OWNERS MANUAL

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External 2400 bps Modem
With Send/Receive Fax

For IBM PC-Compatible Computers

This is a brief summary of the manual, designed to save you time.

The **"General Information"** chapter summarizes the features of the faxmodem and discusses data communications and fax software. This section is optional reading.

"Connecting the FaxModem" is a must for first time modem users. You may not need to read this chapter if you've installed modems before. If you haven't you should read the entire chapter and follow the instructions carefully.

"Getting Ready to Communicate" helps guide you in the configuration of your faxmodem and software, and explains the function of the status lights, non-volatile memory, and the speaker.

The **"Troubleshooter's Guide to Common Problems"** details the most common problems and solutions relevant to installing and using the faxmodem.

"User Modes" is a discussion of the three modes of operation of the faxmodem. For modem operation these include Command Mode and Data Mode, including the Modem Escape Code and Modem Transmission Speed. For the most part, you do not need to read this chapter if, like most modem users, you will only be controlling your modem through your communications software, or if you are already familiar with these aspects of operation with a Hayes-compatible modem. Fax Mode is also discussed briefly in this chapter. A more detailed discussion of fax operation can be found in the manual accompanying your fax software.

The **"Command Set"**, **"Dialing"**, and **"Diagnostics"** chapters are primarily for programmers interested in the detailed operation of the faxmodem. The typical user does not need this information, since these functions are normally handled by the communications or fax software, eliminating any need to give commands directly to the faxmodem.

(continued)

This faxmodem combines a 2400/1200/300 bps Hayes-compatible modem with 9600/7200/4800/2400 send fax capability and 4800/2400 receive fax capability. It uses a Rockwell class 1 modem chip for superior performance, and plugs into the serial port of any computer, including laptops and notebooks. Thanks to its small size and light weight, it is extremely transportable.

General Description

This faxmodem is a Hayes and CCITT V.22 bis/V.22 compatible auto-dial/auto-answer modem that provides all the fallback and operation requirements for asynchronous data communications at 2400, 1200, and 300 bps, and supports all the current Hayes commands for asynchronous operation, including all S Registers, AT Commands, and Dial Commands. It also supports the V.27ter and V.29 fax protocols for sending a fax at 9600, 7200, 4800, or 2400 bps and receiving a fax at 4800 or 2400 bps, and can automatically sense and adjust to the speed of a slower fax machine. Settings and phone numbers can be saved to the modem's non-volatile memory.

Special features include superior call progress tone detection, a high-power micro speaker and amplifier with software volume control for better call monitoring, adaptive equalization, and MOV varistor lightning protection.

The faxmodem supports the Rockwell Protocol Interface, to facilitate efficient software implementation of error correction (V.42, MNP2-4) and data compression (V.42bis, MNP5). With appropriate software, this modem will perform these functions as well as modems that do so via hardware.

Key Features

Your faxmodem has the following features:
- Compatible with Hayes AT commands, S registers, dial modifiers, and fax commands
- Supports operation for the following protocols:
  - CCITT V.22 bis (2400 bps International Standard)
  - Bell 212A (1200 bps U.S. Standard)
  - CCITT V.22 (1200 bps standard used in most countries outside the U.S.)
  - Bell 103 (300 bps U.S. Standard)
  - CCITT V.27ter (4800/2400 bps Fax Standard) transmit and receive
  - CCITT V.29 (9600/7200 bps Fax Standard) transmit
- Incorporates Rockwell Protocol Interface to achieve V.42/MNP2-4 and V.42bis/MNP5 support without additional hardware (appropriate software required)
- Adaptive Equalization
- Automatic speed selection/Automatic fallback to slower speed
- Facsimile is Group III, EIA-578 Service Class 1
- Data/fax handshake discriminator
- Full and half duplex operation

- Auto-originate and auto-answer modes
- Non-volatile memory
- Forced originate and answer modes
- Auto reverse mode
- 40-character command buffer for chaining commands
- Automatic Diagnostics
  - Power-up Self Test
  - Local and Remote Analog Loopback
  - Local and Remote Digital Loopback
- Dialing Capabilities
  - Autodial in tone, pulse, or a combination of tone and pulse
  - Reverse mode dialing
  - Dials up to 36 digits
  - Call progress tone detection
  - Manual dial override
  - Programmable number of rings before answer

Modem Communications Software

Most modem users will use data communications software to operate the modem; that is, to send data from the computer to the modem and vice-versa. Most communications software goes well beyond this point. For example, software with "file transfer" capability is capable of sending a file from your computer to another computer.

When functioning as a modem, the faxmodem can be controlled without communications software by using AT commands. For example, you might use AT commands when using the modem with a terminal or other device that does not have the capability to run software. In this case, the modem would directly control the basic functions required to take the outgoing data from the serial port of your computer and send the incoming data through the serial port to be displayed on the monitor screen, the simplest form of modem communications.

External modems generally do not come with software, since they can be used with virtually any computer or terminal and software must be computer-specific. Since the faxmodem's modem is compatible with the Hayes AT commands, S registers, and dialing commands, you can use it with virtually communications software written for your computer.

This modem also includes the Rockwell Protocol Interface (RPI) to support error correction (V.42, MNP2-4) and data compression (V.42bis, MNP5). To take advantage of these features, your software must support RPI.

Fax Software

You will also need software to control the class 1 fax capability of your faxmodem. Since fax control commands are not yet fully standardized, it is possible that certain fax software may not be compatible with this faxmodem. Make sure that your fax software is for Class 1 faxmodems.

Introduction

This chapter describes the connection of your faxmodem to a personal computer or terminal. Connecting the faxmodem to other serial devices is similar. The main difference is the type of cable used and the method of configuration. We have included a brief discussion in this chapter of the types of cables that are normally used to connect the faxmodem to computers, terminals and other serial devices.

As discussed in the "General Information" chapter, the fax capability of this faxmodem requires fax software, and therefore can not be used with a terminal or with computers for which fax software is not available.

If you are an experienced modem user, you may not need to read this chapter. Otherwise, you should read the chapter in its entirety.

Major topics discussed in this chapter are:

- Connection Diagram

- The Serial Connector

- The Serial Cable

- Serial Connector Pin Assignments

- Making the Serial Connection

- The Phone Line and Telephone Connections

- The Power Cube

- Power Up and Installation Testing

Connecting the FaxModem

This section explains the procedure for connecting the faxmodem to the phone line, the power, the PC or other serial device and, if desired, a telephone.

Once the faxmodem is connected it must be configured. Configuration is covered in the next chapter, "Getting Ready to Communicate".

Connection Diagram
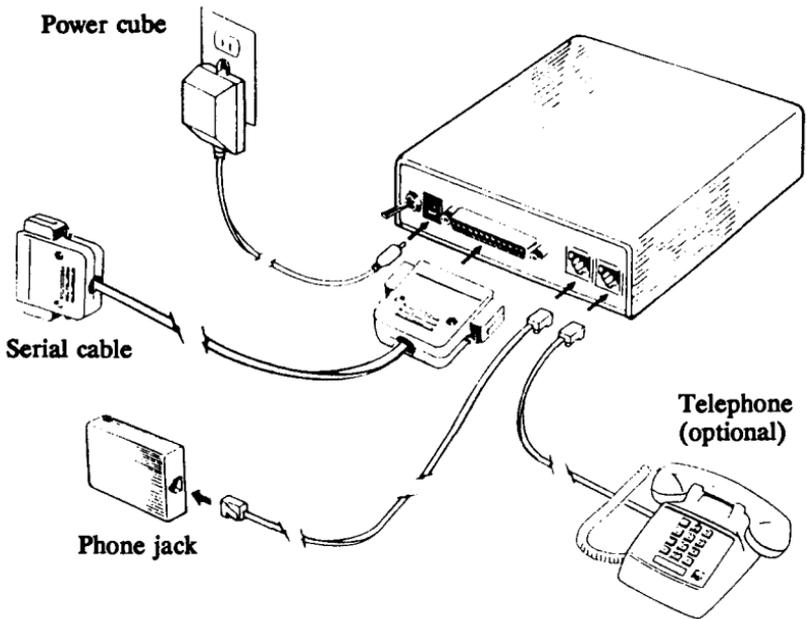
The Serial Connector

To connect the faxmodem to your computer, the computer must have an unused serial port, also known as an RS-232 interface. The jack that you plug this serial connection into comes in several different shapes, but the most common by far is the DB-25 connector, followed by the "DB-9" on older MacIntosh computers, and the "Circular 8" on the Mac Plus and the Mac SE. These connectors are illustrated on the following page.

Common Serial Connectors
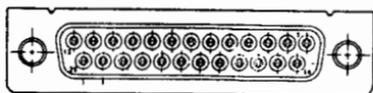
DB-25   Mini Circular 8   DB-9
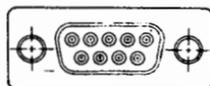
On computers with plug-in expansion slots like the IBM PC and compatibles, the serial port is normally part of an expansion card, and therefore can be found at the expansion card slot openings at the back of the PC. Many other machines, particularly those without expansion slots (including laptops and other portables), have the serial port built-in. Either way, it will normally be labeled "serial port" or "RS-232C".

The Serial Cable

External modems and faxmodems normally do not come with serial cables, since each computer requires a different cable depending on the type of serial connector it uses and how that connector is wired.

Since the serial port of this faxmodem is compatible with the Hayes 2400 external modem, the easiest way to specify the correct cable to your computer dealer is by asking for the cable to connect a Hayes 2400 modem to your brand and model of computer.

If you are using a Macintosh computer, see Appendix F for information about the correct cable to use.

More About Serial Cables

There are two types of serial configuration: Data Communications Equipment (commonly known by the initials DCE) and Data Terminal Equipment (commonly known by the initials DTE). The serial port of this faxmodem is configured as Data Communications Equipment (DCE), just like the Hayes Smartmodem 2400. The serial ports of all terminals and most computers are configured as Data Terminal Equipment (DTE).

Each type of computer requires a special cable with a male (with the pins sticking out) DB-25 connector on one end to plug into the modem, and the appropriate connector for your computer or terminal on the other end. Therefore, if your computer is configured DTE (and most are), you should ask for a DTE-to-DCE straight-through cable with a male DB-25 connector on one end, and the appropriate connector for your computer or terminal on the other end. It is preferable that the cable be shielded.

