud rate (+/-0,01%)	Modulation	Carrier Freq [Hz]
K56flex	56,000 - 32,000	multiple	PCM	multiple
V.34bis	33,600/31,200	2,400	TCM	1,800
V.32bis	14,400	2,400	128-TCM	1,800
V.32bis	12,000	2,400	64-TCM	1,800
V.32bis	7,200	2,400	16-TCM	1,800
V.32	9,600	2,400	32-TCM	1,800
V.32 uncoded	9,600	2,400	16-QAM	1,800
V.32	4,800	2,400	4-DPSK	1,800
V.29*	9,600	2,400	16-QAM	1,700
V.29*	7,200	2,400	8-QAM	1,700
V.29*	4,800	2,400	4-DPSK	1,700
V.27bis*	4,800	1,600	8-PSK	1,800
V.27bis*	2,400	1,200	4-DPSK	1,800
V.26bis*	2,400	1,200	4-DPSK	1,800
V.23	1,200 / 75	1,200 / 75	FSK	
V.23	600 / 75	600 / 75	FSK	
V.22bis†	2,400	600	16-QAM	1,200 Orig. 2,400 Ans.
V.22†	1,200	600	4-DPSK	1,200 Orig. 2,400 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.			

Error Control

Error control keeps the modem data link error-free by detecting and re-transmitting erroneous data. ZyXEL modems support both MNP and V.42 error control protocols. The MNP protocol was an industry de facto standard developed and licensed by Microcom, Inc. ZyXEL modems support level 4 and 3 error control protocols, commonly denoted as MNP4 and MNP3. V.42 is a standard developed by ITU-T. V.42 supports both LAPM (Link Access Procedure for Modem) and MNP4. A V.42 handshake will try an LAPM connection first, and if not successful, it will try MNP4.

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

CRC (Cyclical Redundancy Check) Error Detection

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

Data Compression

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

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

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

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

Run Length Encoding

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

Adaptive Frequency Encoding

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

String Coding

Instead of sending each data character individually, a token for a character string is sent. The modem adaptively builds a dictionary of string tokens according to data that appears. Comet 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.

AT&K4 enables data compression negotiation. For some applications, like BBSs, where transmission of compressed files is common, the MNP5 data compression process actually produces more redundant data and slows down transmission.

Hardware or Software Flow Control

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

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

&K0 Disables flow control.

&K3 Enables CTS/RTS flow control.

&K4 Enables XON/XOFF DTE/DCE flow control.

&K5 Enables transparent XON/XOFF DTE/DCE flow control.

&K6 Enables CTS/RTS and XON/XOFF DTE/DCE flow control. (default)

Hardware CTS/RTS

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

Software XON/XOFF

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

5 Special Functions

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

Caller Number Delivery (Caller ID)

Caller Number Delivery (CND), commonly called **Caller ID,** is a new kind of phone service that may be offered by your local phone company. Check your phone company for availability.

With CND service, the phone company's central office will send the coded caller information to the called station. This information is sent once between the first and second rings. The Comet modem can decode this caller information and present it to the connected computer/terminal during the second ring period as part of the call progress ring message.

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.

Use the Caller ID commands listed below to configure your modem:

Command	Function & Description
#CID=0	Disables caller ID. (default)
#CID=1	Enables caller ID with formatted presentation to the DTE. The modem will present the data items in a <Tag><Value> pair format. The expected pairs are data, time, caller code (telephone number), and name.
#CID=2	Enables Caller ID with unformatted presentation to the DTE. The Modem will present the entire packet of information, excluding the leading U's, in ASCII printable hex numbers.

Caller ID Result Codes

n = 0-2 OK

Otherwise ERROR

Caller ID Inquiries

#CID? Retrieves the current Caller ID mode from the modem.

#CID=? Returns the mode capabilities of the modem in a list with each element separated by commas.

Caller ID Formatted Form Reporting

The modem presents the data in the <tag> = <value> pair. Spaces are present on both sides of the equal sign.

Tag	Function & Description
DATE	DATE = MMDD where MM is the month number (01 to 12) and DD is the day number (01..31).
TIME	TIME = HHMM where HH is the hour number (00 to 23) and MM is the minute number (00 to 59).
NMBR	NMBR = <number> or P or O where <number> is the telephone number of the caller, where P indicates that the calling number information is not available since the originating caller has requested private service, and where O indicates that the calling number information is not available or out of service at the calling location.
NAME	NAME = <listing name> where <listing name> is the subscription name.
MESG	MESG = <data tag> <length of message> <data> <checksum> in printable ASCII hex numbers. This tag indicates a data item not listed above. The message is only possible for Multiple Message Format.

The modem does not present any Caller ID information if the DCE detects a checksum error in the Caller ID packet.

In the event of an unrecognized data tag, the modem will present the data in ASCII hex numbers following the MESG tag.

Setting **AT#CID=2** will cause the modem to report CND information in its ASCII coded hexadecimal raw data format. The DTE software is responsible for explaining the data.

Distinctive Ring

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

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

The ring types supported and the corresponding ring cadence detect criteria are:

Type	Ring Sequence
1	2s on; 4s off
2	0.8s on, 0.4s off, 0.8s on; 4s off
3	0.4s on, 0.2s off, 0.4s on, 0.2s off, 0.8s on; 4s off

The ring indicate (RI) output does not toggle on the first ring if AT-SDR≠0.

The RI output waveform is the same for all ring types detected, e.g., RI is on for the total duration of the ring period.

6 AT Command Set Summaries

Command	Function
A	Go on-line in answer mode
B0 B1(default)	Select ITU-T 300bps or ITU-T V.22 1200bps protocol Select Bell 300bps or Bell 212A 1200bps protocol
C1	Normal transmit carrier switching
D DL DS=n	Go on-line in originate mode Dial the number contained in the following dial string Dial the last-dialed number Dial the number stored in NVRAM at location n (0-3)
E0 E1(default)	Disable command echo Enable command echo
H0 H1	Go on-hook,hang up Go off-hook,ready to dial
I0 I1 I3 I4 I5 I6 I7	Report the product code Report firmware checksum and product information Report firmware revision Report manufacturer information Report the country code Report data pump model and code revision Report the DAA code
L0 L1(default) L2 L3	Low speaker volume Low speaker volume Medium speaker volume High speaker Volume
M0 M1(default) M2 M3	Speaker is always off Speaker is off while receiving carrier,but on during handshaking Speaker is always on Speaker is off during dialing and receiving carrier,but on during answering
N0 N1(default)	Automode detection is disabled Automode detection is enabled
O0 O1	Return to on-line data mode without a retrain Return to on-line data mode with a retrain
P	Set pulse dialing as the default
Q0(default) Q1	Allow the modem to send result codes to the DTE Prohibit the modem from sending result codes to the DTE
Sn?	Read the contents of the S-register specified by ‘n’
Sn=v	Set S-register n to value v
T	Set DMTF (tone) dialing as the default

Command	Function				
V0 V1(default)	Display result code in digital format Display result code in verbose format				
W0(default) W1 W2	Connect message report only the DTE speed Connect message report the line speed, the error correction protocol, and the DTE speed Connect message report only the DCE speed				
Xn	Select extended result code				
	X0	X1	X2	X3	X4(default)
Connect Message	Partial	Full	Full	Full	Full
Dialtone Monitor	Off	Off	On	Off	On
Busy Tone Monitor	Off	Off	Off	On	On
Y0(default) Y1	Disable long-space disconnect Enable long-space disconnect				
Zn	Perform a soft reset and load user profile n (n=0 or 1)				
&C0 &C1(default)	DCD remains ON at all times DCD follows carrier state				
&D0 &D1 &D2(default) &D3	DTR is ignored DTR drop causes the modem to return to the command state without disconnecting DTR drop causes the modem to hang up, inhibit auto-answer DTR drop causes the modem to perform a soft reset (to profile set with &Y)				
&Fn	Restore factory-default profile n (n=0 or 1)				
&G0(default) &G1 &G2	Disable guard tone (for US models) Disable guard tone Select 1800Hz guard tone				
&K0 &K3 &K4 &K5 &K6(default)	Disable flow control Enable RTS/CTS flow control Enable XON/XOFF flow control Enable transparent XON/XOFF flow control Enable both RTS/CTS and XON/XOFF flow control				
&P0(default) &P1 &P2 &P3	10 pulses/sec, 39/61 make-break ratio 10 pulses/sec, 33/67 make-break ratio 20 pulses/sec, 39/61 make-break ratio 20 pulses/sec, 33/67 make-break ratio				

