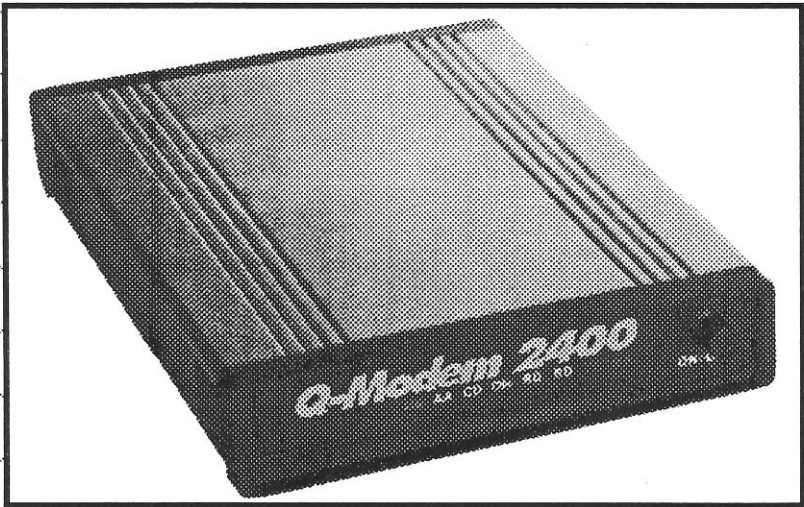


Q-Modem 2400

User's Guide



Quality Computers™

Congratulations on purchasing a Q-Modem 2400™. The Q-Modem 2400 is an intelligent, versatile modem that is fully compatible with the industry-standard "AT" command set and transmits data at 300, 1200, and 2400 bits per second (bps). It offers automatic answer and automatic dial (for both pulse and tone dialing), and it has two modular phone jacks—one for the telephone line and one for a phone. It includes a programmable nonvolatile memory that stores a telephone number and custom configuration profile (without DIP switches). In short, the Q-Modem 2400 provides the excellent price/performance you've come to expect from Quality Computers.

And the Q-Modem 2400 is easy to use: with a few simple commands, you can access other computers and networks all over the world. You can find lots of practical information, including news, airline schedules, weather reports, college descriptions, and more. And you can have fun getting free software, the latest computer news, and information on all sorts of hobbies.

This operator's manual is designed to answer any questions you have about your Q-Modem 2400. If we can help you further, please call us at (313) 774-7740 between 10 a.m. and 5:30 p.m. ET. Thank you for buying a Quality Computers product.

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GETTING STARTED

Before using your Q-Modem 2400, you need to connect or install your modem. This chapter explains how.

What You Have and What You Need

The following items should be in your Q-Modem 2400 package:

- Q-Modem 2400
- *Q-Modem 2400 Operator's Manual*
- *Q-Modem 2400 Reference Card*
- AC power adapter
- telephone cable
- warranty registration card

If you purchased the modem with telecommunications software, the software and its manual should also be in the box.

In addition to the items listed above, you will need the following:

- **Telecommunications software** (if you purchased the modem without software). If you have an Apple II, we suggest Talk Is Cheap (TIC), Point-to-Point, or ProTERM; for Macintosh users, we suggest White Knight or Microphone. All have their advantages. Contact Quality Computers for more information on any of these packages
- **A modular telephone line jack.** (You'll run a phone cable between your modem and this jack.)
- **If you have an external modem: a shielded RS-232C cable.** This cable must have a DB-25P (male) connector on one end and a connector for attaching the cable to your computer's serial port on the other end. Quality Computers can supply this cable if you don't have one.

Modem Settings

Before connecting or installing your modem, you should determine if you need to change these modem settings: 300 baud protocol (Bell/CCITT) and dumb/smart mode. You probably don't need to change any of them, but if you check them now, you won't have to worry about them later when it is less convenient.

300 Baud Protocol (Bell/CCITT)

When shipped, Q-Modem 2400s are set to use either the "Bell" protocols (Bell 103/Bell 212A/CCITT V.22bis) or the "CCITT" protocols (CCITT V.21/V.22/V.22bis). Those made for use in the United States and Canada are set to use the Bell protocols, and those made for use in other areas are set to use CCITT.

If you plan to make calls to or receive calls from modems *outside your country*, you need to be aware of the Bell/CCITT communication protocols, and you might need to change the protocols your modem uses. You will also need to change the protocols your modem uses if you do not live in the U.S. or Canada and the CCITT protocols do not work in your country. If you think you might need to change the communication protocols your modem uses, jump ahead and read Chapter 6 now, before finishing this chapter.

Dumb/Smart Mode

When shipped, the Q-Modem 2400 is set to "smart" mode. If necessary, you can physically change the setting to "dumb" mode.

In dumb mode, the modem will answer calls, but it will not do anything else. (For example, it will not accept AT commands or numbers to be dialed from it.) This can be useful for modems used to run Bulletin Board Systems (BBSs) or for similar applications.

It is very unlikely that you need your modem to be in dumb mode. Appendix E explains how to change this setting.

Connecting an External Q-Modem 2400

Before connecting the modem, *make sure your computer is turned off*. Then follow these steps.