Some computers (but not many) are configured DCE instead of the normal DTE. For these computers, instead of a straight-through cable, you would ask for a "null modem cable" (sometimes called a "crossover cable" or a "modem eliminator cable").

Serial Connector Pin Assignments *

Pin No.	Label	Description	Direction
1	N/A	Protective ground	N/A
2	RXD	Received data	to modem
3	TXD	Transmitted data	from modem
4	RTS	Request to send	to modem
5	CTS	Clear to send	from modem
6	DSR	Data set ready	from modem
7	N/A	Signal ground (common return)	N/A
8	RLSD	Received line signal detector	from modem
12	CI	Modem speed indicator	from modem
20	DTR	Data terminal ready	to modem
22	RI	Ring indicator	from modem

* A more complete description of the function of each line appears in Appendix E, "Serial Connector Pin Assignments".

Making the Serial Connection

Once you have the proper cable to connect the faxmodem to your computer, the most difficult part of the job is done.

To complete the serial connection, just plug the cable into the connectors on the faxmodem and the computer, and if the connectors have locking screws, turn them until they are tight (but not too tight) to hold the connectors in place.

The Phone Line and Telephone Connections

There are two standard modular phone jacks (RJ11C) on the faxmodem. One of these jacks goes to the wall jack where you would normally plug in a standard single-line telephone. If you would like, you may plug a standard single-line phone into the other. You do not need to plug in a phone to use the faxmodem, but you may find it convenient to have a phone beside your computer.

The two phone jacks on the faxmodem are interchangeable. You may plug the telephone or the cord connecting the faxmodem to the phone line into either jack.

The cord provided for connecting the faxmodem to the phone line has a modular RJ11 plug on both ends. If your phone system does not have modular jacks, you will need a modular adapter, sold at most hardware stores or any place that telephone accessories are sold.

If you are installing the faxmodem on a multiple line office phone or electronic key system, see the Appendix B, "Connecting the FaxModem to the Telephone Line".

The Power Cube

The power cube that comes with the faxmodem plugs into any standard 110 volt, 60 cycle outlet, the kind found in the U.S.. The faxmodem must be used only with the power cube that came with it.

Simply plug the power cube into any standard outlet, and then into the jack marked "Power".

Power Up and Installation Testing

Flip the power switch on your faxmodem to the ON position. The MR (Modem Ready) light should come on. Depending on various modem settings and factors external to the modem, other lights may also be on.

When you first turn on the faxmodem, it automatically performs a self-test to verify that it is functioning properly. This test operates in the "analog loopback mode" using internally generated test patterns. If an error is found, it will send an error message to the monitor the first time it is used.

Introduction

Now that you have connected your faxmodem, you're ready to start communicating.

Whether you're using the faxmodem with communications software or with a terminal, there is some configuration that will need to be done before you actually start communicating.

Major topics discussed in this chapter are:

- Using the FaxModem with a Personal Computer

- Setting Up Your Modem Communications Software

- Entering the Initialization String and Dial String

- Special Dial String for "Call Waiting" Customers

- Running a Brief Modem Test

- Setting Up Your Fax Software

- Using Your Faxmodem

- Using the Modem with a Terminal

- Using the Modem with a Printer or Other Serial Device

- The Status Lights

- Using Non-Volatile Memory for Power-Up Configuration

- Monitor Speaker

Using the FaxModem with a Personal Computer

To use your faxmodem with a personal computer, you will need modem communications software <u>and</u> fax software. Each type of computer (for example, IBM PC or compatible, Apple IIe, Macintosh, etc.) requires communications software written especially <u>for that type of computer</u>. For this reason, external modems often do not come with software.

Since the faxmodem's modem is fully compatible with the Hayes AT command set, the S registers, and the Hayes dialing commands, it will work with virtually any communications software written for your computer.

Most communications software will allow you to configure modem communications parameters by setting up and saving an "initialization sequence". That way, the software sends the proper configuration to your modem every time you start the program. (Note: the modem will receive the initialization string <u>only</u> if it is turned on prior to starting your program.) Most software packages allow you to keep a directory of your frequently called data communication numbers, and let you configure communications parameters differently for each one.

Your communications software manual will cover the procedures for configuration in detail.

Unfortunately, faxmodems are not as standardized. If you have a computer other than a PC compatible or Mac there may not be compatible fax software available for it, and the fax capability requires software for its use.

Setting Up Your Modem Communications Software

Install your modem communications software according to the instructions that came with the program. Some programs do not come with printed manuals but contain the manual on disk. The first time you use your communications software, you will probably need to tell the software which serial port the modem is using (typically "COM1" or "COM2"). You may also be asked to select the "modem type" from a menu. If you don't see this modem listed by name on the menu, select "Hayes Smartmodem 2400B", or another Hayes-compatible 2400 baud modem.

If your software suggests an initialization string for this modem, you should use it. This string of commands will be sent to the modem each time you start the communications program, assuming the modem is already turned on. If this modem is not listed by your software and no initialization string is suggested, use the following initialization string:

AT &F &C1 &D2

Note, however, that if you have saved any settings in the modem's non-volatile memory (described in a later section of this manual), the contents of the initialization

string will override what you have stored there. In particular, the &F command resets the modem to factory default values. Therefore, if you have saved non-default settings in non-volatile memory, remove the &F from the initialization string.

If the software does not provide a dial string, use

ATDT

If your telephone service includes "Call Waiting" and you can turn it off by dialing *70 before the telephone number, use the following dial string instead of the one above:

Dial String: **ATDT*70,**   (note: be sure to enter the ,)

If your software asked you to specify the type of modem you are using, there is probably nothing more you need to do to configure it further. However, if you did not specify the type of modem, you can check the following settings (which should resemble this list):

Dialing command suffix:	<CR> or ^M or !	[Note: this differs from one program to another.]
Hangup command:	~~~+++~~~ATH0 <CR>	[Note: ~ means pause. Use the pause character required by your program.]
Auto-answer command:	~~~+++~~~ATS0=1 <CR>	[See previous note.]
Wait for connection:	45 (seconds)	
Pause between redial:	1 (second)	
Auto-baud detect:	ON	
Drop DTR to hang up:	YES	
Send init if CD high?	YES	

5) Running a Brief Modem Test

To confirm that your modem is communicating with your computer, you can perform the following test:

Run your modem communications software in "terminal", "local", or "dumb" mode. In many programs this is the mode entered automatically when the program starts. Type **AT** and press [enter]. You should see

AT
OK

Setting Up Your Fax Software

If fax software came with your faxmodem, it is pre-configured, but you will still need to tell it which serial port you are using. The setup menu will ask you to make some

other decisions, for example, the number of rings before answering and decisions relating to the formatting of the page. These are covered in more detail in your fax software manual.

Using Your FaxModem

After you set up your communications software and fax software, you are ready to start using your faxmodem. While you may want to read further in the manual at this point to learn about the AT command set, your best bet is to get familiar with the software that you are using to control the faxmodem, and then to learn by doing. Get started! Try calling a bulletin board, calling a friend with a modem and transferring a file, and sending some faxes.

Using the Modem with a Terminal

If you're using the modem with a terminal, you can configure most communications parameters using DIP switch settings on the terminal. See your terminal's instruction manual to determine the exact settings required. The fax capability of your faxmodem will not work with a terminal.

To change other settings (or if your terminal can not be configured using DIP switches) you can give AT commands from the keyboard of the terminal, and you can store certain configuration information in the faxmodem's non-volatile memory. For more information about non-volatile memory, see the section "Using Non-Volatile Memory Instead of DIP Switches for Power-Up Configuration" in this chapter. The "Command Set" chapter provides details about the AT command set.

Using the Modem with a Printer or Other Serial Device

If you want to use the modem with a printer or other serial device that does not have a keyboard, you'll need a computer or terminal that does have a keyboard to do the configuration. Plug the faxmodem into the serial port of the computer or terminal and plug in the power cube. You may then configure the modem by typing in the appropriate commands from the keyboard.

Once you have done the configuration, you can disconnect the faxmodem from the computer or terminal. If you unplug the power cube or turn the faxmodem off, or you will lose any configuration parameters that you have not stored in non-volatile memory.

The Status Lights

There are eight status lights on the front of the modem. These lights let you follow the operation of the modem as it dials, connects, answers calls, and sends or receives data.

The function of each light is briefly described below.

HS (High Speed)	Modem is operating at 2400 bps or faster.
AA (Auto-Answer)	Modem is set to answer incoming calls automatically. This can be done by using AT commands or your software. The light will go off with each ring when there is an incoming call. The modem will answer after the number of rings specified by Register S0. However, the default value of 0 (none), means that the modem will not auto-answer unless you change the register setting.
CD (Carrier Detect)	Modem has detected a carrier signal from a remote modem or fax machine.
OH (Off Hook)	Modem has taken control of the telephone line; it is drawing DC current from the line, similar to an off-hook telephone.
RD (Receive Data)	Data is being transferred from the modem to your computer or other serial device.
SD (Send Data)	Data or commands are being sent from the serial port of your computer or other device to the modem.
TR (Terminal Ready)	Modem is receiving the Data Terminal Ready signal from the terminal or computer. If you are using a Macintosh, you may not see this light.
MR (Modem Ready)	Modem is receiving power. When the modem is in self-test mode, it will flash.

Using Non-Volatile Memory Instead of DIP Switches for Power-Up Configuration

The non-volatile memory feature allows you to set the configuration that your modem will use on power-up. Non-volatile memory can be very important, because some communications software packages require that your modem be in a specific configuration or they will not operate correctly. The non-volatile memory allows you to set your modem to power-up in the configuration required by your software.

Some older software packages have instructions for setting the modem's DIP switches, because many 1200 bps modems used DIP switches for configuration. To use your modem's non-volatile memory, you just issue a single command to "set" each "switch". From then on, the modem will always power-up with the right setting, unless you issue a command to change the setting.

The chart below shows how the non-volatile memory duplicates the function of the DIP switches, and shows the memory's factory default configuration. The factory

default configuration is chosen so that no change will need to be made for the vast majority of software packages.