Command	Function		
	Asynchronous mode selection		
&Q0	Select direct asynchronous operation		
&Q5(default)	Try to negotiate an error-corrected link (using S36)		
&Q6	Select asynchronous operation in normal mode (speed buffering)		
&S0(default)	DSR is always ON		
&S1	DSR is active from answer tone detected to carrier drop		
&T0	Terminate test in progress		
&T1	Initiate a local analog loopback test		
&T8	Initiate a local analog loopback with self-test		
&V	Display current configuration and saved profiles		
&Wn	Store the active profile as NVRAM profile n (n=0 or 1)		
&Yn	Set power-up default profile to n (n=0 or 1)		
&Zn=x	Store dial string x (up to 35 digits) to NVRAM (n=0 to 3)		
%C0	Disable data compression		
%C1	Enable MNP5 data compression negotiation		
%C2	Enable V.42bis data compression		
%C3(default)	Enable both V.42bis and MNP5 data compression		
%E0	Disable line quality monitor and auto-retrain		
%E1	Enable line quality monitor and auto-retrain		
%E2(default)	Enable line quality monitor and fallback/fall forward		
%E3	Enable line quality monitor and auto-retrain, but hang-up immediately when EQM reaches hang-up threshold		
%L	Report received line signal level		
%Q	Report line signal quality		
\A0	64 characters maximum MNP block size		
\A1(default)	128 characters maximum MNP block size		
\A2	192 characters maximum MNP block size		
\A3	256 characters maximum MNP block size		
\Bn	Send break of length n * 100ms (n=1 to 9,default=3)		
\G0(default)	Disable modem to modem flow control (XON/XOFF)		
\G1	Enable modem to modem flow control (XON/XOFF)		
\Kn	Set break handling:		
	Break transmitted from PC	\B command received	Break received from remote
\K0	Enter command mode	Clear buffers and send break	Clear buffers and send break to PC
\K1	Clear buffers and send break	Clear buffers and send break	Clear buffers and send break to PC
\K2	Enter command mode	Immediately send break to remote	Immediately send break to PC

Command	Function		
\K3	Immediately send break to remote	Immediately send break to remote	Immediately send break to PC
\K4	Enter command mode	Send break to remote in sequence	Send break to PC in sequence
\K5 (default)	Send break to remote in sequence	Send break to remote in sequence	Send break to PC in sequence
\N0 \N1 \N2 \N3 \N4 \N5	Select normal (speed buffering) mode Select direct (pass-through) mode Select reliable link mode Select auto-reliable mode Select LAPM error-correction mode Select NMP error-correction mode		
\V0 \V1	Connect messages are controlled by the command settings X,W,and S95 Connect messages are displayed in the single line format		
**0	Download to flash memory at last sensed line speed		
**1	Download to flash memory at 38.4 kbps		
**2	Download to flash memory at 57.6 kbps		
#CID=0 (default) #CID=1 #CID=2 #CID? #CID=?	Disable caller ID Enable caller ID with formatted presentation Enable caller ID with unformatted presentation Retrieve the current Caller ID mode Return the mode capabilities		
+FCLASS=n	Set fax service class, n=0: data mode (default), n=1: Fax Class 1, n=Fax Class 2		
+FAE=n	Fax/data auto answer; n=0: fax modem only, n=1: fax or data auto-detection		
+FRH=n	Receive data with HDLC framing		
+FRM=n	Receive data		
+FRS=n	Receive silence		
+FTH=n	Transmit data with HDLC framing		
+FTM=n	Transmit data		
+FTS=n	Stop transmission and wait for n * 10ms		
+FCLASS=n	Set fax service class, n=0: data mode (default), n=1: Fax Class 1, n=Fax Class 2		
+FAA=n	Adaptive answer		
+FAXERR	Fax error value		
+FBOR	Phase C data bit order		

Command	Function
+FBUF?	Report buffer size
+FCFR	Report confirmation to receive
+FCON	Fax connection response
+FCIG	Set polled station identification
+FCIG:	Report polled station identification
+FCR	Capability to receive
+FCR=	Capability to receive
+FCSI:	Report called station ID
+FDCC=	DCE capabilities parameters
+FDCS:	Report current session
+FDCS=	Current session results
+FDIS:	Report remote capabilities
+FDIS=	Current session parameters
+FDR	Begin or continue phase C receive data
+FDT=	Data transmission
+FDTC:	Report polled station capabilities
+FET:	Post page message response
+FED=n	Transmit page punctuation
+FHNG	Call termination with status
+FK	Session termination
+FLID=	Local ID string
+FLPL	Document for polling
+FMDL?	Identify model
+FMFR?	Identify manufacturer
+FPHCTO	Phase C time-out
+FPOLL	Polling request
+FPTS:	Page transfer status
+FPTS=	Page transfer status
+FREV?	Identify revision
+FSPL	Enable polling
+FTSI:	Report transmit station ID
#BDR	Select baud rate (turn off autobaud)
#CLS	Select data, fax, or voice
#MDL?	Identify model
#MFR?	Identify manufacturer
#REV?	Identify revision level
#TL	Audio output transmit level
#VBQ?	Query buffer size
#VBS	Bits per sample
#VBT	Beep tone timer
#VCI?	Identify compression method

Command	Function
#VGT	Set playback volume in command state
#VLS	Voice line select
#VRA	Ringback goes away timer (originate)
#VRN	Ringback never came back timer (originate)
#VRX	Voice receive mode
#VSD	Enable silence deletion
#VSK	Buffer skid setting
#VSP	Silence detection period (voice receive)
#VSR	Sampling rate selection
#VSS	Silence deletion tuner (voice receive)
#VTD	DTMF/tone reporting
#VTM	Enable timing mark placement
#VTS	Generate tone signals
#VTX	Voice transmit mode

Fax commands are located in Chapter 9 of the floppy disk edition of the Comet 3356 User's Manual.

Voice commands are located in Chapter 10 of the floppy disk edition of the Comet 3356 User's Manual.

7 +MS Modulation Commands

This extended-format command selects the modulation and, optionally, enables or disables automode, specifies the lowest and highest connection rates, selects u-Low or A-Low codec type, and enables or disables robbed bit signaling generation (server modem) or detection (client modem) using one to five subparameters. The command format is:

+MS=<mod> [,[<automode>][,[<min_rate>][,[<max_rate>][,
[<x_law>][,[<rb_signaling>]]]]]]<CR>

Notes:

1. For 14400 bps and lower speeds, the Nn command and S37 register can alternatively be used, in which case the +MS subparameters will modified to reflect the Nn and S37=x settings. Use of the Nn and S37=x commands is not recommended but is provided for compatibility with existing communication software. (S37 is not updated by the +MS command.)

2. Subparameters not entered (enter a comma only or <CR> to skip the last subparameter) remain at their current values.

Reporting Selected Options

The modem can send a string of confirmation to the DTE consisting of selected options using the following command:

+MS?

The response is:

+MS: <mod>,<automode>,<min_rate>,<max_rate>,<x_law>,
<rb_signaling>

For example,

+MS: 56,1,300,56000,0,0 [RC56 default values]

Reporting Supported Options

The modem can send a string of information to the DTE consisting of supported options using the following command:

+MS=?

The response is:

+MS: (list of supported <mod> values), (list of supported <automode> values), (list of supported <min_rate> values), (list of supported <max_rate> values), (list of supported <x_law> values), (list of supported <rb_signaling> values)

For example,

+MS: (0,1,2,3,9,1`0,11,56,64,69), (0,1), (300-33600), (300-56000), (0,1), (0,1)

Subparameter Definitions

1. <mod>= A decimal number which specifies the preferred modulation (automode enabled) or modulation (automode enabled) to use in originating or answering a connection. The options are:

<mod>	Modulation	Possible Rates (bps)[1]	Notes
0	V.21	300	
1	V.22	1200	
2	V.22 bis	2400 or 1200	
3	V.23	1200	See Note 2
9	V.32	9600 or 4800	
10	V.32 bis	14400, 12000, 9600, 7200 or 4800	
11	V.34	33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400	default
56	K56flex	56000, 54000, 52000, 50000, 48000, 46000, 44000, 42000, 40000, 38000, 36000, 34000, 32000	
64	Bell 103	300	
69	Bell 212	1200	

Notes : 1. See optional <automode>, <min_rate>, and <max_rate> subparameters.
2. For V.23, originating modes transmit at 75 bps and receive at 1200 bps; answering modes transmit at 1200 bps and receive at 75 bps. The rate is always specified as 1200 bps.

The modem may also automatically switch to another modulation (automode), subject to the following constraints:

a. The modem may not be able to automatically switch from the current modulation (specified by <mod>) to some other modulation. For example there is no standard way to automode from Bell 103 to V.23.

b. The DTE may disable automode operation (see <automode> below).

c. The DTE may constrain the range of modulations available by specifying the lowest and highest rates (see <min_rate> and <max_rate> below).

2. <automode> is an optional numeric value which enables or disable automatic modulation negotiation using V.8 bis/V.8 or V.32 bis Annex A. The options are:

<automode>	Option Selected	Notes
0	Automode disabled	
1	Automode enabled using V.8 bis/V.8 or V.32 Annex A	default

The default value is 1, which enablesautomode. Note, however, there are modulations for which there is no automode negotiation, e.g., Bell 212 (<mod>=69).