1. Insert the male end of the RS-232C cable into the female plug (A) on the back of the Q-Modem 2400. Then insert the other end (B) into the serial port of your computer (or terminal).
2. Plug the power cord (C) into the Q-Modem 2400 socket labeled 9VAC. Then plug the power adapter into a wall socket.
3. Plug one end of the telephone cable provided with your modem into the socket labeled LINE (D) on the back of the modem. Plug the other end into a modular wall jack.
4. You can also connect an optional telephone to the Q-Modem 2400 by simply plugging its modular cord into the socket labeled PHONE (E) on the back of the modem. This allows normal voice communications over the phone when your Q-Modem is not in use.
5. Turn the modem on by pressing the button ON/OFF on the front of the modem. Every time the modem is turned on, it automatically performs a brief self-test (about three seconds long). The modem does not recognize AT commands during the self-test.

Power-on Testing the External Q-Modem 2400

With the modem connected to your computer, you can verify that it is working properly. Start by turning the modem on by pressing its ON/OFF power button and then checking the lights on the front of the modem. The MR light will light up, and others may also. If the MR light is not lit, press the modem's ON/OFF button again; if it still doesn't light, refer to Chapter 8.

Some other lights may be lit because of the way your system is set up; these do not indicate problems. However, if the OH, RD, or SD lights are lit, you may have a problem (see below).

If the OH light is lit, there may be a problem with the modem. Refer to Chapter 8 for instructions on handling this problem.

If the RD and/or SD lights are lit, or if they are flashing on and off, one of the following things is happening: your RS-232C cable is shorted out, there's a problem with your computer's serial port, or there's a problem with the modem. Turn the modem off, disconnect the RS-232C cable, and turn the modem back on. The RD and SD lights should be off. If one or both are on, refer to Chapter 8.

Indicator Lights on the External Q-Modem 2400

Eight indicator lights on the front of each external modem report the modem's status.

HS (High Speed). When lit, indicates the modem is communicating at 2400 bps.

AA (Auto Answer). Acts differently if the Q-Modem's auto answer mode is enabled or disabled. When auto answer is enabled, this light is usually lit but goes off during an incoming call's rings. When auto answer is disabled, this light is usually off but goes on during an incoming call's rings.

CD (Carrier Detect). When lit, indicates the Q-Modem 2400 is receiving a valid data carrier signal from the remote modem and it has locked onto that signal. In other words, your modem has successfully connected to the modem at the other end of the telephone line.

OH (Off Hook). When lit, indicates the modem is in the off-hook position, equivalent to lifting the telephone receiver off its cradle. When not lit, indicates the modem is hung up.

RD (Receive Data). Flashes on and off quickly when data is being sent from the Q-Modem to your terminal. This indicator may sometimes appear to be lit continuously because it flashes on and off so quickly.

SD (Send Data). Flashes on and off quickly when data is being transferred from your terminal to the Q-Modem 2400. This indicator may sometimes appear to be lit continuously because it flashes on and off so quickly.

TR (Terminal Ready). When lit, indicates the Q-Modem is ready to communicate with the terminal.

MR (Modem Ready). When lit, indicates the modem is receiving power.

USING SOFTWARE AND AT COMMANDS

Installing & Using Communications Software

Once your modem is connected or installed, you will use your telecommunications software to perform most of the tasks you need to do. Because you'll use your software to dial numbers, transfer files, etc., and your software will operate the modem for you, you probably won't need to use the rest of this manual.

You *will* need to read parts of this manual in some situations, including these:

- You need to do something that your software is not able to do. For example, you may want to set up your modem for auto answer. Some telecommunications software can do this, but other software cannot. Consult your software manual to find out if your software can do the task you want done.
- Your software requires you to send commands directly to the modem yourself (TIC requires this).
- Your software requires that you reconfigure your modem. *Most software does NOT require you to do this.* If you need to reconfigure your modem, be sure to read Chapter 4.
- You are setting up a Bulletin Board System (BBS).
- You are having problems with the modem. Chapter 8 will be particularly helpful in this case.

Using Q-Modem 2400 AT Commands

When you need to do something with your modem and you can't or don't want to use your telecommunications software to do it, you'll use the Q-Modem 2400 AT commands. These commands can be used to perform various tasks, from dialing phone numbers to changing the modem speaker volume. In fact, when you tell your telecommunications software to perform a task, it uses AT commands to do it.

Remember, it's usually easier to use your telecommunications software to perform tasks than it is to use AT commands. Thus when you have the choice, use your software instead of AT commands.

Various chapters in this manual explain how to use the Q-Modem 2400 AT commands to accomplish specific tasks. The rest of this chapter explains how the AT commands work, and Appendix A describes each command in detail.

Command State and On-line State

The Q-Modem 2400 has two states: command and on-line. When you turn the modem on, it is immediately in the command state. It must be in the command state for AT commands to be used. When the Q-Modem 2400 connects to another modem, it changes to the on-line state. The modem must be in the on-line state for data to be transmitted.

In other words, if you're connected to a network, bulletin board system, or other remote computer (i.e. you're in the on-line state) you can transmit data, but you must change to the command state to send AT commands.

To switch from one state to the other, use the escape code or commands, as follows: to switch from the on-line state to the command state, enter the escape code (+++); to switch from command state to the on-line state, issue the **O** (on-line), **A** (answer), or **Dn** (dial) command (in other words, answer a call or dial a number). The escape code is explained in this chapter. The **O**, **A**, and **Dn** commands are described in Appendix A.

Command Line

Each command line may contain one or more **AT** commands and must start with the ASCII letters **AT** or **at** (except the **A/** command). The Q-Modem 2400 will not recognize **At** or **aT**.

The **AT** signals the beginning of a command line and is often referred to as the “Attention” code. (In fact, **AT** stands for “ATtention”.) The Q-Modem examines the **AT** code to determine your computer’s baud rate, parity, word length, and number of stop bits. The Q-Modem then stores your current configuration in its RAM memory. You can choose to save these settings in the Q-Modem’s nonvolatile memory by issuing the **&W** command.