If you are experiencing a problem with your modem, particularly if your software will not acknowledge the modem, is unable to dial, or says that carrier is not present before the modem has dialed, check to see what your software requires for the settings of Data Terminal Ready (DTR) and Data Carrier Detect (DCD). If you need to change the settings, refer to the chart below and to a discussion of this issue in the "Troubleshooter's Guide to Common Problems".

DIP Switch Equivalent	DIP Switch Setting	Function	AT Command to Set Non-Volatile Memory (* = Default)
1	UP	Modem Follows DTR	AT&D2&W0&Y0
	DOWN	Modem Ignores DTR	AT&D0&W0&Y0 *
2	UP	Verbal Result Codes	ATV1&W0&Y0 *
	DOWN	Numeric Result Codes	ATV0&W0&Y0
3	UP	Result Codes Disabled	ATQ1&W0&Y0
	DOWN	Result Codes Enabled	ATQ0&W0&Y0 *
4	UP	In Local Command State, Echo Characters	ATE1&W0&Y0 *
	DOWN	In Local Command State, Do Not Echo Characters	ATE0&W0&Y0
5	UP	Auto-answer On	ATS0=1&W0&Y0
	DOWN	Auto-answer Off	ATS0=0&W0&Y0 *
6	UP	DCD Follows Carrier	ATC1&W0&Y0
	DOWN	Forces DCD Always On	ATC0&W0&Y0 *

If you ever want to switch ALL of the settings back to the factory default configuration, use the command: **AT&F**

Modem Speaker

Your modem has a speaker for monitoring dialing. Volume is controlled by using the AT Commands L1, L2, and L3 to set low, medium, and high volume respectively. Your modem is shipped set for medium volume. You may find it convenient to specify the speaker volume in the software initialization string, as shown earlier in this chapter. For more information on speaker control commands, including the commands for storing a different default volume setting in the modem's non-volatile memory, see "AT Commands" in the "Command Set" chapter.

The following are the most common causes for error:

1) If all the characters that you type appear twice on the screen, your communications software may be set for "half duplex" when it should be set for "full duplex". This can be corrected by using your communications software configuration menu to change from half to full duplex.

2) Your software's selection of the number of data bits, the parity, and the number of stop bits is different from the modem that you're calling. You should normally use 8 data bits, NO parity, and 1 stop bit (8,NONE,1). The second most common setting is 7 data bits, EVEN parity, and 1 stop bit (7,EVEN,1). If you call another modem and connect, but get **incomprehensible characters displayed** (even after some normal connection noise), try changing these settings.

3) You are calling a modem set up for one speed, and you are at a different speed. Some 2400 bps information services have dedicated lines that can only communicate at 2400 bps. Therefore, if you call them with a 300 or 1200 bps modem speed you will not be able to communicate. On the other hand, many bulletin boards and other services will adjust to the speed of the calling modem.

4) Your communications software has not been set up properly. Re-check the initialization string and dial string specified in your software manual and in "Setting Up Your Modem Communications Software". Remember that commands in the initialization string are sent to the modem each time you start your software and will override settings stored in the modem's non-volatile memory.

5) You are turning your modem on after you start up your software. This can cause a problem, because most programs will send an initialization string to the modem when the software starts up. If the modem is off at that time, it will not receive the initialization string. Solution: Turn on your modem, then start up your software.

6) If your software requires that your modem ignore DTR (which is the modem's default setting) and you are using the &D2 command in the modem initialization string or have stored it in non-volatile memory, your modem will not work properly. If this is the case, store the &D0 command in non-volatile memory:

AT&D0&W0&Y0

Also, make sure that the modem initialization string does not contain &D2.

Conversely, if your software requires that your modem follow Data Terminal Ready, the above considerations apply in reverse. If you are having problems, include &D2 in the modem initialization string.

7) If your software requires that DCD always be forced ON (which is the modem's default setting), and you are using the &C1 command in the modem initialization

string or have stored it in non-volatile memory, your modem will not work properly. If this is the case, store the &C0 command in non-volatile memory:

AT&C0&W0&Y0

Also, make sure that the modem initialization string does not include &C1.

Conversely, if your software requires that Data Carrier Detect follow carrier, the above considerations apply in reverse. If you are having problems, include &C1 in the modem initialization string.

8) Your modem's power-on setup is not what your communications software wants. Be sure you know what setting the software wants, and re-read "Using Non-volatile Memory Instead of DIP Switches for Power-up Configuration". In general, you can use the software's modem initialization string to solve this type of problem.

9) You are communicating in or with an area outside the USA where you need to generate a special tone called a "guard tone" to disable echo suppressors. Guard tones are set with the &G command, as discussed in the Command Set chapter, under AT Commands.

10) Your faxmodem works as a modem but will not fax. Make sure that your fax software is intended for use with Class 1 faxmodems. If you are using a Macintosh, make sure that you have the right cable. See Appendix F.

Introduction

This chapter describes the modes of operation of the faxmodem, the command mode and the data mode. It also lists the result codes used in each mode to keep the user informed of the status of communication and convey that status to the software.

This chapter also describes in detail the AT command set for both modem and fax communications, and other commands used for direct control of the faxmodem. Normally you will not need to use these commands. Your software acts as a friendly interface to the faxmodem, isolating you from the AT command set, so it's most important that you first familiarize yourself with the commands and procedures of your specific modem or fax software.

Major topics discussed in this section are:

- FaxModem Communication Modes - Command and Data Modes

- The Escape Code

- Modem Transmission Speed

- Fax Transmission Speed

- Faxmodem Result Codes

FaxModem Communication Modes

Your modem's hardware operates in one of two possible modes: the command mode or the data mode. Upon powerup or after reset, the modem will automatically perform a self-test. Immediately following this test, the modem enters the command mode configured in the default configuration, or if non-volatile memory is installed, in the configuration specified there.

Command Mode

In command mode, the user communicates with the modem via AT commands. This mode is used for modem configuration or dialing. After execution of an AT command, the modem will return result codes to show that the command has been executed. The result codes are detailed later in this chapter and a complete listing of the AT commands appears in the next chapter. After a connection has been established with a remote modem or fax, the faxmodem enters data mode, unless otherwise specified by the dial modifier.

If you are using communications software, you won't need to use AT commands in most instances. The software works as your interface to the modem, providing a more user-friendly way to give commands and change configuration settings. The software will use AT commands to tell the faxmodem whether to communicate as a modem or a fax, to change settings, and control faxmodem operation.

Data Mode

In data mode, the faxmodem receives characters from your computer, converts the data to analog signals, and then transmits these signals over the telephone line. The faxmodem also receives analog signals from the telephone line when in data mode and converts them to digital signals for use by your computer. When the faxmodem is sending or receiving modem data (as opposed to fax data) it constantly checks the data stream for the "escape code" sequence.

The "Escape Code"

When you turn on your computer the modem automatically enters the command mode, and when you connect to another modem it automatically enters data mode.

Since the modem will not respond to any commands in the data mode during modem communications, the escape code allows you to return to the command mode at any time. After using the escape code to get to command mode, type **ATO** (the Online Command) to get back to data mode. The escape code will only work during modem communications.

You may also use one of the other data call termination procedures to go from data mode to command mode, as described in "Modem Call Termination".

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The default escape code sequence is + + + preceded and followed by 1 second with no data. The escape character may be changed from + to something else by changing the S2 register; this may be appropriate when using Compuserve or some other service whose modem may "escape" due to the service's echoing of the + character, resulting in your call being disconnected.

The "escape code guard time" is defined as the time delay between the last character of the escape code transmitted and the next data character. The default time is one second. The escape code guard time is set by changing register S12. The escape code character must be entered three consecutive times, followed by the escape code guard time, a period of time during which no characters are sent.

Simply put, if you want to send a command to your modem while you're in Data Mode, do the following:

1) Type nothing for one second.
2) Type + + +   (Don't type [enter].)
3) Wait one second before typing any other character.

The modem returns to the command mode and sends the result code 'OK'.

Modem Transmission Speed

For two modems to communicate with each other, they must connect at the same transmission speed (either 300, 1200, or 2400 bps), and your communications software must also be set for the correct speed so that it can interpret the incoming data.

Ideally, you should know in advance the speed that the answering modem is set for, and set your modem to the same speed using your communications software setup menu. Software that has a dialing directory will normally let you configure the speed (and other parameters) in advance differently for each modem number that you call, so that you won't have to set the speed every time.

Of course, it's not always possible to know the speed of the modem that you're calling, and the tricky thing is that two modems will connect even if they are set for different speeds (the only exception to this is when the answering modem is "300 bps only" in which case the originating modem must be set for 300 bps or there will be no connection).

Most modems can "fall back" to a slower speed automatically to establish connection to a slower modem. The speed at which the connection is actually established is displayed on your monitor with the result codes CONNECT (which means 300 bps), CONNECT 1200, or CONNECT 2400.

Some software will fall back to a slower speed automatically. However, if you see garbled characters displayed after connection, the problem may be that your software does not do this. If you change your communication software setting to the speed displayed by the connect message, the problem should disappear.

Fax Transmission Speed

This faxmodem can send faxes at 9600, 7200, 4800, and 2400 bps. It can receive faxes at 4800 and 2400 bps.

Since the fax "handshake protocol" automatically "negotiates" the transmission speed (that is, it automatically makes sure that the two fax devices are connected at the highest mutually compatible speed), you don't have to worry about setting the speed correctly in fax mode.

Faxmodem Result Codes

There's a good chance that you will never encounter fax result codes, since your software most likely intercepts them. However, you probably will see data mode result codes.

Result codes are the verifications that commands have been executed. Result codes may be selected as English words or numeric digits, or they may be disabled entirely (see "Set Commands"). For screen display purposes, word result codes are followed by a carriage return/linefeed sequence; numeric result codes are followed by a carriage return only. The following table lists the data mode result codes.