For <automode> = 0 (automode disabled,i.e., fixed modulation):

a. If <max_rate> is within the rates supported by the selected modulation, the selected rated is that specified by <max_rate>. For example,

+MS=10, 0, 1200, 4800 selects V.32 bis 4800 bps fixed rate.

b. If <max_rate> is greater than the highest speed supported by the modulation specified by <mod>, the starting rate is the highest rate supported by the selected modulation. For example,

+MS=10, 0, 2400, 14400 selects V.32 bis 14400, 12000, 9600, 7200, or 4800 bps.

c. To emulate issuance of the N0S37=x command sequence to select fixed mode operation, specify the <max_rate>and<min_rate> both to be the (same) requested speed, and <mod> to be the modulation for that speed. For example,

+MS=11, 0, 16800, 16800 selects V.34 16800 bps fixed mode (no comparable S37 command).

+MS=10, 0, 12000, 12000 selects V.32 bis 12000 bps fixed mode (same as N0S37=10).

For <automode> = 1 (automode enabled, i.e., automatically selected speed and modulation) :

The modem connects at the highest possible rate in accordance with V.8 bis/V.8, or V.32 bis Annex A if V.8 bis/V.8 is not supported by the remote modem.

a. If <max_rate> is greater than the highest rate supported by the modulation specified by <mod>, the modem automodes down from the highest rate of the selected modulation. For example,

   +MS=10, 1, 1200, 24000 selects automoding down from V.32 bis 14400 bps.

b. To emulate issuance of the N1S37=x sequence command, specify the modulation and the rate to start automoding down from using <mod> and <max_rate>, respectively. Set <min_rate> to 300 to allow automoding all the way to V.21 300 bps. For example:

   +MS=11, 1, 300, 16800 selects automodestarting at V.34 16800 bps (no comparable S37 command).

   +MS=9, 1, 300, 12000 selects automode starting at V.32 bis 12000 bps same as N1S37=10).

3. <min_rate> is an optional number specifies the lowest rate at which the modem may establish a connection. The value is decimal coded, in units of bps, e.g., 2400 specifies the lowest rate to be 2400 bps. The default is 300 for 300 bps.

4. <max_rate> is an optional number specifies the highest rate at which the modem may establish a connection. The value is decimal coded, in units of bps, e.g., 14400 specifies the highest rate to be 14400 bps. The default is 28800 for 28800 bps.

5. <x_law> is an optional number which specifies the codec type. The options are:

   0=μ-Law

   1=A-Law

   Note that ATZ will reset the <x_law> selection to 0 (μ-Law).

6. <rb_signaling> is an optional number which enables or disables robbed bit signaling generation in a server modem or enables or disables robbed bit signaling detection in a client modem. The options are:

   0=Robbed bit signaling generation (server modem) or detection (client modem) disabled. (default)

1=Robbed bit signaling generation (server modem) or detection (client modem) enabled.

Note that ATZ will reset the <rb_signaling> selection to 0. (default)

Result Codes:

OK Valid subparameter string

ERROR Otherwise.

8 Status Registers & Result Codes

S-Registers "ATSn=x"

Command	Function & Description	Range (default)
S0	Number of rings before Auto Answer. 0 value disables auto-answer.	0-255 (0)
S1	Ring counter.	0-255 (0)
S2	ASCII value of Escape character.	0-255 (43)
S3	ASCII value of Carriage Return character.	0-127(13)
S4	ASCII value of Line Feed character.	0-127 (10)
S5	ASCII value of Backspace character.	0-32 (8)
S6	Waiting time before blind dialing. (seconds)	2-255 (2)
S7	Wait for carrier after dial. (seconds)	1-255 (50)
S8	Pause time for comma. (seconds)	0-255 (2)
S9	Carrier detect response time. (1/10 seconds)	1-255 (6)
S10	Delay between loss of carrier and hang-up. (1/10 seconds)	1-255 (14)
S11	DTMF (Touch-tone) tone duration. (1/1000 seconds)	50-255 (95)
S12	Escape guard time. (1/50 seconds)	0-255 (50)
S18	Test timer. (seconds)	0-255 (0)
S24	Sleep inactivity timer. (seconds)	0-255 (0)
S25	Delay to DTR. (1 second for sync mode 1; 0.01 for otherwise)	0-255 (5)
S26	RTS to CTS delay interval. (0.01 seconds)	0-255 (1)
S29	Flash dial modifier time (0.1 seconds)	0-255 (0)
S30	Inactivity disconnect timer. (10 seconds)	0-255 (0)
S32	XON character	0-255 (17)
S33	XOFF character	0-255 (19)
S36	LAPM failure control	(7)
S37	Desired line connection speed	(0)
S38	Delay before forced-disconnect. (seconds)	0-255 (0)
S46	Data compression protocol Selection	136/138 (138)
S48	V.42 negotiation action	0,7,128 (7)
S86	Call failure reason code	
S91	PSTN transmit attenuation level (- dBm)	0-15 (10)
S92	Fax transmit attenuation level (- dBm)	0-15 (10)
S95	Extended result codes	

S-Register Definitions

S0 - Number of Rings to Auto-Answer

Sets the number of the rings required before the modem automatically answers a call. Setting this register to zero disables auto-answer mode.

S1 - Ring Counter

S1 is incremented each time the modem detects a ring signal on the telephone line. S1 is cleared if no rings occur over an eight second interval.

S2 - Escape Character

S2 holds the decimal value of the ASCII character used as the escape character. The default value corresponds to an ASCII '+'. A value over 127 disables the escape process, i.e., no escape character will be recognized.

S3 - Carriage Return Character

Sets the command line and result code terminator character. Pertains to asynchronous operation only.

S4 - Line Feed Character

Sets the character recognized as a line feed. Pertains to asynchronous operation only. The Line Feed control character is output after the Carriage Return control character if verbose result codes are used.

S5 - Backspace Character

Sets the character recognized as a backspace. Pertains to asynchronous operation only. The modem will not recognize the Backspace character if it is set to a value that is greater than 32 ASCII. This character can be used to edit a command line. When the echo command is enabled, the modem echoes back to the local DTE the Backspace character, an ASCII space character and a second Backspace character; this means a total of three characters are transmitted each time the modem processes the Backspace character.

S6 - Wait Time for Dial Tone Before Blind Dialing.

Sets the length of time, in seconds, that the modem will wait before starting to dial after going off-hook when blind dialing. This operation, however, may be affected by some ATX options according to country restrictions. The “wait for Dial Tone” call progress feature (W dial modifier in the dial string) will override the value in register S6.

The modem always pauses for a minimum of 2 seconds, even if the value of S6 is less than 2 seconds.

S7 - Wait Time For Carrier After Dial, For Silence, or For Dial Tone After “W” Dial Modifier (US Models)

1. Sets the length of time, in seconds, that the modem will wait for carrier before hanging up. The timer is started when the modem finishes dialing (originate), or 2 seconds after going off-hook (answer). In originate mode, the timer is reset upon detection of answer tone if allowed by country restrictions.

2. Sets the length of time, in seconds, that modem will wait for silence when encountering the @ dial modifier before continuing with the next dial string parameter.

S8 - Pause Time For Dial Delay

Sets the time, in seconds, that the modem must pause when the “,” dial modifier is encountered in the dial string.

S9 - Carrier Detect Response Time

Sets the time, in tenths of a second, that the carrier must be present before the modem considers it valid and turns on RLSD. As this time is increased, there is less chance to detect a false carrier due to noise from the telephone line.

S10 - Lost Carrier To Hang Up Delay

Sets the length of time, in tenths of a second, that the modem waits before hanging up after a loss of carrier. This allows for a temporary carrier loss without causing the local modem to disconnect.

S11 - DTMF Tone Duration

Sets the duration of tones in DTMF dialing. This value has no effect on pulse dialing.

S12 - Escape Prompt Delay (EPD)

Defines the maximum period, in fiftieths of a second, allowed between receipt of the last character of the three escape character sequence from the DTE and sending of the OK result code to the DTE. If any characters are detected during this time, the OK will not be sent. Note that sending of the OK result code does not affect entry into command mode.

S18 - Test Timer

Sets the length of time, in seconds, that the modem conducts a test (commanded by &Tn) before returning to the command mode. If this register value is zero, the test will not automatically terminate; the test must be terminated from the command mode by issuing an &T0 or H command. When S18 is non-zero, the modem returns the OK message upon test termination.

S24 - Sleep Inactivity Timer

Set the length of time, in units of 10 seconds, that the modem will operate in normal mode with no detected telephone line or DTE line activity before entering low power sleep mode.

S25 - Delay To DTR

Sets the length of time that the modem will ignore DTR for taking the action specified by &Dn. Its unit is one hundredth of a second.

S26 - RTS to CTS Delay

Sets the time delay, in hundredths of a second, before the modem turns CTS ON after detecting an OFF-to-ON transition on RTS when &R0 is commanded.

S29 - Flash Dial Modifier Time

Sets the length of time, in units of 10ms, that the modem will go on-hook when it encounters the flash (!) dial modifier in the dial string. The time can be limited as it is a country dependent parameter.

S30 - Disconnect Inactivity Timer

Sets the length of time, in tens of seconds, that the modem will stay online before disconnecting when no data is sent or received. In error-correction mode, any data transmitted or received will reset the timer. In other modes, any data transmitted will reset the timer. Set S30=0 to disable the timer.

S32 - XON Character

Sets the value of the XON character.