Command Line Buffer

The modem places each command you type into a command buffer that holds up to 40 characters. The modem does not place the **AT**, Return, line feed characters, or spaces into the buffer, so the buffer’s 40 spaces only hold characters from actual commands. If a command line contains more than 40 command characters, the modem ignores the commands and displays the **ERROR** result code when it receives the command line’s Return character.

The buffer stores the last command line it received until it receives another command line or the modem is switched from the command state to the on-line state. Because it remembers this last command line, you can re-execute that command line by issuing the **A/** command. (Remember, the **A/** should not be preceded by the **AT** prefix or followed by Return.)

Command Syntax

Q-Modem commands must comply with these syntax rules:

- The prefix **AT** must precede all commands except **A/** and be in all uppercase (**AT**) or all lowercase (**at**) characters.
- Multiple commands can appear on one command line. You can separate these with spaces to improve readability (the modem’s command interpreter ignores the spaces).

- Each command line must end with Return ([**CR**]—ASCII 13) unless you configure the modem to accept a substitute. (If you need to configure the modem to accept a substitute, refer to Chapter 4 for information on configuring the modem and Appendix C for a description of S register 3). If you don’t type Return, the modem ignores the line. The **A/** command is the only exception to this rule; the modem recognizes this command without Return.
- A line feed character following the Return is optional and is ignored by the modem.

The following are examples of valid command lines. Each ends with Return [**CR**].

```
AT D T 555-5055 [CR]
ATH [CR]
AT &F &C1 &D2 &W [CR]
A/
```

The **A/** command is neither preceded by **AT** nor followed by Return.

Result Codes

After the modem receives a command, it responds by returning a result code. The most common result code is **OK**, which means the modem understood your command and everything is fine. Other result codes, their numeric forms, and their meanings are listed in Appendix B.

Result codes can be represented by English words or with numbers. Word (verbal) result codes are preceded and followed by Return and line feed characters. Number (numeric) result codes are followed by Return.

Escape Code (+++)

The escape code is a string of three ASCII plus signs (+++) preceded and followed by a “guard time” during which no other data is transmitted. It is used to leave the on-line state without hanging up. To use it, do the following:

1. Do not transmit any data for a period equal to the guard time. The default setting for the guard time is 1 second (set in S register 12).
2. Type the escape code quickly. Do not follow with Return.
3. Do not transmit any data for another period of time equal to the guard time.

The modem responds to these steps with the **OK** result code. If it doesn't, either it received data during the guard time or the escape code was typed too slowly. The time between each plus sign ('+') in the escape code should not exceed the guard time.

The plus signs in the escape code can be changed to another ASCII character. To do this, change the value in register S2 using the **Sr=n** command. Chapter 5 describes register S2, and Chapter 5 describes the **Sr=n** command.

3

DIALING & ANSWERING CALLS

Most of the time, you'll use your telecommunications software to dial numbers and answer calls, and you'll be able to ignore this chapter. But at some point you may need to tell your software something it does not inherently know, or you may need to set your modem up to auto answer if your software can't do it for you. This chapter tells you what you need to know in these situations.

In addition, this chapter tells you the baud rates at which two modems connect in various situations.

Dialing Methods

You can use one of the following methods to dial telephone numbers without using software:

- The modem dials the number you type at the keyboard.
- You dial the number yourself on a telephone and give the modem a command at the keyboard that tells it you want to connect to another modem.
- The modem dials a number stored in its nonvolatile memory.

The following sections explain these dialing methods.

Note: Every time you connect to another modem, you will receive a **CONNECT** result code telling you that modem's baud rate (for example, **CONNECT 1200**). If your computer is set to a different baud rate, you must immediately use your software to change your computer's baud rate to the rate of the modem you connected to. If you are using your communications software to dial, it will take care of this detail for you.

Dialing Numbers from the Keyboard

The Q-Modem 2400 dials telephone numbers when you give it the dial command (**Dn**) where *n* is the telephone number. The **Dn** command can be used alone or with modifiers. The modifiers are listed below and explained in detail in Appendix A.

T	touch-tone dial
P	pulse dial
R	reverse mode (from originate to answer mode)
W	wait for dial tone before processing the next symbol in the dial string
@	wait for quiet answer
,	pause before processing the next symbol in the dial string
!	flash
;	return to command state after dialing
S	dial stored number

The modem uses the dial command modifiers in the order it encounters them on the command line, from left to right.

In the following example, the modem first selects pulse dialing (**P**) and dials a nine (9), and then it selects tone dialing (**T**) and dials the rest of the number.

```
AT D P9 T5559624 [CR]
```

The number in *n* must be an ASCII string containing numbers 0 through 9 (for pulse dial lines) or those numbers and the characters A, B, C, D, #, and * (for touch-tone dial lines). Also, the number in *n* cannot exceed the size of the command buffer (40 characters excluding the AT prefix, the Return control character, and the line feed control character).

To aid readability, spaces, hyphens, and parentheses can be added to the dial command line without affecting its function.

Simple Example

```
AT DT (405) 555-9624 [CR]
```

In this example, the Q-Modem 2400 goes off-hook, waits for a dial tone, and then touch-tone dials the number (405) 555-9624.