Data Mode Result Code Table

Digit Code	Word Code	Meaning Of Code
0	OK	Command line executed without errors
1	CONNECT	Connection established at 300 bps
2	RING	Local ringing signal detected
3	NO CARRIER	Carrier lost or never detected
4	ERROR	Error in the command line
5	CONNECT 1200	Connection established at 1200 bps
6	NO DIALTONE	No dial tone detected
7	BUSY	Busy signal detected
8	NO ANSWER	No silence detected when dialing a system not providing a dial tone
10	CONNECT 2400	Connection established at 2400 bps

Introduction

This chapter describes the AT command set. If you're using communication software and fax software, you shouldn't have to use AT commands. Your modem will be controlled by your communications software. However, if you are writing software that you want to control the modem, or if you want to understand the "behind the scenes" operation of the modem, you'll want to learn more about the AT command set. Major topics discussed in this chapter include:

- Command Execution

- Command Structure

- AT Immediate Commands

- AT Set Commands

- AT Fax Commands

- S Registers Table

- Description of S Registers

Command Execution

Your modem accepts only ASCII characters (loosely speaking, the characters on the keyboard) as commands. The commands entered while the modem is in command mode are stored in a memory buffer that is 40 characters long. Unless the echo back is disabled (E0 command), these characters will also be echoed back to your computer and displayed on the monitor screen. Upon seeing a carriage return showing that the command is ended, the command is compared to a list of valid commands, and if a match is found, the function associated with the command is executed.

<u>A command line must start with the Attention code AT.</u> Commands may be strung together in a single command line. If desired, each command may be separated by a space for readability; however, the command string may not exceed 40 characters and spaces. The command or string of commands will be executed when you enter a carriage return, and a result code is sent back after the <u>last</u> command that is executed in the command string. If there is an error in the command string, the subsequent commands in that string will not be executed. The result codes are displayed on the monitor, unless they have been intentionally disabled.

Command Structure

It is very important that certain guidelines for issuing commands to the modem are followed.

If an error was made while entering a command in command mode, it can be edited at any time (before pressing the return key). Pressing the backspace key deletes the last character entered. By pressing the backspace key repeatedly, the entire command line may be deleted, except for the AT command at the beginning of the command line.

Each command line <u>must</u> end with a carriage return (press [enter]). The modem does not begin command execution until it receives a carriage return.

Spaces and hyphens are ignored. Commands may be entered in either upper or lower case, but must not change case within the same line.

A missing parameter in a command that requires a parameter to fully define the command evaluates to zero. For example, ATH is the same as ATH0.

The command buffer is 40 characters long. If a command line exceeds 40 characters, the modem will abort execution of the command line and display an error message.

AT Modem Commands

The faxmodem's modem command set consists of two types of commands: Immediate Commands and Set Commands. The Immediate Commands will always use the current default settings, unless the command specifies otherwise. The table below lists the Immediate commands and their functions.

AT Immediate Commands

Command	Function
AT	Command line prefix. The ATtention command precedes all other commands listed below except for A/ and the escape code. For example, the command DT would be typed ATDT.
A/	Repeat the previous command (not to be preceded by AT). Should not be followed by <CR>.
A	The modem is set to answer mode and goes off-hook immediately.

(continued)

Command	Function
Dn	Dial the number immediately following this command, where n is the number to be dialed, or that number combined with other dial modifiers as shown below. Any combination of the dial modifiers listed below may be strung together to perform the desired dialing sequence.

<u>Dial Modifier</u>   <u>Function</u>

T	Touch tone dialing
P	Pulse dialing (default)
R	Reverse mode. Puts modem in answer mode immediately after dialing.
W	Wait for a continuous tone before dialing the next number. Useful for dialing procedures requiring such a wait. The modem waits for the number of seconds set by register S7 for the tone to occur. If the tone is not heard, BUSY or NO DIALTONE is issued.
@	Wait for a "quiet answer" - one or more rings followed by 5 seconds of silence - for the length of time specified in register S7.
,	Pause the length of time specified by S8 (default = 2 sec.). Each comma equals the pause length specified. You may use as many commas as you like.
!	Flash. This character can be used to go temporarily on-hook in order to get a new dialtone. (Note: Some software uses ! as a carriage return).
;	Remain in the command state after dialing. The semicolon can only be placed at the end of a dial command.
S=n	Dial stored number 0, 1, 2, or 3 that has been previously stored in non-volatile memory using the &Zn command.

0-9 # * ABCD	Characters that may be used in dialing. # * and ABCD are for tone dialing only
Dial example 1:	AT DT1234567 This example tells the modem to tone dial the number 123-4567. Blank spaces within a command are ignored.
Dial example 2:	ATDP9W411,,,,, This example tells the modem to pulse dial 9, wait for a second dialtone, tone dial the number 411, and pause 10 seconds. Further dial modifiers (but not commands!) could be added on the same line.

Command	Function
Hn	Controls the modem on/off hook relay n = 0, on-hook (disconnected) n = 1, off-hook
In	Returns product ID/checksum. n = 0, returns product ID. n = 1, Normally this performs a checksum, but on this modem the datecode is returned. n = 2, performs checksum, returns result code. n = 3, returns ROM part # and revision level
On	Puts modem in the online data mode. n = 0, online n = 1, online with equalizer retrain sequence (2400 bps only). Issuing an 'On' command always takes modem off-hook.
Zn	Causes a software reset, with registers set to configuration stored in non-volatile memory. Commands following this on the same line are not executed. n = 0, Recall profile 0 (stored using &W0 command) n = 1, Recall profile 1 (stored using &W1 command)

AT Set Commands

Set commands are used to configure the modem, allowing you to select operation speeds and standards, result code format, and various other options. The default configurations are listed first.

Command	Function
Bn	Selects V.22 or Bell 212A in the 1200 bps mode. n = 1, Bell 212A with 2225 Hz Answer Back Tone n = 0, CCITT V.22 with 2100 Hz Answer Back Tone
En	Determines whether the modem echoes the data received in the command mode back to the local computer. n = 1, echo on n = 0, echo off
Ln	Speaker Volume n = 2, medium n = 0 or 1, low n = 3, high

Command	Function
Mn	Speaker Control n = 1, speaker on until carrier detected n = 0, speaker off n = 2, speaker always on n = 3, speaker on after dialing until carrier detected
Qn	Result codes on/off. n = 0, codes are sent n = 1, codes are <u>not</u> sent
Sr?	Reads the contents of status register r.
Sr=n	This command may be used to modify an S Register of the modem. It assigns a value n to the status register r. Registers may be reset to the default values by issuing an '&F' or 'Z' command. See "Modem Registers Table" for a list of S registers.
Vn	Sets result code format. n = 1, words n = 0, numeric
Xn	Sets dialing mode, result code format for dial command. The Vn command determines if the result code is sent as words or digits. (See "FaxModem Result Codes" for a complete listing of codes.) n = 4, Dialtone and busy signal detected. Result codes 0-7 and 10 enabled. n = 0, Dialtone and busy signal not recognized (blind dialing). Result codes 0-4 enabled. n = 1, Dialtone and busy signal not recognized (blind dialing). Result codes 0-5 and 10 enabled. n = 2, Dialtone detected. Busy signal not detected. Result codes 0-6 and 10 enabled. n = 3, Busy signal detected. Dialtone not detected. Result codes 0-5,7, and 10 enabled.
Yn	Long Space Disconnect Option n = 0, disabled n = 1, enabled
&Cn	Data Carrier Detect Option n = 0, DCD always on. n = 1, DCD set by modem when remote carrier detected.
&Dn	Data Terminal Ready Option. DTR on/off time as specified by S25. n = 0, modem ignores DTR. n = 1, switches to command mode when DTR goes off. n = 2, same as n = 1. Also hangs up, disables auto answer. n = 3, initializes modem when DTR goes off.

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Command	Function
&F	Sets values for S Registers and Commands to factory default.
&Gn	Guard Tone (used only when in CCITT modes) n = 0, no guard tone n = 1, reserved n = 2, 1800 Hz This command need never be used when communicating over U.S. phone lines. Outside the U.S., the modem may need to generate an additional tone, along with its carrier, to disable echo suppressors in the central office. This guard tone varies by country.
&Mn	Communications Mode n = 0, Asynchronous n = 1, n = 2, n = 3, Reserved
&Pn	Pulse dial make/break ratio. n = 0, 39/61 @ 10 pps (for U.S. and Canada) n = 1, 33/67 @ 10 pps (for UK/HK) n = 2, 39/61 @ 20 pps n = 3, 33/67 @ 20 pps

&Qn	Communications Mode Option	
	Idle State	On-line State
n = 0	Normal	Asynchronous
n = 1, 2, 3	Reserved	Reserved

Command	Function
&Sn	Data Set Ready option. DSR ON indicates that the modem is connected to a communication channel and is ready. n = 0, DSR is always on n = 1, DSR turned on at start of handshaking, off in test mode, idle state, or when carrier is lost
&Tn	Controls Test. See "Diagnostics" for important details on testing. n = 0, Ends current test and returns to command mode n = 1, Initiate local analog loopback n = 3, Initiate local digital loopback n = 4, Grant request from remote modem for remote digital loopback n = 5, Deny request from remote modem for remote digital loopback n = 6, Initiate remote digital loopback n = 7, Initiate remote digital loopback w/ self-test n = 8, Initiate local analog loopback w/ self-test
&V	Displays active configuration profiles (S Register settings, commands, and telephone numbers). Inputs from the DTE are ignored while this information is being sent.