S33 - XOFF Character

Sets the value of the XOFF character.

S36 - LAPM Failure Control

This register is read when the S48 register contains the value 128 or if an attempted error correction link fails. These fallback options are initiated immediately upon connection if S48=128.

Bit	Value	Action
bit 0,1,2	000	Modem disconnect.
	001	Modem stays on-line and Direct mode connections established.
	010	Reserved.
	011	Modem stays on-line and a Normal mode connection is established.
	100	An MNP connection is attempted and if it fails, the modem disconnects.
	101	An MNP connection is attempted and if it fails, a direct mode connection is established.
	110	Reserved.
	111	An MNP connection is attempted and if it fails, the normal mode connection is established. (default)

S37 - Desired Line Connection Speed

Sets the value of the line connection speed.

bit 0-4 Desired line connection speed. This is interlinked with the Fn command. If an invalid number is entered, the number is accepted into the register, but **S37** will act as if the default value has been entered.

0 = Attempt auto mode connection. (default)
1-3 = Attempt to connect at 300 bps.
4 = Reserved.
5 = Attempt to connect at V.22 1200 bps.
6 = Attempt to connect at V.22bis 2400 bps.
7 = Attempt to connect at V.23.
8 = Attempt to connect at V.32 bis/V.32 4800 bps.
9 = Attempt to connect at V.32 bis/V.32 9600 bps.
10 = Attempt to connect at V.32 bis 12000 bps.
11 = Attempt to connect at V.32 bis 14400 bps.
12 = Attempt to connect at V.32 bis 7200 bps.

bit 5-7 Reserved.

S38 - Delay Before Forced Hang Up

This register specifies the delay between the modem's receipt of the H command to disconnect (or ON-to-OFF transition of DTR if the modem is programmed to follow the signal), and the disconnect operation. Applicable to error-correction connection only. This register can be used to ensure that data in the modem buffer is sent before the modem disconnects.

1. If S38 is set to a value between 0 and 254, the modem will wait that number of seconds for the remote modem to acknowledge all data in the modem buffer before disconnecting. If time expires before all data is sent, the NO CARRIER result code will be issued to indicate that data has been lost. If all data is transmitted prior to time-out, the response to the H0 command will be OK.

2. If S38 is set to 255, the modem does not time-out and continues to attempt to deliver data in the buffer until the connection is lost or the data is delivered.

S46 - Protocol Selection

This register controls whether the modem tries to use data compression when the modem establishes an error corrected link. The default is for the modem to use data compression (138).

Value	Description
136	Execute error correction protocol with no compression.
138	Execute error correction protocol with compression. (default)

S48 - V.42 Negotiation Action

The V.42 negotiation process determines the capabilities of the remote modem. However, when the capabilities of the remote modem are known and negotiation is unnecessary, this process can be bypassed.

Value	Description
0	Disable negotiation: bypass the detection and negotiation phases.
7	Enable negotiation. (default)
128	Disable negotiation: bypass the detection and negotiation phases.

S86 - Call Failure Reason Code

When the modem issues a NO CARRIER result code, a value is written to this S-Register to help determine the reason for the failed connection. S86 records the first event that contributes to a NO CARRIER message.

S86 =	0	Normal disconnect, no error occurred.
S86 =	4	Loss of carrier.
S86 =	5	V.42 negotiation failed to detect an error-correction modem at the other end.
S86 =	9	The modems could not find a common protocol.
S86 =	12	Normal disconnect initiated by the remote modem.
S86 =	13	Remote modem does not respond after 10 retransmission of the same message.
S86 =	14	Protocol violation.

S91 - PSTN Transmit Attenuation Level

Sets the transmit attenuation level from 0 to 15 dBm for the PSTN mode resulting in a transmit level from 0 to -15 dBm.

S92 - Fax Transmit Attenuation Level

Sets the transmit attenuation level from 0 to 15 dBm for the fax mode resulting in a transmit level from 0 to -15 dBm.

S95 - Extended Result Codes

This register can override some of the W command options. Set the appropriate bit to 1 to enable the corresponding result code, regardless of the W command setting Set the bit to 0 to disable the result code.

Bit	Description
0	CONNECT indicates DCE speed.
1	Append /ARQ to the CONNECT result code if the protocol is other than NONE.
2	CARRIER result code.
3	PROTOCOL: result code.
4	Reserved.
5	COMPRESSION: result code.
6	Reserved.
7	Reserved.

Result Code Options

"ATXn" Result Code Option Table

The following table shows the different options available when setting the ATXn command:

ATV0	ATV1	X0	X1	X2	X3	X4
0	OK	V	V	V	V	V
1	CONNECT	V	V	V	V	V
2	RING	V	V	V	V	V
3	NO CARRIER	V	V	V	V	V
4	ERROR	V	V	V	V	V
5	CONNECT 1200		V	V	V	V
6	NO DIALTONE			V		V
7	BUSY				V	V
8	NO ANSWER	V	V	V	V	V
9	CONNECT 600		V	V	V	V
10	CONNECT 2400		V	V	V	V
11	CONNECT 4800		V	V	V	V
12	CONNECT 9600		V	V	V	V
13	CONNECT 7200		V	V	V	V
14	CONNECT 12000		V	V	V	V
15	CONNECT 14400		V	V	V	V
16	CONNECT 19200		V	V	V	V
17	CONNECT 38400		V	V	V	V
18	CONNECT 57600		V	V	V	V

19	CONNECT 115200		V	V	V	V
20	CONNECT 230400		V	V	V	V
22	CONNECT 1200RX/75TX		V	V	V	V
23	CONNECT 75RX/1200TX		V	V	V	V
24	DELAYED					V
32	BLACKLISTED					V
33	FAX	V	V	V	V	V
35	DATA	V	V	V	V	V
40	CARRIER 300	V	V	V	V	V
44	CARRIER 1200TX/75RX V.23	V	V	V	V	V
45	CARRIER 75TX/1200RX V.23	V	V	V	V	V
46	CARRIER 1200	V	V	V	V	V
47	CARRIER 2400	V	V	V	V	V
48	CARRIER 4800	V	V	V	V	V
49	CARRIER 7200	V	V	V	V	V
50	CARRIER 9600	V	V	V	V	V
51	CARRIER 12000	V	V	V	V	V
52	CARRIER 14400	V	V	V	V	V
53	CARRIER 16800	V	V	V	V	V
54	CARRIER 19200	V	V	V	V	V
55	CARRIER 21600	V	V	V	V	V
56	CARRIER 24000	V	V	V	V	V
57	CARRIER 26400	V	V	V	V	V
58	CARRIER 28800	V	V	V	V	V
59	CONNECT 16800		V	V	V	V
61	CONNECT 21600		V	V	V	V
62	CONNECT 24000		V	V	V	V
63	CONNECT 26400		V	V	V	V
64	CONNECT 28800		V	V	V	V
66	COMPRESSION CLASS 5	V	V	V	V	V
67	COMPRESSION V.42BIS	V	V	V	V	V
69	COMPRESSION NONE	V	V	V	V	V
76	PROTOCOL:NONE	V	V	V	V	V
77	PROTOCOL:LAPM	V	V	V	V	V
78	CARRIER 31200	V	V	V	V	V
79	CARRIER 33600	V	V	V	V	V
80	PROTOCOL:ALT	V	V	V	V	V
81	PROTOCOL:ALT-CELLULAR	V	V	V	V	V
84	CONNECT 33600		V	V	V	V
91	CONNECT 31200		V	V	V	V
150	CARRIER 32000	V	V	V	V	V
151	CARRIER 34000	V	V	V	V	V
152	CARRIER 36000	V	V	V	V	V
153	CARRIER 38000	V	V	V	V	V
154	CARRIER 40000	V	V	V	V	V
155	CARRIER 42000	V	V	V	V	V
156	CARRIER 44000	V	V	V	V	V
157	CARRIER 46000	V	V	V	V	V

158	CARRIER 48000	V	V	V	V	V
159	CARRIER 50000	V	V	V	V	V
160	CARRIER 52000	V	V	V	V	V
161	CARRIER 54000	V	V	V	V	V
162	CARRIER 56000	V	V	V	V	V
165	CONNECT 32000		V	V	V	V
166	CONNECT 34000		V	V	V	V
167	CONNECT 36000		V	V	V	V
168	CONNECT 38000		V	V	V	V
169	CONNECT 40000		V	V	V	V
170	CONNECT 42000		V	V	V	V
171	CONNECT 44000		V	V	V	V
172	CONNECT 46000		V	V	V	V
173	CONNECT 48000		V	V	V	V
174	CONNECT 50000		V	V	V	V
175	CONNECT 52000		V	V	V	V
176	CONNECT 54000		V	V	V	V
177	CONNECT 56000		V	V	V	V
+F4	+FCERROR	V	V	V	V	V

9 Fax Operation

The Comet can be used as a fax machine, and this chapter explains how. In the sections below, we will describe how the modem works as a fax machine, the ITU-T T.30 fax protocol and the Class 1 and 2 fax commands. The instructions for using the included modem/fax/voice utility program are included on the software disk. Some distributors and dealers also include other software with the Comet. For help with such software, refer to the documentation that came with it.