If the modem does not receive a valid carrier within 30 seconds (the default value of S register 7), the modem goes on-hook (hangs up) and sends the **NO CARRIER** result code. If the modem does receive a valid carrier within the time allowed, the modem will send the **CONNECT**, **CONNECT 1200**, or **CONNECT 2400** message, depending on the connection baud rate. If this rate is different than your terminal's setting, you may need to change your software's baud rate setting before proceeding.

Pulse Dialing Example

```
AT DP (405) 555-9624 [CR]
```

This example command includes the **P** modifier, which tells the modem to pulse dial the numbers that follow it.

Example of Dialing out from a PBX

Example 1: Using W

```
AT D 9W 5559624 [CR]
```

In this example, the modem dials one digit, 9, to access an outside line and then waits for a dial tone before it dials the rest of the dial string.

Example 2: Using a Comma

```
AT D 9, 5559624 [CR]
```

In this example, the modem dials the first nine (9) to access an outside line and then waits for a dial tone before it dials the rest of the dial string.

Example of Combining Pulse and Touch-Tone Dialing

```
AT D P9 W T5559624 [CR]
```

This example combines several of the features described in previous examples. The **P** modifier tells the modem to pulse dial the number that follows it (9). The **W** modifier tells the modem to wait for a dial tone. The **T** modifier tells the modem to touch-tone dial the numbers that follow it.

Example of Issuing Commands Before the Dial Command

```
AT B1 SØ=1 DT 555-9624 [CR]
```

Note that commands cannot be placed after the dial command on a command line.

Example of Punctuation and Spaces in a Dial Command

```
AT DT 1 (502) 555-9624 [CR]
```

You can include punctuation and spaces in a dial command to improve readability because the auto-dialer ignores elements on a command line after the dial command. This feature allows you to avoid confusing command lines like the following:

```
ATDT15025559624 [CR]
```

Example of Making a Call in Answer Mode

```
AT DT 5559624 R [CR]
```

In this example, the R modifier tells the modem to make the call in answer mode.

Example of Returning to Command State After Dialing

```
AT DT 5559624; [CR]
```

In this example, the semicolon tells the modem to return the command state after dialing. You can then issue additional commands, such as hanging up the phone (ATH) or instructing the computer to look for a carrier (ATO) or even to dial additional numbers (see below).

Example of Dialing a Number Longer than the Buffer

```
AT DT 9W (206)555-96248834998841!87504766543; [CR]
```

This string completely fills the command buffer, but the semicolon at the end of the line causes the modem to return to the command state so a second string can be processed. When it's ready for the second string, the modem returns the OK result code. At that time, a second string containing the rest of the number can be dialed, as follows:

```
AT DT 2196 #21135532 [CR]
```

Note that the first command line in this example contains the ! dial command modifier, which causes the modem to go on-hook (hang up) for one half second. This operation (sometimes called a flash or hook-flash) is used in some telephone systems for transferring calls, conference calling, or call waiting.

Dialing From a Telephone

This dialing method combines dialing a number on a telephone and typing a command to cause the Q-Modem to connect with another modem. The Q-Modem 2400 offers two ways to do this:

- The first lets you call a remote modem that is set to auto answer. It is to be used in situations where you won't talk to a person before the modems connect. When you can, we recommend simply using the modem to dial the number, instead of using this method.
- The second method lets you talk to someone at the other end of the line and then connect the modem without hanging up.

To use the first method, type following command line but do *not* press Return:

```
AT X3 D
```

Then dial the number yourself on the telephone. When you hear a carrier from the remote modem, press Return. The modem will attempt to connect with the remote modem.

To use the second method—call someone, talk to them, and then start using the modem without hanging up the phone—follow the procedure below.

1. Talk to each other using telephones plugged into the PHONE jacks on the backs of your modems.
2. When you're done talking and you're ready to start using the modems, don't hang up your telephone receivers.
3. *One of you:* Type ATA [CR].

The other one: Type AT X3 D [CR]. You'll both hear a high-pitched squeal from the phone and from your modem speakers, if they're turned on. Then you'll both see a CONNECT result code appear on your screens.

4. Hang up your phone receivers and use your computers however you wish. When you're done, simply hang up the modems by issuing the H command (directly or through your software).

Storing a Telephone Number

To store a single telephone number in the Q-Modem's nonvolatile memory, use the **&Zn** command where *n* is the telephone number you want to store, as shown below. (The telephone number in this example is "P9 W12065559624".)

```
AT &Z P9 W12065559624 [CR]
```

The **&Zn** command saves any of the digits and symbols that are valid in dial commands. It ignores punctuation, spaces, and all other characters. The number of digits and symbols plus the number of dial modifiers must not exceed 33. If it does, it will be truncated to 33 characters when saved into nonvolatile memory. The **&Z** is not stored with the dial string.

Dialing a Stored Number

To dial a stored number, use the **Dn** command with **S** modifier. This command causes the modem to get the number stored in nonvolatile memory, load it into the command buffer, and then dial it as though it were an ordinary dial command. The command is issued as follows:

```
AT DS [CR]
```

Answering Calls

The Q-Modem 2400 provides three ways to answer calls:

- You issue the **A** command when you detect an incoming call. The **A** command causes the modem to answer the call immediately.
- You talk to another person on a telephone and then connect your modems without hanging up. This method is described earlier in this chapter, in the section called "Dialing From a Telephone."

- You set up your modem to "auto answer." In this case, your modem automatically answers any incoming call. The rest of this section explains how to use auto answer.