Command	Function
&Wn	Store Active Profile. Sends and stores acceptable values for certain commands and S Registers to non-volatile RAM. The following may be stored: Commands: Bn,En,Ln,Mn,Qn,Vn,Yn,Xn,&Cn,&Dn,&Gn, &Jn,&Ln,&Pn,&Qn,&Rn,&Sn,&Xn,&Yn Registers: S0,S14,S18,S21,S22,S23,S25,S26,S27,S28 The last DTE speed and parity are also stored. Stored values are used on power-up or hard reset. n = 0, Store active profile in location 0 n = 1, Store active profile in location 1
&Xn	Asynchronous Data Transmission Clock Source n = 0, Internal Clock n = 1, 2 Error
&Yn	Select Stored Profile on Power Up Option n = 0, Select profile 0 on power up or hard reset n = 1, Select profile 1 on power up or hard reset See the &Wn command for particular commands and S registers stored.
&Zn=x	Store Telephone Number. Stores up to four dialing strings in non-volatile memory for later recall using DS (dial stored number) command. Command format: &Z <up to 36 characters> <CR> &Z= <up to 36 characters> <CR> &Zn <up to 36 characters> <CR> where n=0 to 3 If the delimiter (=) is not present, the characters following the &Z are treated as telephone numbers and/or modifiers and are stored in location 0. If the delimiter is present, the characters following it are stored in the location specified by the character preceding the delimiter (0 to 3). If not specified, 0 will be used. Allowable characters: 0 1 2 3 4 5 6 7 8 9 A B C D # * T P R W @ , ! ;
%Dn	DTMF attenuation n = 0, 0 dB attenuation For n = 1 to 7, attenuation = 2*n dB

Command	Function
%J	Secondary defaults. Resets all S registers and commands to the &F defaults with the following exceptions: S6 3 seconds; range 3-255 S11 95 ms; range: 60-255 %Ln 6 dB (%L3) %Dn 2 dB (%D1)
%Ln	Transmit attenuation n = 0, 0 dB attenuation For n = 1 to 7, attenuation = 2*n dB

AT Fax Commands

This faxmodem implements the following commands and functions associated with its fax capability.

The following commands will never be used directly in the operation of your fax-modem. They will be issued from your fax software, which provides a user-friendly interface for fax operation.

For those interested in fax software development, more detailed descriptions of the commands shown below and other important information relating to control of the fax hardware can be obtained from the Telecommunications Industry Association, located at 1722 Eye Street N.W., Suite 440, Washington, D.C. 20006. Ask for information about EIA-578 Service Class 1 commands.

AT Fax Commands

All **default values** are listed in **bold**.

Command	Function
+FAA=n	Data/fax auto answer. Configures faxmodem to detect whether an incoming call is data or fax. n = **0** Disable data/fax auto answer. Fax-modem answers according to the +FCLASS setting. n = 1 Enable data/fax auto answer mode.
+FCLASS=n	Select service class. n = **0** Return to data mode. n = 1 Fax class 1

Command	Function

+FF=n	Enhanced flow control for data transfer between DTE and DCE.
	    n = 0 Disable enhanced flow control interface. In this mode, data transfer is compatible with the EIA-578 standard.
	    n = 1 Enable enhanced flow control.

+FRH=n	Receive data with HDLC framing. Off-hook use only. n = 0
+FRM=n	Receive data. Off-hook use only. n = 24 or **48** (for 2400 and 4800).
+FRS=n	Receive silence. Off-hook use only. n = **0**, specifiable in 10 ms intervals
+FRTn	Receive test data. Faxmodem goes off-hook and begins demodulating received data at specified rate. n = 24 or **48**
+FTH=n	Transmit data with HDLC framing. Off-hook use only. n = **3**
+FTM=n	Transmit data. Off-hook use only. n = 24, **48**, 72, or 96
+FTS=n	Stop transmission and wait. Off-hook use only. n = **0**, specifiable in 10 ms intervals

+FTTn=m	Transmit test data. n = rate, m = pattern.
	    n = 24, 48, 72, or **96**
	    m = **0** ASCII data (20H - 7FH sequential)
	    m = 1 All zeros
	    m = 2 All ones
	    m = 3 Alternate 10
	    m = 4 Sliding 0 (01111)
	    m = 5 Sliding 1 (00001)

+F<command>?	Report active configuration. Responses are:
	+FAA? 0 = auto-answer disabled
	            1 = auto-answer enabled
	+FCLASS? 0 = data mode
	            1 = fax class 1

+F<command>=?	Report operating capabilities for a given command. Alternatively, the command +F<command>=<parameter>? interrogates the faxmodem as to whether a particular function is supported.

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S Registers

The S Register default values are set to function reliably under most circumstances. However, you may want to change the default values in some cases. For example, it may take an especially long time to get a dialtone in your office, so you may want to set S6 for a longer wait time.

The command ATSn? displays the current value of an S Register, where n is the S Register number. For example, the command ATS0?S7? will display the values of S0 and S7.

To change an S register value, type **ATSr=n**, where r = the register number and n = the desired value.

The S Registers Table is shown following:

Modem S Registers Table

* indicates that the S Register is stored to the modem's non-volatile memory upon receipt of the &W command. This ensures that the contents of these registers will not be lost if the modem loses power.

Register	Range	Units	Default	Description
S0*	0-255	rings	0	Rings before modem answers
S1	0-255	rings	0	Count rings
S2	0-127	ASCII	43 (+)	Escape code character
S3	0-127	ASCII	13 (CR)	Carriage return character
S4	0-127	ASCII	10 (LF)	Linefeed character
S5	0-32,127	ASCII	08	Backspace character
S6	2-255	seconds	2	Wait for dialtone
S7	1-255	seconds	30	Wait time for carrier after dialing
S8	0-255	seconds	2	Pause time for comma
S9	1-255	1/10 sec.	6	Carrier detect response time
S10	1-255	1/10 sec.	14	Carrier loss to hangup delay
	If "Call Waiting" service from your phone company is breaking your modem connection, increasing the value of S10 may solve the problem, but you must increase the value of S10 for both modems.			
S11	50-255	msec.	95	DTMF dialing speed

Register	Range	Units	Default	Description
S12	0-255	1/50 sec.	50	Escape code guard time
S13				Reserved
S14*	Bit-mapped	none	AA hex	Records command settings
S15				Reserved
S16	Bit-mapped	none	00	Modem test options (See "Diagnostics" and &T command for more information.)
	For all bits, 0 = corresponding test disabled. Bit 0 = 1 &T1 enabled Bit 1 Reserved Bit 2 = 1 &T3 enabled Bit 3 = 1 &T6 enabled Bit 4 = 1 Modem is in Remote Digital Loopback initiated by remote modem Bit 5 = 1 &T7 enabled Bit 6 = 1 &T8 enabled Bit 7 Reserved Notes: 1. Only one test may be performed at a time. 2. The &T0 command terminates any test in progress and sets S16 to 00.			
S17				Reserved
S18*	0-255	seconds	0	Test duration timer. See "Diagnostics" for details. Note: 0 = disable timer
S19				Reserved
S20				Reserved
S21*	Bit-mapped	none	00	Records command settings
S22*	Bit-mapped	none	76 hex	Records command settings
S23*	Bit-mapped	none	07 hex	Records command settings
S24				Reserved

Register	Range	Units	Default	Description
S25*	0-255	0.01 or 1 seconds	5	Detect DTR change.
	If &Q1 is selected, S25 is the delay in seconds after a connection has been made, but before the modem examines the DTR lead. If in the on-line or on-line command state, changes in DTR that last less than the time specified by S25, in 0.01 increments, are ignored by the modem.			
S26*	0-255	0.01 sec.	1	RTS to CTS delay intervals. Reserved
S27*	Bit-mapped	none	40 hex	Records command settings
S28*	Bit-mapped	none	00	Records command settings

Introduction

Unless you have a terminal, the operation of your faxmodem will generally be controlled through your modem or fax software, so that under normal circumstances you won't need to control dialing parameters directly. The following information is therefore intended more as an overview of the faxmodem's operation than as a guide to its use.

Your faxmodem originates a call by dialing a remote modem or fax device using either pulse or DTMF (tone), depending on which dial modifier was used, P for pulse or T for tone. You can switch back and forth between pulse and tone in the middle of a dial sequence by inserting these characters at the correct place in the dialing command sequence.

Dialing can be performed in one of two possible modes:

1) "Call Progress Mode", where the modem monitors the progress of the call, and uses its ability to recognize dialtone to enter the correct digits in sequence at the correct times.

2) "Blind Mode", where the modem does not monitor the call progress signal. In blind mode, programmed pauses take the place of dialtone recognition.

When it is in modem communications mode, the modem normally places itself in originate mode when any dial command is entered. If, however, reverse mode dialing (R command) is specified, the modem will reconfigure itself in the answer mode when dialing is completed.

If call progress mode is enabled, the modem will detect the presence of a dial tone before proceeding with the dialing of numbers. When call progress mode is disabled, the modem uses blind dialing, in which the numbers are dialed without waiting for the presence of a dial tone.

Major topics discussed in this section are as follows:

- Call Progress Speaker

- Call Progress Dialing

- Blind Dialing

- Auto-Answer Mode for Modem Communications

- Modem Call Termination

- Modem Handshake Protocol

- Fax Handshake Protocol

Call Progress Speaker

Your modem has an on-board speaker that lets you track the progress of your call. When you get your modem, the speaker is configured so that it is on whenever the phone is off-hook, and turns off when carrier is detected. This allows you to follow the progress of the call by listening to the dialtone, ring, and busy signals. You can also configure the speaker so that it is either off all the time or on all the time by using the Set Command Mn.

The volume of the speaker can be adjusted using the AT Set Command Ln. The default setting is L2 (medium volume). The speaker volume may also be set for L1 (low) or L3 (high).

Call Progress Dialing

Once the dialing command is entered, the modem goes off-hook and looks for the dial tone. When it hears the dialtone it will continue the dialing sequence. Remember that the S6 Register sets the amount of time that the modem will look for a dialtone before it abandons dialing.

If a W is encountered anywhere in the dialing sequence, the modem searches for another dialtone before proceeding with the remainder of the dialing sequence.

In modem communications mode, when the dialing sequence is complete the modem waits for a modem answer tone. When this tone is detected, the modems complete the modem handshake sequence. The modem then automatically goes into data mode.

If reverse mode was selected (see R dial modifier) the modem dials and immediately puts out an answer tone. No further commands are executed after the R is encountered. It may be necessary to insert a few commas before the R to allow time for the phone company to make the connection. When the calling modem detects an originate tone, the modems complete the handshake sequence.

Blind Dialing

Blind dialing is similar to call progress dialing except that the call progress signals are disabled. You enter blind dialing mode by using the Set Commands X0, X1, or X3. Once off-hook, the modem delays the dialing sequence by the time specified in status register S6 (wait for dial tone). Since the W "wait" command is disabled in blind dialing mode, you may want to use a comma "delay" command in its place when blind mode dialing. To wait for a second dial tone (for PBX systems), place one or more commas ',' (pause dial modifier) between the numbers where the dialtone will be encountered. After the dialing sequence is complete in modem communications mode, the modem looks for an answer tone and completes the "modem handshake" as above.