Modem as Fax Machine

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

The Comet supports Group 3 send and receive facsimile functions. For normal fax operation, you must connect the modem to a computer, usually a PC. The computer serves as the input/output device for the fax function. The RS-232 serial connection or the ZyXEL serial port interface connects the Comet to the computer. The Comet uses the same interface for both data and fax applications. In fax operations, the modem performs protocol handshaking and image data transfer. The computer handles image data creation, capturing, conversion, compression, decompression, retrieving, and storing.

ITU-T T.30 Fax Protocol

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

The Comet allows for fax speeds up to 14400 bps when transmitting to a fax machine which complies with the V.17 fax standard. Speeds will fall back to 12000, 9600, or 7200 bps in poor line conditions. When connecting to a G3 fax device, the Comet allows for fax speeds up to 9600 bps and will automatically fall back to 7200, 4800, and 2400 bps if the line quality is poor.

Fax Command sets

The Comet supports four command sets for fax operation:

- Class 1 command set

- TIA PN-2388 Class 2 command set

Defining the Fax Command Sets

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

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

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

Flow Control

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

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

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

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

- CTS is not used when receiving fax.
- RTS is used to inform the Comet that the computer cannot accept data at this moment. The modem will not pass received data to the DTE if RTS is turned off.

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

FAX Class 1 AT Command Set

Command	Options	Function & Description	Ref.

+FCLASS=n		Service Class ID.	
	n=0 *	Select Data Mode.	
	n=1	Select Facsimile Class 1.	
	n=2	Select Facsimile Class 2.	
	n=8	Select voice mode.	
+F<command>?		Report Active Configuration.	
+F<command>=?		Report Operating Capabilities.	
+FAE=n		Data/Fax Auto Answer.	
	n=0 *	Disable data/fax auto answer mode.	
	n=1	Enable data/fax auto answer mode.	
+FRH=n		Receive Data with HDLC Framing.	
	n=3	V.21 channel 2 300 bps.	
	n=24	V.27 ter 2400 bps.	
	n=48	V.27 ter 4800 bps.	
	n=72	V.29 7200 bps.	
	n=73	V.17 7200 bps long.	
	n=74	V.17 7200 bps short.	
	n=96	V.29 9600 bps.	
	n=97	V.17 9600 bps long.	
	n=98	V.17 9600 bps short.	
	n=121	V.17 12000 bps long.	
	n=122	V.17 12000 bps short.	
	n=145	V.17 14400 bps long.	
	n=146	V.17 14400 bps short.	
+FRM=n		Receive data.	
	n=…	(Same as +FRH).	
+FRS=n		Receive silence. Report with an OK result code after n 10 ms-intervals of silence.	
+FTH=n		Transmit data with HDLC framing.	
	n=…	(Same as +FRH).	
+FTM=n		Transmit data.	
	n=…	(Same as +FRM).	
+FTS=n		Stop transmission and wait. Terminate and wait for n 10-ms intervals before responding OK.	

FAX Class 2 AT Command Set

Command	Options	Function & Description	Ref.
+FCLASS=n		Service Class ID.	

	n=0 *	Select Data Mode.	
	n=1	Select Facsimile Class 1.	
	n=2	Select Facsimile Class 2.	
	n=8	Select voice mode.	
+F<command>?		Report Active Configuration.	
+F<command>=?		Report Operating Capabilities.	
+FAE=n		Data/Fax Auto Answer.	
	n=0	Disable data/fax auto answer mode	
	n=1	Enable data/fax auto answer mode	
+FAA=n		Adaptive answer.	
	n=0 *	Constrains the DCE to answer as set by +FCLASS.	
	n=1	Auto answer as a facsimile or a data modem depending on the call.	
+FAXERR		Fax error value.	
+FBOR		Phase B data bit order.	
+FBUF?		Buffer size (read only).	
+FCFR		Indicate confirmation to receive.	
+FCON		Facsimile connection response.	
+FCIG		Set the polled station identification.	
+FCIG:		Report the polled station identification.	
+FCR		Capability to receive.	
+FCR=		Capability to receive.	
+FCSI:		Report the called station ID.	
+FDCC=		DCE capabilities parameters.	
+FDCS:		Report current session.	
+FDCS=		Current session results.	
+FDIS:		Report remote capabilities.	
+FDIS=		Current sessions parameters.	
+FDR		Begin or continue phase C receive data.	
+FDT=		Data transmission.	
+FDTC:		Report the polled station capabilities.	
+FET:		Post page message response.	
+FET=N		Transmit page punctuation.	
+FHNG		Call termination with status.	
+FK		Session termination.	
+FLID=		Local ID string.	
+FLPL		Document for polling.	
+FMDL?		Identify model.	
+FMFR?		Identify manufacturer.	

+FPHCTO		Phase C time out.	
+FPOLL		Indicates polling request.	
+FPTS:		Page transfer status.	
+FPTS=		Page transfer status.	
+FREV?		Identify revision.	
+FSPL		Enable polling	
+FTSI:		Report the transmit station ID.	
+FBADLIN:		# of consecutive bad line.	
+FBADMUL:		Error rate multiplier.	
+FBUG:		Session message reporting.	
+FCQ:		Copy quality capability.	
+FCTCRTY:		CTC retry value.	
+FDFFC:		Data compression format conversion.	
+FECM:		Error correction mode.	
+FLNFC:		Page length format conversion	
+FLO:		Flow Control	
+FMINSP:		Minimum phase C speed	
+FRBC:		Phase C data rcv byte count	
+FREL:		Phase C EOL alignment	
+FTBC:		Phase C xmit byte count	
+FVRFC:		Vertical resolution format conversion	
+FWDFC:		Page width format conversion	

10 Voice Operation

Voice mode refers to the Comet'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.

The modem is configured into Voice Mode (modem models not supporting business audio) or Voice/Audio Mode (modem models supporting business audio) in response to the AT #CLS=8 command, and this mode is composed of the Voice and Audio sub-configurations as described in this section. Additional voice/audio AT commands are available to support selection of operational parameters from both inside and outside the Voice/Audio Mode.

a) Voice Sub-Configuration. Enhanced Adaptive Differential Pulse Code Modulation (ADPCM) coding and decoding of analog voice is accomplished with a 7.2 kHz sampling rate and 2 or 4 bits/sample quantization, and supports efficient compression and decompression of digitized voice. Additionally, the Voice Configuration supports concurrent tone generation/detection capabilities.

b) Audio Sub-Configuration (Available Only for Modem Models Supporting Business Audio). Linear PCM coding and decoding of analog audio is accomplished with 7.2 kHz or 11.025 kHz sampling rates and 8 bits/sample quantization, and supports superior sound quality as compared to ADPCM. With a sampling rate of 7.2 kHz, the Audio Sub-configuration supports concurrent tone generation/detection capabilities. With a sampling rate of 7.2 kHz or 11.025 kHz, this sub-configuration can be used to record and playback monophonic data in 8-bit unsigned linear PCM format.

Note: The term "voice" is used to refer to both voice and audio functions, except where otherwise noted.

The Voice/Audio Mode (i.e., either sub-configuration) supports three submodes once a voice connection has been established (refer to the descriptions of the #CLS command): Online Voice Command Mode, Voice Receive Mode, and Voice Transmit Mode. Determination of whether operation takes place in the Voice sub-configuration or the Audio sub-configuration is made by use of the #VBS and #VSR commands (refer to the descriptions of these commands).

9.1 VOICE/AUDIO SUBMODES

9.1.1 Online Voice Command Mode

Online Voice Command Mode is the default Voice submode entered when the #CLS=8 command is issued, and may also be entered from Voice Receive Mode or Voice Transmit Mode. Entry into Online Voice Command Mode is indicated to the DTE via

the VCON message, after which AT commands can be entered without aborting the telephone line connection.

If the modem is the answerer, it enters Online Voice Command Mode immediately after going off-hook, and can report instances of DTMF tones and calling tones to the DTE. If the modem is the originator, it enters Online Voice Command Mode based on detection of the ringback cadence going away, upon expiration of the ringback never came timer, or upon detection of answer tone, and the modem can report DTMF tones, answer tones, busy tone, and dial tone to the DTE. (Note that DTMF tone reporting is supported in this mode if DTMF reporting is enabled via the #VTD command.)

When this mode is entered as a result of going off-hook with the D or A command, VCON is always sent to the DTE, after which the modem accepts commands. If this mode is entered from Voice Transmit Mode, the DTE has issued the <DLE><ETX>, and the modem responds with VCON. If this mode is entered from the Voice Receive Mode because of a key abort, the modem issues the <DLE><ETX> followed by VCON.

If the #VLS command has switched in a handset or other device in place of the telephone line, Online Voice Command Mode is immediately entered, whereas if the telephone line is selected, a physical connection with another station must occur before entering this mode.

9.1.2 Voice Receive Mode

Voice Receive Mode is entered when the DTE issues the #VRX command in order to receive voice data. This typically occurs when either recording a greeting message, or when recording voice messages from a remote station.