The Q-Modem 2400 answers incoming calls automatically (auto answer) if you set register **S0** to a nonzero value. The value you set it to determines the number of rings the modem will wait before it answers the call. The following example command sets the modem so it answers incoming calls after the second ring:

```
AT S0=2 [CR]
```

If you set the modem to auto answer and your modem shares a line with a telephone, the modem may answer calls before you can intercept it. For this reason, the modem defaults to not answering calls automatically. We recommend being very careful with auto answer unless you have a dedicated modem phone line.

If you set the modem to answer incoming calls, the **AA** indicator light on the front of the (external) modem remains lit unless the modem is detecting a ring. When the modem detects a ring, the light goes off briefly. Note that if the modem is not set to auto answer mode, the **AA** light works in the opposite manner; that is, it is off until it detects a ring and then lights during the ring.

Because it follows the industry 2400 baud standard, the modem must be set to 2400 baud if it is to answer at 2400. If it is set to, say, 1200 baud and someone calls in at 2400, the modem will answer at 1200. The section in this chapter called "Dialing, Answering, and Baud Rates" explains further the baud rates at which two modems connect under different circumstances.

If you plan to connect your Q-Modem 2400 directly to a mainframe or minicomputer where it will be dedicated to auto answer operation, you *might* need to change the modem's configuration from the default settings. Because every situation is different, it's hard to say what you'll need to change if you have problems. We suggest trying **&D** (which causes the modem to ignore **DTR**) or **&C** (which causes **DCD** to always stay on) or both. Please call Quality Computers Technical Support if you need assistance.

If you plan to use your Q-Modem 2400 to run a BBS, you *might* need to change your modem's configuration from the factory settings. Please refer to your BBS software manual or contact the BBS software publisher for more information on how your modem should be set.

Dialing, Answering, and Baud Rates

The Q-Modem 2400 lets you communicate at various baud rates, including 300, 1200, and 2400 bps. When the Q-Modem 2400 is switched on, the rate defaults to the value previously stored in the nonvolatile memory. Then each time your software sends an AT command line to your modem, the modem switches to the rate at which the software sent the command line (i.e. the rate the software is set to).

The following tables show the baud rates to which the answering modem will shift when one industry-standard 2400 baud modem calls another. The tables assume that both modems are using the same communication protocols.

To determine the rates at which your Q-Modem 2400 will connect with a 300 or 1200 baud modem, use the tables below while keeping the following in mind:

- A 300 baud modem can *only* connect at 300 baud.
- A 1200 baud modem acts the same way as a 2400 baud modem, as shown in the tables, with one exception: a 1200 baud modem cannot connect at 2400 baud.

The first table shows the rates when the "Bell" (Bell 103/Bell 212A/CCITT V.22bis) protocols are used, and the second shows the rates when the "CCITT" (CCITT V.21/V.22/ V.22bis) protocols are used. If you purchased your modem in the United States or Canada, it is probably set to use the Bell protocols. If you purchased your modem somewhere else, it probably uses the CCITT protocols. If you're not sure which type of protocols your modem uses, read the section called "Determining Your Protocols" in Chapter 6.

In both cases, when the two modems connect, you'll see the **CONNECT** result code followed by the communication rate at which the modems connected; for example, **CONNECT 1200**. If your software is set to a different baud rate than the one indicated in the **CONNECT** result code, you need to change the software baud rate to match the result code.

Connection Baud Rates on Bell Modems

		Originating Modem Calls At		
		<u>300</u>	<u>1200</u>	<u>2400</u>
Answering	300	300	1200	1200
Modem	1200	300	1200	1200
Set To	2400	300	1200	2400

For example, if the answering modem is set to 2400 baud and the originating modem calls at 1200 baud, the answering modem's rate will automatically fall back to 1200 baud to make the connection. Whenever you answer with your modem set to 2400 baud, your modem will adjust its baud rate automatically to the rate of the incoming call.

Connection Baud Rates on CCITT Modems

		Originating Modem Calls At		
		<u>300</u>	<u>1200</u>	<u>2400</u>
Answering	300	300	*	*
Modem	1200	*	1200	1200
Set To	2400	*	1200	2400

For example, if the answering modem is set to 2400 baud and the originating modem calls at 1200 baud, the answering modem's rate will automatically fall back to 1200 baud to make the connection.

In the situations marked with an asterisk, the modems will connect, but they won't work properly. (On external modems, the RD light will turn on and stay on—without flickering—in these situations.) For a 300 baud connection to be made on modems set to use CCITT protocols, both modems *must* be set to 300 baud.

4

CREATING CUSTOM MODEM CONFIGURATIONS

Should You Configure Your Modem?

Before your Q-Modem 2400 left the factory, it was set up to act a certain way; for example, it returns full-word result codes and waits for a dial tone before dialing. These settings will work for most situations. In some circumstances, however, like if you want to use your modem to auto answer, you may need to change your modem's configuration. This chapter tells how to do that.

Remember, you need to use your telecommunications software to change many modem settings, including baud rate, word length, and parity. After you change the settings in your software, the modem will put the settings into effect when the next AT command is issued (either when you type a command at the keyboard, or when your software issues a command).

How Modem Configuration Works

There are three types of modem configurations: factory, active, and stored. The following sections explain what each is and how you can use them.

Factory Configuration

The factory configuration is stored in the modem's permanent memory (called firmware ROM). The word "default" in AT command and S register descriptions indicates which settings are factory configuration settings.

Active Configuration

The active configuration is the configuration you're using when you have your modem turned on. It is stored in the modem's temporary memory (called temporary RAM).