Auto-Answer Mode for Modem Communications

When the auto-answer configuration is selected, the modem automatically answers the phone after 'n' rings. You set n (the number of rings) by typing S0=n in command mode. For example, if you would like the modem to answer after 5 rings, you would type S0=5. This value is then entered into status register S0. The value in status register S0 controls the number of rings that will occur before the modem answers, after which the modem waits two seconds (billing delay) and then sends only an answer carrier tone to the originating modem. It then proceeds with the appropriate modem handshake. After the handshake is completed, the modem sends a result code (unless disabled) and enters data mode.

If the A command is used (ATA), the modem answers the phone without waiting for a ring.

Manual Dialing for Modem Communications

If you do not wish to dial from the keyboard of your computer through the modem, you may plug an ordinary tone or rotary phone into either one of the standard phone jacks on the modem, and dial manually. After dialing, type ATX1D and hang up the phone. The modem will then wait for an answer tone from the remote modem.

Modem Call Termination

Connection may be terminated by either the calling modem or the remote modem in the following ways:

Data Terminal Ready   When configured for &D2 or &D3, if the Data Terminal Ready (DTR) signal goes low for more than 50 msec, the modem begins a disconnect sequence (except for certain test modes). The modem then returns to the command mode.

Carrier Loss   If the carrier signal is lost for more than 1.4 seconds, the modem returns to the command mode. This time can be set using the S10 register. The telephone line connection is automatically broken and the modem placed on-hook as a result of carrier loss.

If "call waiting" is breaking your modem connection, you may be able to get around this problem by increasing the value of this register to 30 (3 seconds). You must increase the value of the S10 registers in <u>both</u> modems for this to work.

Carrier Not Detected   If the carrier signal is not detected within a specified time interval after dialing (determined by register S7), the modem goes on-hook and then returns to the command mode.

Modem Handshake Protocol

Modem handshake protocols for Bell 103, Bell 212A, V.22, and V.22 bis are specified by the respective Bell and CCITT standards. After the handshake sequence is complete, the modem automatically enters the data mode.

Fax Handshake Protocol

The fax handshake protocol polls the answering facsimile device and automatically sets all necessary parameters for fax communication according to CCITT standards. Your faxmodem is a Class 1 faxmodem; handshaking is handled by the fax software.

This modem incorporates extensive diagnostic capabilities, including a powerup self-test, local analog and digital loopback testing, remote digital loopback with or without self-test, and local analog loopback with self-test.

General Instructions

The type of diagnostic test is set by the command &Tn. The duration of the test is set by register S18 (see the important note about this at the end of this section). Register S16 is a bit-mapped register that reflects the type of test in progress.

To run any diagnostic test, your modem must be in asynchronous command mode, the normal state of your modem when you are entering AT commands. Make sure that your software is set for full duplex and that you have echo turned on (E1, which is the modem's default setting). You can use the local analog loopback tests (&T1 and &T8) without establishing a connection to another modem (see instructions below). To use the remote (&T6 and &T7) or local (&T3) digital loopback tests, you must first establish a connection and then use the escape code (default = + + + preceded and followed by 1 second of no keystrokes) to return to command mode before issuing the test command.

You can terminate a test before the test timer expires by typing **AT&T0**, but in the local analog loopback (&T1) and remote digital loopback (&T6) tests, you must type the escape sequence before sending the &T0 command.

Important note about the test timer S18: The value in the test timer register S18 remains unchanged at the end of a test. It will remain in effect during subsequent tests unless you explicitly change it or use the software reset (ATZ) command. AT&T0 does not affect the S18 register. This point is important because you have to be aware of when you have the test timer disabled (S18=0) and when you don't. When it is disabled, you have to explicitly terminate the test.

Tests that Involve Only Your Computer and Modem

The local analog loopback test (&T1) sends data from the computer to the modem. The modem uses an internal analog loop to send the data back to the computer. To run a 10-second test, type **ATS18=10&T1**   Then type in a test message, and the modem should echo back the characters you type onto your screen. After 10 seconds, the modem will respond with "OK".

To run this test with the test timer disabled, type **ATS18=0&T1**   Then type in characters and see them echoed back onto your screen. To terminate this test, type the escape code. The modem responds with "OK". Then type **AT&T0**

The local analog loopback with self-test (&T8) checks the modem's internal transmit and receive circuits. It does not use data from the computer; instead, the modem generates its own test pattern and uses an analog loopback to check for errors.

Therefore, when running this test, you do not type in characters at the keyboard. When the test is complete (either because the timer has expired or because you have ended it with AT&T0), the modem responds with the number of errors detected and "OK".

If this test (&T8) passes and &T1 fails, there is a good chance that your computer is at fault.

> > The previous two tests (&T1 and &T8) are the only ones you can perform without using telephone lines and a remote modem. The other three tests are described briefly below.

Tests that Use the Phone Line and a Remote Modem

The following two tests involve a remote modem and require that it be configured to participate in remote digital loopback tests (via use of the AT&T4 command on the remote modem). By default, Hayes-compatible modems are configured to accept this type of test.

The remote digital loopback test (&T6) tests your computer, the local and remote modems, and the telephone line. With the remote modem set to participate in this type of test, establish a connection with the remote modem and issue the escape code. Then type **AT&T6**   Now, when you type characters, your modem sends these characters to the remote modem, which uses a digital loopback to send the characters back to your modem and your computer screen. If the characters echoed are incorrect, there is a problem in one of the tested components. To terminate this test, use the same procedure as in the local analog loopback test (&T1).

The remote digital loopback self-test (&T7) tests the remote modem and the telephone line. It is the same as the previous test, except that the local modem sends a standard test pattern to the remote modem and checks the returned data for errors. Therefore, in this test you do not type characters on your computer. When the test is complete, the modem responds with the number of errors detected and "OK".

The following test provides a service to older remote modems.

The local digital loopback test (&T3) uses a digital loop on your modem to allow a remote modem to perform a remote digital loopback test. Most remote modems can already initiate such a test via the &T6 and &T7 commands. For those that can't, this command allows such a test to take place.

This faxmodem is registered with the Federal Communications Commission (FCC) for direct connection to the telephone line using an RJ-11C telephone jack. The faxmodem complies with Part 68 and Part 15, subpart J, of the FCC Rules. On the faxmodem board there is a label that contains, among other information, the FCC registration number and the Ringer Equivalence Number (REN) for this equipment.

The REN is useful to determine the quantity of devices that may be connected to the telephone line and still have all 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 that may be connected to the line, contact the local telephone company.

This equipment should not be used on coin-operated telephone lines. Connection to party lines is subject to state tariffs.

If trouble is experienced, disconnect this equipment from the telephone line to determine if it is causing the malfunction. If the equipment is determined to be malfunctioning, its use should be discontinued until the problem has been corrected. No repair of modification of this equipment should be attempted.

If the equipment should cause harm to the telephone network, the telephone company shall, if possible, notify the customer that temporary discontinuance of service may be required; however, where prior written notice is not possible, the telephone company may temporarily discontinue service without notice, if such action is necessary under the circumstances. The telephone company may make changes in its communications facilities, equipment, and operations procedures, where such action is reasonably required in the operation of its business and is not inconsistent with the rules and regulations of the FCC.

The FCC Rules Part 68 require that, if requested, the phone company be provided with the following information about the faxmodem being installed:

1) The phone number of the line to which the faxmodem will be connected.
2) The FCC registration number of the faxmodem, and
3) The ringer equivalence number of the faxmodem, which is .4A and .7B.

The FCC registration number and the ringer equivalence number may be found on the board.

All modems and faxmodems generate radio frequency energy and if not installed and used properly, i.e., in strict accordance with these instructions, may cause interference to radio and television reception. This faxmodem has been tested and found to comply with the limits for a Class B Computing Device in accordance with the specifications in Subpart J of Part 15 of the FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio and television

reception, which can be determined by turning the equipment off and on, try to correct the interference by one or more of the following measures:

- Relocate the receiving antenna.
- Relocate the device with respect to the receiver.
- Move the device away from the receiver.
- Plug the device into a different outlet so that the device and receiver are on different branch circuits.
- If necessary, consult the dealer or an experienced radio/television technician for additional suggestions. The FCC has prepared a helpful booklet, "How to Identify and Resolve Radio-TV Interference Problems," available from the U.S. Government Printing Office, Washington, DC 20402, Stock # 004-000-00345-4.

To meet FCC requirements for Class B installation, shielded cables are required to connect the device to a personal computer or other Class B certified devices.

The purpose of this section is to explain how to connect your modem to a telephone line. Your modem comes with a modular telephone cord that is to be used for this purpose. On each end of this cord is a modular telephone plug which will plug into standard modular telephone jacks. One end of the cord plugs into either of the modem's jacks, and the other end plugs into a modular jack connected to the telephone network. The other modem jack can be used to plug in a local phone or other phone device.

There are several different types of modular telephone jacks and not all jacks will work with your modem. A simple test is to check if you can plug a standard single-line phone into a jack and successfully make a call. If this works, then you can definitely plug your modem into that jack.

You should not plug the modem into a modular jack which works with a "skinny wire" electronic office key phone. These phones have three or more line-select buttons, and a thin wire that plugs into a phone jack.

The following phone jacks can be easily converted to a standard modular jack by buying an inexpensive adapter at Radio Shack, a telephone store, or a telephone or electrical supply house.

4-prong
to
modular
adaptor

4-prong jack
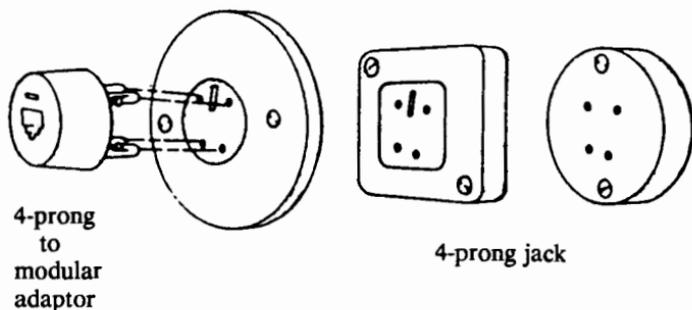
If you have a two-line modular jack (RJ14), plugging in the modem will connect it to line 1. If you'd like to be able to use the modem on either line 1 or line 2, you need a "two-line, three-way jack."