In Voice Receive Mode, voice samples from the modem analog-to-digital converter (ADC) are sent either to the ADPCM coder for compression, or to the PCM coder for linear PCM coding, and can then be read by the host. AT commands control the voice sampling rate as well as codec bits-per-sample rates, and can also be used to select adjustment of the silence detection period and sensitivity level when ADPCM compression is selected.

In this mode, and when the sampling rate is 7.2 kHz, the modem detects and reports DTMF, dial tone, and busy tone cadence as enabled by the #VTD command. additionally, the modem detects and reports inactivity (periods of silence) as enabled by the #VSS command. The modem can exit the Voice Receive Mode only via a DTE Key Abort, or via Disconnect Inactivity timer (S30) expiration.

9.1.3 Voice Transmit Mode

Voice Transmit Mode is entered when the DTE issues the #VTX command in order to transmit voice data. In this mode, when the sampling rate is 7.2 kHz, the modem continues to detect and report DTMF and calling tones if enabled by the #VTD

command. This mode is typically used when playing back greeting messages or previously received/recorded messages.

In this mode:

1. If the Voice Sub-configuration is in operation, voice decompression is provided by the ADPCM codec, and the decompressed ADPCM voice data is then reconstituted into analog voice by the DAC at the original compression quantization sample-per-bits rate.

2. If the Audio Sub-configuration is in operation, PCM decoding is provided by the linear PCM decoder, and the decoded audio data is then reconstituted into analog voice by the DAC at the original 1 sample/8 bits rate.

9.2 VOICE/AUDIO CAPABILITIES

9.2.1 Call Establishment - Originate

Directed Originate (Dial as a specific modem type)

For most call originations, it is known ahead of time what type of call is being attempted, and it is acceptable to disconnect if the remote side of the connection does not cooperate. In this case, the modem can be configured ahead of time with the existing +FCLASS (and +FAE=0 or +FAA=0) or the #CLS command to be a data, fax, or voice/audio modem. For Data and Fax Modes, the modem subsequently either succeeds with the desired type of connection, or eventually hangs up.

For the Voice/Audio Mode, the DTE has the option of hanging up if there are indications that the remote station has not answered in voice, thus implementing a directed originate for voice. The following are the three connection type choices:

Voice/Audio

The modem dials and reports call progress to the DTE, which reduces to reporting “NO DIALTONE”, “BUSY”, or “NO ANSWER”.

The modem allows the DTE to program a time period, which if elapsed after any ringback is detected, forces the modem to assume the remote has gone off-hook. A secondary time period (safety valve) can define a maximum elapsed time after dialing for receiving no ringback before the modem assumes that the remote has gone off-hook. This safety valve is devised in case the remote picks up the telephone before any ringback is generated, and no other tones are detected. In this mode, the modem is attempting to make a voice connection only and therefore, while waiting for ringback to disappear, it is also feasible to disconnect upon detection something which is definitely not voice from the remote, such as any answer tone. The modem provides detection of ringback went away or never came.

Fax

The modem dials and reports call progress to the DTE as in all modes. A Fax Class 1 or Fax Class 2 handshake is pursued according to the current configuration.

Data

The modem dials and reports call progress to the DTE as in all modes. A data handshake is pursued according to the current configuration.

Adaptive Originate (Dial with Voice/Data/Fax Discrimination)

The DTE may wish to originate a call which adapts to the remote answerer. For instance, the user may wish to send a voice message if a human picks up the telephone, but a facsimile if a fax machine answers. The modem can facilitate this type of adaptive originate by extending what it does for the directed originate modes. After determining that the remote station has picked up the line, the modem goes back to Online Voice Command Mode, thus terminating the connecting state. Once in this mode, the modem reports what it receives from the answerer via specific result codes to the DTE. The DTE can then have the option of pursuing a data, fax, or voice/audio connection.

9.2.2 Call Establishment - Answer Directed Answer (Answer as a specific modem type)

If the DTE wants to be only one kind of answerer (i.e., voice/audio, fax, or data), it can configure the modem to answer exclusively in the chosen mode.

Voice/Audio

The modem is configured to answer in Voice/Audio Mode only and assumes the caller will cooperate. After going off-hook, the voice VCON is issued, no answer tone is generated, and the modem is immediately placed in Online Voice Command Mode. The DTE typically responds by sending a greeting message of some type, and DTMF tone recognition/reporting can be enabled. Eventually, an incoming voice message can be recorded by the host. (Unpredictable results occur if the caller is not prepared for a voice call.)

Fax

The modem is configured to answer in Fax Class 1 or Fax Class 2 Mode only, and it assumes the caller is going to cooperate. This configuration has the effect of disabling Voice/Audio Mode, forcing +FCLASS to either 1 or 2, and forcing both +FAA and +FAE to 0.

Data

The modem is configured to answer in Data Mode only and assumes the caller is going to cooperate. This configuration has the effect of disabling Voice/Audio Mode, forcing +FCLASS = 0, and forcing both +FAA and +FAE to 0.

Adaptive Answer (Answer with Voice/Data/Fax Discrimination)

In normal operation, it is desirable for a modem supporting fax and voice to provide the ability to discriminate between the two when answering unsolicited or unattended calls. (It is most often the case that a fax is received or a voice message recorded when nobody is present.)

Data/Fax Discrimination

If the DTE wishes to allow for a data or fax call, the +FCLASS and +FAA or +FAE commands can be configured for adaptive answer between data and Class 1 or Class 2 fax.

Voice/Fax Discrimination

This is the most important discrimination capability needed from the user's standpoint. The modem must be configured for Voice/Audio (#CLS=8), causing the modem to enter Online Voice Command Mode immediately upon going off-hook. In Voice/Audio Mode, the DTE automatically receives indications of DTMF tones and Calling Tones. The DTE can now switch to Voice Transmit Mode in order to play a greeting message, perhaps one which instructs the caller how to enter specific DTMF sequences to switch modes. The DTE can then react to the response, or the lack thereof, to such a message. The modem supports switching to Class 1 or Class 2 answer mode by virtue of the #CLS=1 or #CLS=2 command, and if such a switch is made and fails, the modem reports the failure but does not hang up, allowing the DTE further experimentation time. If the user wishes to switch to Class 1 or Class 2, but also wants the DTE to indeed hang up the line if the fax fails, the +FCLASS command should be used instead of the #CLS command. The only difference between these commands is that issuing +FCLASS cancels the modem's memory of voice, whereas #CLS causes the modem to remain off-hook, even if a fax or data handshake fails, until it receives an H command.

Voice/Data/Fax Discrimination

The DTE can try data modem operation after an answer by changing the #CLS setting to 0. A data handshake attempt can be added based upon DTMF responses or lack thereof.

9.2.3 Voice/Audio Data Transfer

A significant area of concern when handling the transfer of voice/audio data is the data transfer rate on the modem/DTE interface. Data transfer rates can be expressed as the number of interrupts which must be serviced per time period to keep up. This is a function of the sampling rate and compression method (if any) used by the modem, and the DTE interface speed required to handle the data flow on the telephone line side.

Tables 9-1a and 9-1b demonstrate the relationship between the sampling rate, interrupt rate, and DTE speed necessary for the modem to support various compression ratios. The built-in 16C550A UART-compatible interface in the MCU hardware is required to support Voice/Audio Mode operation in the Microsoft Windows environment.

Table 9-1. DTE Speeds a. 9.2 kHz Sample Rate

Modem Samples per 8-bit Byte

Required Asynchronous DTE Speed (8N1 Format)

Implied DTE Speed Supported

1 (8-bits)

72,000 bps
115.2 kbps

2 (4-bits)
36,000 bps
38.4 kbps

4 (2-bits)
18,000 bps
19.2 kbps

b. 11.025 kHz Sample Rate

Modem Samples per 8-bit Byte
Required Asynchronous DTE Speed
(8N1 Format)
Implied DTE Speed Supported

1 (8-bits)
110,250 bps
115.2 kbps

9.2.4 Tone and Status Monitoring Shielded <DLE> Statuses

The modem can detect specific tones and other status information, and report these to the DTE while in any of the three voice submodes. The modem simultaneously looks for 1300 and 1100 Hz calling tones when answering, and for CCITT and Bell answer tones when originating. The modem can also detect dial or busy tones in any of the three voice submodes. All detected tones, as well as certain other statuses addressed in Table 9-2 such as silence and telset off-hook (i.e., handset off-hook) are reported as shielded codes.

When in Online Voice Command Mode or Voice Transmit Mode, the codes in Table 9-2 are sent to the DTE immediately upon verification by the modem of the associated tone, status, or cadence. In this mode, the 2-character code is not buffered, nor does the

DTE have the ability to stop the code with flow control. If the DTE has started (but not completed) sending any AT command, the Tone Monitoring function is disabled until the command has been received and processed.

The modem can discriminate between single and multiple DTMF tones received. If calling tone, dial tone, busy tone, or answer tone is detected, this detection is reported repeatedly (at reasonable intervals) if the DTE takes no action, and the tone continues to be detected.