Changing the Active Configuration

You can create a custom configuration by changing the settings in the S registers that comprise the active configuration. The Q-Modem 2400 AT commands let you change most of these registers indirectly, by issuing single commands. They are explained in Chapter 2 and Appendix A. As an alternative to using the AT commands, you can directly change the register settings by issuing the `Sr=n` command described in Chapter 5. We recommend using the AT commands (instead of changing the settings directly) whenever possible.

Other useful commands you may want to use when creating a custom configuration include the following:

- **&F**, which replaces the existing active configuration with the factory configuration
- **Z**, which resets the modem and loads the stored configuration, which is described in following sections

Saving the Active Configuration

You can save most of your active configuration in the modem's nonvolatile memory (nonvolatile RAM) by issuing the `&W` command. The settings that are saved when `&W` is issued are listed later in this chapter in the section called "Modem Settings That Can Be Saved in Stored Configurations." If you don't save the active configuration, it will be lost when you turn the modem off.

Stored Configuration

If you save the active configuration using the `&W` command, it becomes the stored configuration that resides in the modem's nonvolatile RAM. Whenever you turn on your modem, it loads the stored configuration into the active configuration area.

Changing the Stored Configuration

You can change the stored configuration by changing the active configuration and saving it using the `&W` command. If you want to change your modem's stored configuration to the way it was when the modem was shipped from Quality Computers, read "Modem Configuration When Shipped" at the end of this chapter.

Configuration Summary

The following table summarizes the three configurations:

configuration	stored in memory	user-changeable	saved at power loss
factory	permanent (firmware ROM)	no	yes
active	temporary RAM	yes	no, unless saved as stored configuration by issuing &W command
stored	nonvolatile RAM	yes, indirectly, by changing the active configuration and then saving it using &W command	yes

Modem Settings That Can Be Saved

The following table lists the modem characteristics that are saved in stored configurations when the &W command is issued. Also listed are the possible settings of the characteristics and the settings the characteristics have after the &F command is issued (the factory settings).

To change a characteristic, use the appropriate AT command or S register, as listed. Chapter 2 and Appendix A explain the AT commands, and Chapter 5 and Appendix C explain the S registers.

Note that the settings in S registers 1-13, 15-17, 19, 20, and 24 are not saved when the &W command is issued.

Characteristic	Possible Settings	Factory Setting	Cmd.	S Reg.
telephone no.	see &Zn command	none	&Zn	none
auto answer	∅ = disabled 1-255 = ring to answer on	disabled	S∅=n	∅
command echo	no echo, echo	echo	E	14
result codes	disabled, enabled	enabled	Q	14
result code type	words, numbers	words	V	14
dial type if not specified	tone, pulse	pulse	Dn	14
originate/answer	originate, answer	originate	A/Dn	14
test timer length	1-255 seconds (∅=disabled)	disabled	S18=n	18
DCD	on, on only with carrier present	on	&C	21
DTR	see &D command	ignored	&D	21
DSR	on, on only with carrier present	on	&S	21
long space disconnect	disabled, enabled	disabled	Y	21
speaker volume	low, medium, high	medium	L	22
speaker control	see description of M command	M1	M	22
dialing/result codes	see description of X command	X4	X	22
make/break ratio	US/Canada, UK/Hong Kong	US/Can.	&P	22
baud rate	2400, 1200, 300	none	*	23
parity	even, odd, mark, space, none	none	*	23
obey request for test	disabled, enabled	enabled	&T	23
guard tones	disabled, 550 Hz, 1800 Hz	disabled	&G	23
delay to DTR	∅-255 100th sec.	5	S25=n	25
1200 baud protocol	Bell 212A, CCITT V.22	Bell 212A	B	27

* Must be changed using telecommunications software.

Modem Configuration When Shipped

The factory configuration described earlier in this chapter matches the industry standard exactly. But most people actually need a slightly different configuration for their modems to work properly. Because of this, on every Q-Modem 2400, we change two settings and save them in a stored configuration.

So when your modem left the factory, it was configured with the settings listed in the previous table, with these two exceptions:

- DCD was set to "on only with carrier present" (&C1).
- DTR was set to cause the modem to disconnect, assume the asynchronous command state, and disable auto answer if it detects an on-to-off transition of DTR (&D2).

To reset the modem to the configuration it had when you first received it, issue these commands in order:

- &F, which replaces the active configuration with the factory configuration
- &C1 and &D2, which make the active configuration the same as it was when the modem was manufactured
- &W, which saves the active configuration as the stored configuration

All of these commands can be issued in one command line, as shown below:

```
AT &F &C1 &D2 &W [CR]
```

This saved configuration will then be loaded whenever you turn on your modem, until you change the configuration again.

If you have a "CCITT" modem as described in Chapter 6, you'll want to note that issuing the &F command sets the 1200 baud protocol to Bell 212A. Chapter 6 explains how this protocol was set when you originally received your modem.

CHANGING S REGISTER SETTINGS

You can customize your modem's configuration by changing the settings of some of the modem's S registers. You might need to do this when you want your modem to auto answer, for example.

The best way to change your modem configuration is to use the modem's AT commands, which let you change many S register settings indirectly, without having to worry about the modem's lower-level structure. If you have a choice, use AT commands instead of changing the S registers directly.

This chapter explains how to read and modify the S registers. Appendix C describes the S registers in detail.

Reading the Contents of an S Register

The `Sr?` command displays the value in register `r`. The `r` must be a register number from 0 to 27. The modem always returns three decimal digits for each register that is read and follows this number with Return and a line feed character.

Example 1

```
ATS0? [CR]
003 (from modem)
OK (from modem)
```

This command reads a single register, 0, and displays its three-digit value at your terminal. For example, if the value in the register is 3, the modem will display 003.