If all your phones are wall phones, see if there's an unused jack somewhere else at your location. (Some wall phones are not modular. Even if your wall phone is modular, unplugging it is difficult.)

The above information is enough to let you plug in your modem in most homes, and many offices. If it's NOT enough and you're plugging in your modem at home, you

should turn to the section below: "Option 3: Having a modular jack installed by a professional installer." If it's NOT enough and you're plugging in your modem in the office, continue reading.

Offices Without Standard Modular Jacks

If you've read this far, you have several options depending on your situation. These options are summarized below.

OPTION 1:

Your office uses 1A2 mechanical key telephones. These are the telephones with the row of lighted line select buttons and the approximately 1/2 inch thick cable used to connect to the telephones. If you office uses these phones, you can easily install a "sandwich jack" for about $25 which will allow you to plug your modem's telephone cord into the phone system. The only disadvantage of this approach is that someone in your office may accidentally interfere with your modem's transmission by trying to use the phone line that the modem is using.

OPTION 2:

Your phone system connects to the telephone network via modular jacks in your telephone equipment room, AND your modem can be conveniently plugged into one of these jacks. If you choose this option, you won't need an installer. This option ensures that someone cannot interfere with your transmission.

OPTION 3:

You are willing to pay to have a modular jack installed by a professional installer. The installer will connect a modular jack to your existing system.

OPTION 4:

You are willing to pay to have a dedicated phone line installed in your office by your local telephone operating company. This is normally the most expensive approach, since you're paying for an extra line, but does ensure that nobody can accidentally interfere with your transmission.

OPTION 5:

You have a Merlin phone system, and are willing to pay $250 to $300 for an interface unit that will let your modem plug into the standard Merlin 103A block (the block where you normally plug in a Merlin phone) or into the Merlin Control Unit.

Each option is described in more detail below.

OPTION 1: 1A2 Mechanical Key Telephones

Your office has 1A2 mechanical key telephones. These phones have line-select buttons that light up when a line is in use, AND each phone has a thick cord (approximately 1/2 inch thick) that connects to a big connector called an "Amphenol connector."

Thick cable

Amphenol connector
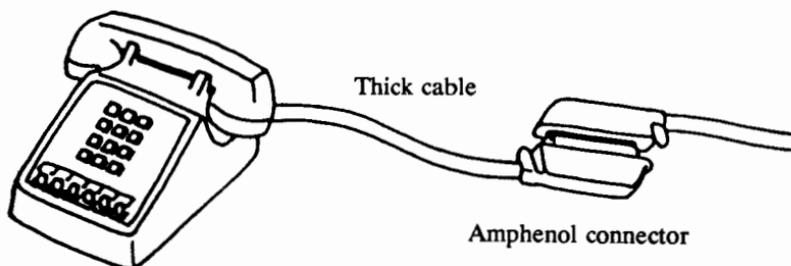
Multi-line "key" phone

If your office has this type of phone system, you can easily attach a "sandwich jack" at the Amphenol connector, and plug your modem into this jack.

Amphenol connector

Plug in modem to any line

"Sandwich" jack

Amphenol connector
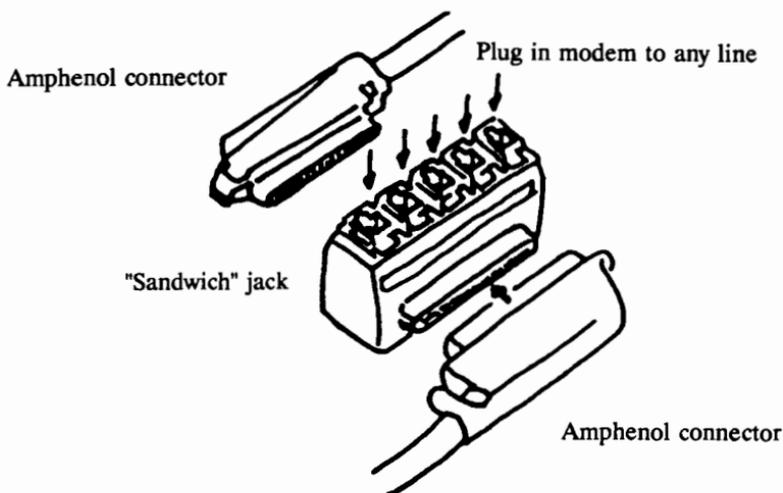
Radio Shack sells a sandwich jack called the "Four-line Telephone Tap" (Cat. No. 43-270). A similar jack called the "SE-180ST Super Tap" is available from Suttle Telephone Apparatus, (618) 943-5721. Most telephone stores and telephone and electrical supply houses also carry the same type of jack. The cost is usually about $25.

OPTION 2: Attaching Your Modem To A Modular Jack Located In Your Telephone Equipment Room

This option should only be considered if you have a "Key" phone system - that is, one in which a typical phone has buttons that let the user select a particular phone line. (This contrasts to a PBX, which automatically assigns a line when you take your phone off-hook and dial a trunk access code like 9.)

First you should look in your telephone equipment room, to see whether your phone system plugs into modular jacks. If it doesn't, look at options 3 and 4.

If your phone system connects to modular jacks, you can connect your modem like this:

To phone system

To central telephone office

Unplug one line   Plug modem cord in here
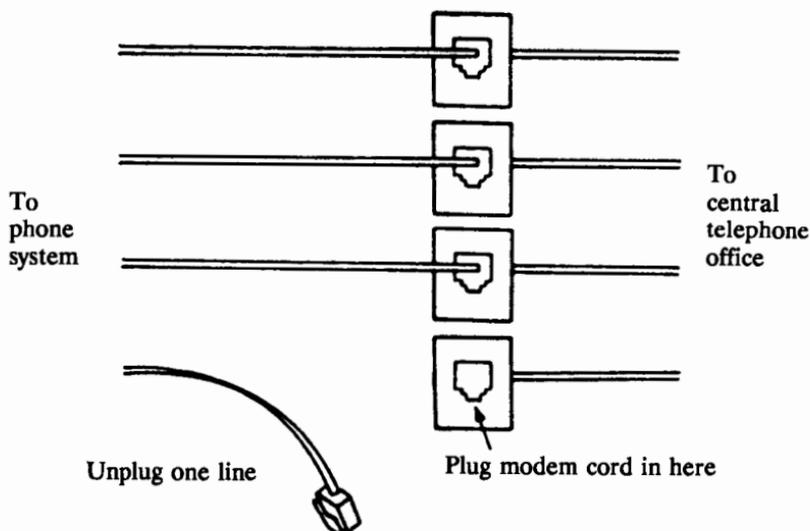
This prevents someone from using the line that your modem is using, and ensures that someone cannot interfere with your modem's data transmission.

OPTION 3: Having A Modular Jack Installed By A Professional Installer

This normally costs about $50 or more, depending on how much wire has to be run and how difficult this is.

In choosing an installer, your best bet is usually your local telephone operating company or the company that currently services your phone system. You should tell

the installer that you need a modular phone jack, which only needs "Tip" and "Ring" to work. Be sure to ask for an estimate of price and "lead time" before you place your order.

If the jack is to be installed in your office, you will need to know the type of phone system you have before you call.

If You Have A Mechanical Key System

Your phones have line-select buttons that light up when a phone is in use, AND each phone has a thick cord that connects to a big connector. If you do not want to use Option 1, a "sandwich" connector described above, you have two other alternatives:

1)   You can have a series jack (RJ31X) installed. When the modem is plugged into this jack, phones in the system will be unable to interfere with transmission by using the line. (If you use this approach, you may want to take a phone off-hook while the modem is in use, so people know not to try to use the line for outgoing calls.) When the modem's cord is unplugged from the series jack, your phone system will work as normal.

2)   Alternately, you can have an RJ12C or RJ13C jack installed. When the modem is plugged into one of these jacks, someone can accidentally interfere with the transmission.

If You Have An Electronic Key System

Your phones have line-select buttons that light up when a phone is in use, AND each phone has a thin wire running out the back of the phone.

Tell the installer to connect a jack to one of the "trunk lines" (this is simply one of the lines coming into your office from the local phone company). You need an "RJ31X series jack". When the modem is plugged into this jack, phones in the system will be unable to interfere with the modem (or use the line used by the modem). (If you use this approach, you may want to take a phone off-hook while the modem is in use, so people won't be inconvenienced by trying to use the modem's line for outgoing calls.) When the modem's cord is unplugged from the series jack, your phone system will work as normal.

The installer can do either one of the following:

1)   Run a 4-wire cable from your telephone equipment room to a series jack anywhere else in your office. Your modem can then plug into this jack using a telephone cord.

2)   Install the jack in or near the telephone equipment room. You will then need
      to use your modem near this room, or use a long telephone cord running
      between your modem and the jack.

Approach 1 is more elegant, but may cost more. Ask your installer whether there's
any difference in cost.

**OPTION 4:   Have A Dedicated Phone Line Installed By Your Local Telephone
Operating Company**

A dedicated phone line bypasses your office phone system, and prevents interference.
However, you will have to pay for installation, and also pay the monthly rate for
having a telephone line.

You can request as many jacks as you like, so you can easily plug the modem in at
different locations.

When ordering the phone line, be sure to ask for an estimate of price and "lead time"
before you place your order.

OPTION 5: Buy a Basic Telephone/Modem Interface For Your Merlin Phone System

The Basic Telephone/Modem Interface (BTMI) works with any Merlin system, and
with all feature cartridges. It will let your modem perform all it's normal functions,
including auto-dial and auto-answer. The BTMI is available from AT&T for $250 to
$300, and you can install it easily yourself.

The BTMI comes with a 14-foot cord, and plugs into either the standard Merlin 103A
block (the block where you normally plug in a Merlin phone) or the Control Unit. It
can be ordered from your AT&T Business Office, or by calling the Parts Hotline at
(800) 222-7278. Ask for part 103-971-479, the 102A interface, also known as the Basic
Telephone/Modem Interface. For more information about the BTMI, please call the
AT&T National Service Assistance Center at (800) 628-2888.