Table 9-2. Codes Sent to the DTE

Code Sent to DTE

Meaning

<DLE>0 Ð

<DLE>9, <DLE>*,

<DLE>#, <DLE>A

Ð<DLE>D

DTMF. Digits 0 through 9, *, #, or A through D detected by the modem, i.e., user has pressed a key on a local or remote telephone. The modem sends only one <DLE> code per DTMF button pushed.

<DLE>a

Answer Tone (CCITT). Send to the DTE when the V.25/T.30 2100 Hz Answer Tone (Data or Fax) is detected. If the DTE fails to react to the code, and the modem continues to detect Answer tone, the code is repeated as often as once every half second.

<DLE>b

Busy. Sent in Voice Receive Mode when the busy cadence is detected, after any remaining data in the voice receive buffer. The modem sends the busy <DLE>b code every 4 seconds if busy continues to be detected and the DTE does not react. This allows the DTE the flexibility of ignoring what could be a false busy detection.

<DLE>c

Calling Tone. Sent when the T.30 1100 Hz Calling Tone (Fax Modem) is detected in any of the voice operating modes. The modem assumes that the calling tone is valid and sends this code only after 4 seconds of proper cadence has been detected. If the DTE does not react to the <DLE>c, and calling tone continues, the code is sent again as often as once every 4 seconds.

<DLE>d

Dialtone. Sent in Voice Receive Mode when dial tone is detected after any remaining data in the voice receive buffer. The modem sends the <DLE>d code every 3 seconds if

dial tone continues to be detected and the DTE does not react. This allows the DTE the flexibility of ignoring what could be a false dial tone detection.

<DLE>e

European Data Modem Calling Tone. Sent when the V.25 1300 Hz Calling Tone (Data Modem) is detected in a voice submode. The modem assumes that the calling tone is valid, and sends this code only after 4 seconds of proper cadence has been detected. If the DTE does not react to the <DLE>e and calling tone continues, the code is sent again as often as once every 4 seconds.

<DLE>f

Bell Answer Tone. Sent when Bell 2225 Hz Answer Tone (Data) is detected. If the DTE fails to react to the code and the modem continues to detect Answer tone, the code is repeated as often as every 1/2 second.

<DLE>h

Hung Up Handset. Sent immediately when the modem detects that the local handset has hung-up (i.e., has transitioned from off-hook to on-hook) while in any of the three voice submodes.

<DLE>o

Overrun. Sent in Voice Receive Mode if the voice receive data buffer overflows, in which case, the latest data is lost in favor of retaining the oldest data in the buffer. (The DTE may not have been reading data from the modem lately.) The modem inserts the <DLE>o at the end of the buffer, thus marking the location where data was lost by the DTE. The modem does not append <DLE>o codes to the buffer contiguously. If more than one data byte is lost before the DTE begins reading again, there is only on <DLE>o code in the data stream. However, if the DTE resumes reading, and then once again allows the buffer to overflow, a new <DLE>o is appended to the data by the modem. Thus, the <DLE>o does not indicate how many bytes of contiguous data has been lost, but may report multiple gaps of lost data in the data stream.

<DLE>q

Quiet. Sent in Voice Receive Mode following any remaining data in the receive voice buffer when the silence detection timer (#VSP) expires and there has been voice data passed to the DTE. Note that with #VSS=0, the Quiet message never occurs. In general, <DLE>q is sent if first there was sound, and now there is no sound, and means that somebody has stopped talking, and according to the criteria selected in the #VSP and #VSS settings, is probably not going to start again. If the DTE ignores the <DLE>q code, the modem automatically resets its timer and sends the code again if the #VSP time period again expires. This allows the DTE time to react to what may be a false silence detection.

Table 9-2. Shielded Codes Sent to the DTE (Contd)

Code Sent to DTE

Meaning

<DLE>s

Silence. Sent in Voice Receive Mode after the silence detection timer (#VSP) expires and if valid voice has not been detected (#VSS). In general, <DLE>s is sent if no sound was detected at all. This differs slightly from Quiet (<DLE>q) in that it can be used by the DTE in its discrimination algorithms as a means of determining if anything at all is coming from the remote station. If the DTE ignores the <DLE>s code, the modem automatically resets its timer and sends the code again if the #VSP time period again expires. This allows the DTE time to react to what may be a false detection of silence.

<DLE>t

Handset Off-Hook. Sent one time when the local handset transition from on-hook to off-hook is detected in any of the three voice submodes.

<DLE>u

Underrun. Sent in Voice Transmit Mode when the voice transmit buffer becomes empty without receiving a <DLE><ETX> or <DLE><CAN> command first. The modem remains in transmit mode, but issues the <DLE>u to indicate that silence is being generated. When the DTE resumes sending bytes, the modem allows a small number of bytes to build up in the buffer before re-enabling the transmitter

to avoid repeated underruns. However, with the underrun condition, the modem does not wait for the XOFF threshold (or timer) to be met before resuming, as it does on an initial transmit or resume operation because the remote listener may be unaware of the underrun, and keeping the silence short may serve to mask the underrun altogether.

<DLE>T

Timing Mark. Sent in Voice Receive Mode, and placed in the data stream at 1 second intervals, when enabled by #VTM = 10.

<DLE><ETX>

End of Stream. <DLE><ETX> is sent to denote the end of a voice data stream, similar to fax Class 1 and 2. This occurs in Voice Receive Mode only after the DTE issues the key abort.

9.2.5 Shielded <DLE> Commands from the DTE Most commands issued for voice are implemented as extensions to the AT command set, and are accepted only if the modem is in a valid command mode, such as Online Voice Command Mode. However, there are some operations which are available to the DTE without necessitating a switch to Online Voice Command Mode. The most obvious of these is the <DLE><ETX> which the DTE issues during Voice Transmit Mode to terminate an output message. Table 9-3 lists shielded <DLE> commands recognized by the modem.

Table 9-3. Shielded DTE Codes

Code Sent to Modem

Meaning

<DLE>p

Pause. Sent during Voice Transmit Mode to force the modem to suspend sending voice data to the selected output device(s). Any data currently in the voice transmit buffer is saved until either a resume (<DLE>r), or cancel <DLE><CAN>, is received, in which case the data is lost. If a <DLE><ETX> is received during the paused state, the modem processes it normally, and also automatically resumes transmission of the data left in the buffer (appended with <DLE><ETX>). Any other data received from the DTE while in this paused state is placed in the transmit buffer according to available space, with flow control active. (This command is ignored in other voice submodes.)

<DLE>r

Resume. Sent during Voice Transmit Mode to force the modem to resume sending voice data to the selected output device(s). Any data currently in the voice transmit buffer is now played. (This command is ignored in other voice modes.) The pause and resume commands are different than a simple suspension of data; data in the buffer is frozen and not played when the DTE pauses.

<DLE>E

Purge DCE Buffer. Sent during the transmission or reception of voice/audio data, by embedding the command in the voice data stream, to purge the corresponding DCE buffer. (See the <DLE><EOT> code.)

<DLE>u

Increment Playback Volume. Sent during audio mode to increment the playback volume. The <DLE>u action command allows the application to increase the playback volume of the headphone and speaker outputs during playback while in the data state. Each <DLE>u will increment the transmit level by 1 unit. Adjustment by a value greater than 1 may be achieved by transmitting a string of <DLE>u codes. For example, a string consisting of "<DLE>u <DLE>u <DLE>u <DLE>u <DLE>u" increases the playback volume by a value of 5 units. The <DLE>u code can be used to adjust the volume within the range of 128-228. (See <DLE><u> and <DLE><d> in Section 9.3.2.)

<DLE>d

Decrement Playback Volume. Sent during audio mode to decrement the playback volume. The <DLE>d action command allows the application to decrease the playback volume of the headphone and speaker outputs during playback while in the data state. Each <DLE>d will decrement the transmit level by 1 unit. Adjustment by a value greater than 1 may be achieved by transmitting a string of <DLE>d codes. For example, a string consisting of "<DLE>d <DLE>d <DLE>d <DLE>d <DLE>d" decreases the playback

volume by a value of 5 units. The <DLE>d code can be used to adjust the volume within the range of 128-228. (See <DLE><u> and <DLE><d> in Section 9.3.2.)

<DLE><CAN>

Cancel. Sent during Voice Transmit Mode to indicate that the DTE has finished transmitting a voice message and wants the modem to discard any remaining data in the voice transmit buffer. The modem immediately purges its buffer, and then responds with the VCON message entering Online Voice Command Mode. (This command is ignored by the modem when not in Voice Transmit Mode.)

<DLE><EOT>

Voice Bytes Buffered Query. Sent during the transmission or reception of voice/audio data, by embedding the command in the voice data stream, to learn the number of corresponding bytes buffered by the DCE at the moment the <DLE><EOT> command is received by the DCE. <DLE>XZBBC=n<DLE> is returned by the DCE, in which "n" represents the number of bytes buffered as a two byte hexadecimal value.

<DLE><ETX>

Terminate. Sent during Voice Transmit Mode to indicate that the DTE has finished transmitting a voice message. The modem completes transmission of any remaining data in the voice transmit buffer before responding with the VCON message and entering Online Voice Command Mode. (This command is ignored by the modem when not in Voice Transmit Mode.)