Example 2

```
ATS0?S7? [CR]
000 (from modem)
030 (from modem)
OK (from modem)
```

This command line reads two registers, 0 and 7, and displays their three-digit values, 0 and 30 respectively, at your terminal.

Modifying the Contents of an S Register

The $Sr=n$ command sets the value in S register r to n . The n must be a decimal integer from 0 to 255.

Example

```
ATS0=4 [CR]
```

This command sets register S0 to 4, which causes the modem to automatically answer all incoming calls after the fourth ring. The modem replies with **OK** to acknowledge that the command has been executed and that the modem is ready to process a new command.

Using a Register Without Naming It

The $Sr=n$ and $Sr?$ commands can also be used without directly naming the register. The modem remembers the last register accessed and allows you to set or read it by typing $AT=n$ or $AT?$.

Example 1

```
ATS0 [CR]  
OK (from modem)  
AT=3 [CR]  
OK (from modem)
```

This example shows how a value of 3 is given to S0 when S0 was the last register accessed.

Example 2

```
ATS0=7 [CR]  
OK (from modem)  
AT? [CR]  
007 (from modem)  
OK (from modem)
```

This example uses the $Sr=n$ command to modify register S0 and then uses $AT?$ to read the register. $AT?$ responds by displaying the value in register S0.

BELL/CCITT INTERNATIONAL COMPATIBILITY

This chapter explains the Bell/CCITT communication protocols and how to change them. You might need to change the protocols your modem uses if any of the following apply to you:

- You plan to make calls to or receive calls from modems outside your country.
- You live outside the United States and Canada yet still need to use the Bell protocols.
- Your modem is set to use the CCITT protocols and you issue the **&F** command to restore the modem's factory configuration. (**&F** sets the 1200 baud protocol to Bell 212A.)

Available Protocols

The Q-Modem 2400 lets you use five different communication protocols: Bell 103, Bell 212A, CCITT V.21, CCITT V.22, and CCITT V.22bis. You will probably only use three of these protocols—one for 300 bps communications, one for 1200 bps, and one for 2400 bps. The three you need to use depend on the protocols of the modem to which you want to connect.

Calls Within a Country

For calls within the United States, within Canada, or between Canada and the United States, use these protocols: Bell 103 at 300 bps, Bell 212A at 1200 bps, and CCITT V.22bis at 2400 bps. All Q-Modem 2400s made for use in the United States and Canada, and all other modems made for use in the United States and Canada are set to use these protocols.

For calls within many other countries, all the CCITT protocols work: (CCITT) V.21 at 300 bps, V.22 at 1200 bps, and V.22bis at 2400 bps. All Q-Modem 2400s made for use in places other than the United States and Canada use these protocols.

If you are not sure which protocols you should use for calls within your country, please contact your local computer dealer.

International Calls

For international calls, both modems *must* use the same protocols. If your modem and the modem to which you want to connect use different protocols, one of the modems must be changed so the protocols are the same.

Determining Your Modem Protocols

When shipped, Q-Modem 2400s are set to use either the "Bell" (Bell 103/Bell 212A/CCITT V.22bis) protocols or the "CCITT" protocols (CCITT V.21/V.22/V.22bis). Those made for use in the United States or Canada are set to use the Bell protocols, and those made for use in other areas are set to use CCITT.

If you are not sure which group of protocols your modem is set to use, you can check the header labeled **B-C** on the modem board. This header indicates the protocol used at 300 baud. Unless the modem has been altered since it left the factory, the 1200 baud protocol is from the same protocol group (Bell or CCITT) as the 300 baud protocol.

Appendix E explains how to check the **B-C** header, and the following section explains how to change the protocols if necessary.

Changing Protocols Between Bell & CCITT

If you need to change your modem's communication protocols, use the following methods.

To change the protocol used at 1200 baud, use the **B** command. **B** sets the protocol to CCITT V.22, and **B1** sets the protocol to Bell 212A. Chapter 2 explains how to use modem commands.

Changing the 300 baud protocol involves a minor hardware change. See Appendix E.

Changing Protocols With Baud Rates

When you use your telecommunications software to set your modem's baud rate, the modem *automatically* switches to the communication protocol that's appropriate for that baud rate. For example, if you use your software to set your baud rate to 1200 baud, the modem automatically uses the Bell 212A protocol (if your modem is set to use the Bell protocols) or the CCITT V.22 protocol (if your modem is set to use the CCITT protocols).

7

RUNNING DIAGNOSTIC TESTS

Which Test to Use

The Q-Modem 2400 has two diagnostic tests you can use at 1200 or 2400 bps to check that the modem is hooked up and functioning correctly. The local analog loopback test tests the RS-232C cable and your terminal, and the local analog loopback with self test tests your modem. We recommend that you only use these tests if you're having problems with your modem.

How to Run a Test

To run a test, simply be sure you're in command state, and then start the test by issuing the command that starts that test. Refer to the test descriptions to learn the appropriate command.

How to Terminate a Test in Progress

You can terminate running tests one of two ways: by entering the **&T** command or by waiting for the test to run longer than the time limit set previously in register S18.

Issue the escape code (to return to the command state) before you send the **&T** command. Note that the modem ignores commands that follow the **&T** command on a single command line.

When set to a nonzero value, register S18 establishes the duration of the modem's tests. When a test runs for the time set in S18 (from 1 to 255 seconds), the modem automatically stops the test and returns to the command state. By default, S18 is set at 0, which disables the test timer.