The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

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

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

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

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

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to a telephone loop which is used by the device, to prevent overloading. The termination on a loop may consist of any combination of devices subject only to the requirement that the total of the Load Numbers of all the devices does not exceed 100.

Does the Fuse Need to be Replaced?

If your faxmodem stops working completely, and none of the status lights are on, check first to see that the power cube is plugged in and check the power switch on the back of the faxmodem to be sure that it hasn't been accidently turned off.

If the power cube is plugged in and the switch is on, you should check the fuse.

The fuse is located inside the faxmodem case, so to check it and replace it (if necessary) you'll have to remove the case's cover.

Removing the FaxModem's Cover (Black Case)

1. Unplug the power supply cord, phone cords and serial cable from the faxmodem.

2. Place the faxmodem flat on a table in front of you, with the front (the side with the lights) facing toward you.

3. Raise the back of the faxmodem (the side with the jacks and switches) off the table slightly, grasping it on top with your thumbs.

Side with Jacks and Switch
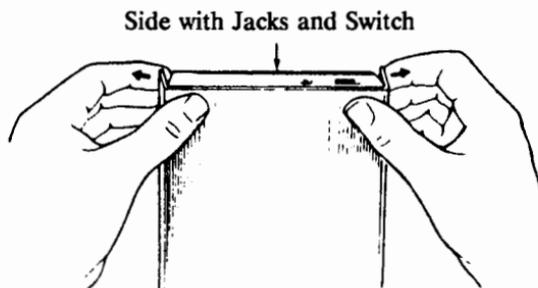
4. Feel how the sides can pull away from the base as shown above? Get a good grip on them and pull them hard to the sides, allowing the base to fall away from the cover.

## Removing the FaxModem's Cover (Silver Case)

1. Unplug the power supply cord, phone cords and serial cable from the faxmodem.

2. Turn the faxmodem upside down and place it flat on a table with the rubber feet facing up. Unscrew the four screws.

3. Grab the back panel and slide the faxmodem out of the case as shown on the following page.

Bottom of Case

Slide out baseplate this way

Rubber feet
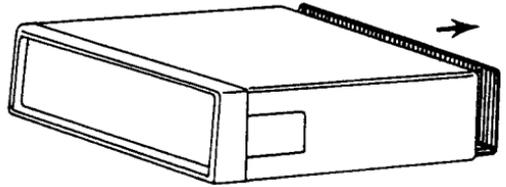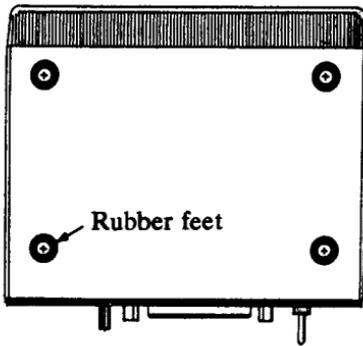
Locating the Fuse

The fuse is located at the back corner of the faxmodem, right next to the power switch, as shown below.
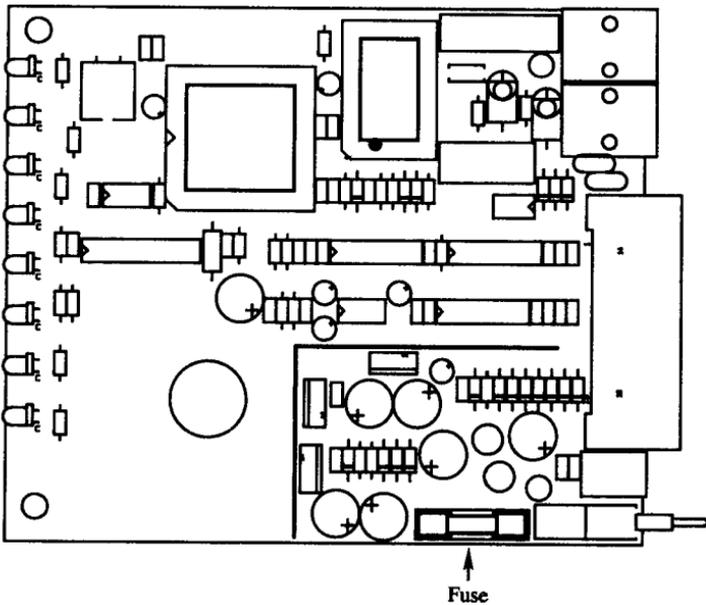
Fuse

Checking the Fuse

Look at the fuse. There should be one continuous wire connected from one end of the fuse to the other, like the fuse on the left. If the fuse looks like the "blown" fuse on the right, it needs to be replaced.

Fuse (5 x 20mm, 2 amps, fast blow)

Burned spot

Good fuse   "Blown" fuse
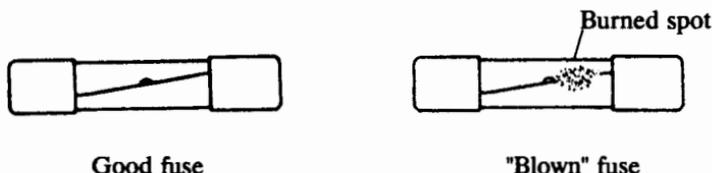
If the fuse is good, check to be sure that there is power at the outlet where your power cube is plugged in. If there is power, the power cube itself may be faulty.

Removing the Old Fuse

To remove the old fuse, put a small screwdriver under the glass part of the fuse and pry it upwards from the two end clips. If you don't have a screwdriver handy, a pencil will also work well. Just push the sharpened end under the glass part of the fuse until it pushes the fuse out from the end clips.

Replacing the Fuse

To replace the fuse, just push the new fuse back into the clips where you removed the "blown" fuse.

The fuse is an "International" type, 5 x 20 mm, 2 amps.

It is preferable to use a normal fast-acting type fuse, such as Radio Shack Catalog #270-1244, rather than a "slow blow" fuse.

Replacing the FaxModem's Cover (Black Case)

1. Place the base flat on a table, with the back of the modem (the side with the jacks) facing you.

2. Carefully line up the cover with the base. Be sure that the top and bottom of the case are in line, and that the back panel is inside the border of the case top.

3. Press the top down with your thumbs, first in the front (where the lights are), and then in the back. The case should snap together easily. Don't force it.

Replacing the FaxModem's Cover (Silver Case)

1. Slide the base that holds the faxmodem board back into the cover.

2. When the holes on the base plate are lined up with the holes in the cover, replace the four screws and the rubber feet. Tighten the screws.

Pin 1 -- Protective Ground

Pin 2 -- Received Data (RXD), Input

The DTE uses the RXD line to send data to the modem for transmission over the telco line or to transmit commands to the modem. The DTE should hold this circuit in the mark state when no data is being transmitted or during intervals between characters.

Pin 3 -- Transmitted Data (TXD), Output

The modem uses the TXD line to send data received from the telco line to the DTE and to send modem responses to the DTE. In command mode, TXD data represents the modem responses to the DTE.

Pin 4 -- Request to Send (RTS), Input

The DTE uses this line for control signals to the modem.

Pin 5 -- Clear to Send (CTS), Output

The modem uses this line to send control signals to the DTE.

Pin 6 -- Data Set Ready (DSR), Output

The modem uses this line, too, to send control signals to the DTE.

Pin 7 -- Signal Ground

Pin 8 -- Received Line Signal Detector (RLSD), Output

When AT&C0 command is not in effect, RLSD output is ON when a carrier is detected on the telco line or OFF when carrier is not detected. RLSD can be strapped ON using the AT&C0 command.

Pin 12 -- Modem Speed Indicator (CI), Output

CI output ON (low) corresponds to the LED on. CI is active when the modem desires or is engaged in the high speed (2400 bps) mode. CI is OFF (high) otherwise.

Pin 20 -- Data Terminal Ready (DTR), Input

The DTE uses this line to control the modem. The setting of the &D command determines how this line is used.

Pin 22 -- Ring Indicator (RI), Output

RI output ON (low) indicates the presence of an ON segment of a ring signal on the telco line. (The ring signal cycle is typically two seconds ON, four seconds OFF.) The OFF (high) condition of the RI output is maintained during the OFF segment of the ring cycle (between rings) and at all other times when ringing is not being received.

For the fax portion of your faxmodem to work with a Macintosh computer, it is important to have the right cable connecting the modem to the computer. Many cables labeled "V-series", "MNP cable", or "High-speed modem cable" will not allow faxing to work. The following commonly available Mac-to-modem cable (sometimes called a "regular" cable), will work:

Mac Mini-DIN		FaxModem 25-pin Male
Pin 1	to	Pin 20 (or pins 4 and 20)
Pin 2	to	Pin 5
Pin 3	to	Pin 2
Pins 4 and 8	to	Pin 7 (or pins 1 and 7)
Pin 5	to	Pin 3
Pin 6		(no connection)
Pin 7		(no connection)

Physical Specifications:

    Configuration: External modem with eight status lights

    Jacks: RS-232C (DB-25 female)
                                          2-RJ11
                                          Power jack

    Size: 5" x 6" x 1.56"

Electrical Specifications:

    Typical Power Requirements: 105 to 130 VAC, 60 Hz

    Power Cube Provided: 9.45 VAC nominal at 600 mA
                                          Class 2 UL and CSA approved
                                          Use only the power cube provided.

    Fuse   5 x 20 mm, 2 amp, fast blow recommended

Performance Specifications:

    Transmit Signal Level: -10 dBm $\pm$ 1 dBm

    Transmit Frequency Tolerance $\pm$ 0.01 percent

    Receive Signal Level   -9 dBm to -43 dBm

    Carrier Detect Levels   ON -43 dBm
                                            OFF -48 dBm

    Receive Frequency Tolerance $\pm$ 7Hz

    Bit Error Rate (BER) at 2400 bps 10^{-5} at 17 dB SNR

    Bit Error Rate (BER) at 1200 bps 10^{-5} at 9 dB SNR

    Bit Error Rate (BER) at 300 bps 10^{-5} at 7 dB SNR

Notes

Notes