9.2.6 Voice Record

To effect recording of a message received via a handset or microphone, the DTE must configure the modem for Voice Mode (#CLS=8), and select the proper relay setup (#VLS) to instruct the modem whether to use the auxiliary device. The modem responds to the #VLS command by issuing a relay activate command to select the input device. When a device other than the telephone line is selected, the modem immediately enters Online Voice Command Mode (indicated by VCON). DTMF detection is therefore enabled as soon as the DTE selects the device, such as a handset, although the user still needs to physically pick up the telephone and press buttons. Even if the DTE has not entered Voice Receive or Transmit Modes (#VTX or #VRX), these DTMF tones are delivered via shielded codes identically to when a physical telephone connection exists but the DTE has not yet commanded receive or transmit. When the DTE decides to record the message, it issues the #VRX command and upon command receipt, the modem immediately switches to Voice Receive Mode. Since the microphone or handset is switched in, the modem immediately issues the CONNECT message indicating that the modem has switched to Voice Receive Mode and is beginning the transfer of ADPCM voice or PCM audio data as well as shielded DTMF tones, and other tones and statuses.

In this recording state, the modem (if so configured) monitors for line silence. If the #VSP period expires, the modem sends the <DLE>q or <DLE>s code to the DTE.

Recording can be canceled only via two events:

1. The DTE sends any character to the modem. This is the key abort, and is the normal method of terminating the receive mode.

2. The S30 Disconnect Inactivity timer expires, which is generally an undesired event.

9.2.7 Voice Playback

To effect playback of a message recorded via a handset or microphone, or of a message recorded during a voice call, the DTE must configure the modem for Voice Mode (#CLS=8) and select the proper relay setup (#VLS) to instruct the modem whether to use the handset or speaker. The modem responds to the #VLS command by issuing a relay activate command to select the input device. The hardware must provide a means of selecting a handset and/or microphone instead of the telephone line, as this input device. When a device other that the telephone line is selected, the modem immediately enters Online Voice Command Mode (indicated by VCON). DTMF detection is thus enabled as soon as the DTE selects the device, such as a handset, although the user still needs to physically pick up the telephone before he can issue DTMF tones. Once selected, however, the user can indeed pick up the telephone and press buttons. Even if the DTE has not entered Voice Receive or Transmit Modes (#VTX or #VRX), these DTMF tones are delivered via shielded codes, identically to when a physical telephone connection exists but the DTE has not yet commanded receive nor transmit.

When the DTE decides to play the message, it issues the #VTX command, and the modem immediately switches to Voice Transmit Mode. Since the speaker or handset is already switched in, the modem immediately issues the CONNECT message indicating that the modem is in Voice Transmit Mode and is expecting voice data from the DTE.

A subsequent <DLE><ETX> has to be issued to switch back to Online Voice Command Mode.

Volume Adjustment During Record

The record volume is adjusted automatically by an automatic gain control (AGC) circuit.

Volume Adjustment During Playback

The playback volume of the headphone and speaker outputs and handset can be adjusted by the #TL command (Section 9.3.2).

9.2.8 Voice Call Termination

Local Disconnect

The DTE can disconnect from a telephone call by commanding a mode change to Online Voice Command Mode (if not already in it), and by issuing the H command.

Remote Disconnect Detection

When in Voice Receive Mode, the modem sends the proper shielded <DLE> code when dial tone or busy tone is detected. The modem stays in Voice Receive Mode, however, until the DTE issues a key abort to force Online Voice Command Mode. The DTE must issue the H command if it wishes to hang up.

9.2.9 Mode Switching

Voice to Fax

If the modem is in Online Voice Command Mode (i.e., it has gone off-hook with #CLS=8 in effect), the DTE can attempt a fax handshake by setting #CLS=1, followed by the A or D command corresponding to fax receive or send. This has the effect of beginning a fax Class 1 handshake (see #CLS command).

Unsuccessful Fax Connection Attempt to Voice A fax handshake which does not succeed, attempted as the result of the DTE modifying the #CLS setting from voice (8) to fax (1), does not result in the modem hanging up, allowing the DTE the flexibility of commanding a switch back to Voice Mode with #CLS=8.

Voice to Data

If the modem is in the Online Voice Command Mode, the DTE can attempt a data handshake by setting #CLS=0 followed by the A or D command. This has the effect of beginning a Data Mode handshake according to the current Data Mode S-register and command settings.

Unsuccessful Data Connection Attempt to Voice

A data handshake which does not succeed, attempted as the result of the DTE modifying the #CLS setting from voice (8) to data (0), does not result in the modem hanging up, allowing the DTE the flexibility of commanding a switch back to

Voice Mode with #CLS=8.

9.2.10 Caller ID

The modem supports Caller ID by passing the information received in Bell 202 FSK modulation to the DTE after the first RING detect. The modem supports both formatted and unformatted reporting of Caller ID information received in ICLID (Incoming Call Line ID) format as supported in certain areas of the U.S. and Canada. The DTE enables this feature via the #CID command.

Voice AT Command Set

Command	Options	Function & Description	Ref.
+FCLASS=n		Service Class ID.	
	n=0 *	Select Data Mode.	
	n=1	Select Facsimile Class 1.	
	n=2	Select Facsimile Class 2.	
	n=8	Select voice mode.	

#V<command>?		Report Active Configuration.	
#V<command>=?		Report Operating Capabilities.	
A		Answering command in voice mode.	
D		Dial command in voice mode.	
H		Hang up in voice mode.	
Z		Reset from voice mode.	
#BDR		Select baud rate (turn off autobaud).	
#CLS		Select data, fax, or voice.	
	n=0	Data.	
	n=1	Class1 Fax.	
	n=2	Class 2 Fax.	
	n=8	Voice mode.	
#MDL?		Identify model.	
#MFR?		Identify manufacturer.	
#REV?		Identify revision level.	
#SPK=mu,sp, mic		Speakerphone setting. mu: sp mic	
#TL		Audio output transmit level (n=0000-7FFF).	
#VBQ?		Query buffer size.	
#VBS		Bits per sample.	
	n=2	Select 2 bits per ADPCM (valid for #VSR=7200).	
	n=4	Select 4 bits per ADPCM (valid for #VSR=7200).	
	n=8	Select 8 bits per ADPCM (valid for #VSR=7200).	
#VBT		Beep tone timer.	
	n=0	Disable the tone generation capability.	
	n=1-40	Set tone duration time.	
#VCI?		Identify compression method.	
#VGT		Set playback volume in the command state. N=128-228. Default:153.	
#VLS		Voice line select.	
	n=0 *	The telephone line interface should be routed through the modem. The OK response is sent to the DTE, and any previous connection is lost.	

	n=1	Route only the handset through the modem. Can be chosen before recording a greeting message.	
	n=2	route only the speaker through the modem.Can be chosen before playing back any message.	
	n=3	only the auxiliary input device (microphone) should be routed through the modem. Can be chosen before recording a greeting message.	
	n=4	the same as #VLS =0, except that the modem enables the internal speaker as well as the telephone line/handset circuit.	
	n=5	selects telephone emulation mode while in #CLS=8 mode. Speakerphone operation is entered during Voice On-line (VCON) mode after completing dialing (ATD) or answering (ATA).	
	n=6	Selects speakerphone mode while in #CLS=8 mode. Telephone emulation operation is entered during Voice On-line (VCON) mode after completing dialing (ATD) or answering (ATA).	
	n=7	valid after Voice On-line mode, mutes the local handset by switching the handset or speakerphone out of the telephone line path if in #VLS=0 or #VLS=6 mode.	
	n=8	Valid after Voice On-line mode. Engages the Caller ID relay to allow recording of conversation when using a handset by routing the signal to the audio codec (if populated).	
	n=9	Routes the handset to the sound codec to allow recording/playback of audio through the local handset.	
#VRA		Ringback goes away timer (originate). n=0-255 (0 - 2.55 sec), default:70	
#VRN		Ringback never came timer (originate). n=0-255 (0 - 2.55 sec), default:100	
#VRX		Voice receive mode.	
#VSD		Enable silence deletion (no function, command response only).	
	n=0,1	Provide no function other than command respond compatibility.	
#VSK	n=255	Buffer skid setting.	

#VSP		Silence detection period (voice receive). n=0-255 (0 - 2.55 sec), default:55	
#VSR		Sampling rate selection.	
	n=7200 *	7200 Hz sampling rate for ADPCM or PCM.	
	n=11025	11025 Hz sampling rate for PCM only.	
#VSS		Silence detection tuner (voice receive).	
	n=0 *	Disables silence detection in Voice Receive Mode	
	n=1	Least sensitive setting.	
	n=2	Midrange setting.	
	n=3	Most sensitive setting.	
#VTD		DTMF/tone reporting.	
#VTM		Enable timing mark placement.	
	n=0 *	Disabled.	
	n=10	1 second interval	
#VTS		Generate tone signals.	
#VTX		Voice transmit mode.	
#FPP:		Select packet protocol	
#VGR:		Voice Receive gain	