Solving Problems Yourself

If you encounter problems with your Q-Modem 2400, *immediately disconnect your modem*. Then try to solve the problem yourself using the following list.

- If you have an external modem and the modem appears to have no power, make sure you are using the power adapter that came with your modem (9 VAC). If you are, press the ON/OFF button once or twice. If the modem still does not have power, disconnected it from your computer and press the ON/OFF button once or twice again. If the modem turns on, the problem is with your computer's serial port or your RS-232C cable; contact your computer dealer for assistance. If the modem does not turn on, the problem is with the modem; call Quality Computers Technical Support for assistance.
- If you cannot connect with another modem, your modem may be using different communication protocols (Bell/CCITT) than the modem with which you are trying to connect. Both modems must use the same communication protocols. Chapter 6 explains how to determine the type of protocols your modem uses and how to change them if you need to.
- If you have issued the &T1 (test) command and then a line of text and the modem is not responding, it's because the modem does not echo the first six to ten characters typed. Try the test again, and type more than ten characters.
- If you have connected to a remote modem but your computer has frozen up or all you see on your screen are garbage characters, one of the following may be the problem:
 - Your computer and modem are communicating at different baud rates because the modem connected at a different rate than it was originally set to. Use your software to change the baud rate so it matches the speed give in the CONNECT result code.

c2. Test Descriptions**&T1 Local Analog Loopback L3 Test**

Checks the data path between your modem and terminal. If the modem is on line, this tests causes the modem to lose the carrier.

Example

```
AT S18=0 &T1 [CR]
```

This command first disables the test timer by setting register S18 to 0 and then starts the local analog loopback test. You should respond by typing a test message such as "Boy oh Boy! I love my Q-Modem". If the modem echoes back the same message, you'll know the test is successful. (You won't begin seeing characters until you've typed six of them.) Then you can end it by issuing the escape code (+++) and then the &T command:

```
AT &T [CR]
```

The modem responds by displaying the OK result code.

You also could have run this test using the test timer by assigning register S18 a value between 1 and 255. If you had, the test would have ended automatically, without you entering &T.

&T8 Local Analog Loopback L3 with Self Test

Checks your modem transmit and receive circuits. If your modem is on line, this test will cause it to lose the carrier.

Example

This example assumes the modem is in the command state and set to echo back to your terminal.

```
AT S18=0 &T8 [CR]
AT &T [CR]
```

This example disables the test timer, runs the test, and terminates the test. If the modem returns 000 followed by OK, the test found no errors. If the test returns a nonzero number such as 001, the test found that number of errors (1). As demonstrated in the &T1 test description, the same test could be run using the test timer. Note that if the test reports 255 errors, it found 255 or more.

- Your computer and the remote modem are set to different data bits (word length), parity, and number of stop bits. The most common are 8 data bits (8-bit word length), no parity, and 1 stop bit (8, none, 1). Use your software to change these settings.
 - Your computer's serial port is not working properly. Contact your local computer dealer for assistance.
 - Your modem is not working properly. Contact Quality Computers Technical Support for assistance.
 - You are using CCITT protocols and trying to make a 300 baud connection with one or both of the modems set to 1200 or 2400 baud. Modems using CCITT protocols must both be set to 300 baud to make a connection at 300 baud. Chapter 3 provides more information.
- If two letters appear on the screen for every one you type while in the command state, disable command echo by issuing the **E** command. You can also solve this problem by using your telecommunications software to change your terminal setting to full duplex operation.
 - If you enter the **+++** escape code but the modem does not acknowledge it by sending the **OK** result code, one of the following may be the problem.
 - You issued the plus signs (+) too quickly. Wait two seconds after sending any characters before sending the escape code, then send the escape code, and then wait two more seconds. You should see the **OK** result code.
 - Your computer is set to a different baud rate than the remote modem is (indicated by the **CONNECT** result code you received). Use your software to change baud rate.
 - The escape code character has been changed in register **S2** from a plus sign to something else. Change the escape code character back to a + or use the character in **S2**.
 - If the **SD** indicator light does not flicker on and off when you press your terminal keys, the terminal is not sending data to the modem. One of the following is probably the reason.
 - The modem and terminal are not connected properly. Check the connections, and make sure the RS-232C cable is plugged into the correct port on the terminal.
 - The RS-232C cable is damaged or the wrong type for your computer. Get a working cable from your dealer.
 - Your computer's serial port is not working properly. Contact your local computer dealer for assistance.
 - Your modem is not working properly. Contact Quality Computers Technical Support for assistance.
- If you type **AT** followed by Return and the modem does not acknowledge it with the **OK** result code, one of the following may be the problem.
 - You are not in the command state. Enter the escape code (**+++**) to switch from on-line state to command state.
 - Your computer is set to a baud rate other than 300, 1200, or 2400. Use your software to change your baud rate.
 - Command echo is disabled. Issue the **E1** or **&F** command, then issue the **&W** command.
 - Result codes may be disabled. Issue the **Q** or **&F** command, then issue the **&W** command.
 - Your computer's serial port is not working properly. Contact your local computer dealer for assistance.
 - If you cannot get your software to hang up, issue the **&D2** command followed by the **&W** command.
 - If you have changed your modem configuration and can't get your modem to work properly, and you want to reset the configuration to the way it was when it was shipped from Quality Computers, read the section in Chapter 4 called "Configuration When Shipped."
 - If you recently issued the **&F** command and you are having problems trying to use the CCITT protocols to connect at 1200 baud, you may need to change your 1200 baud protocol to CCITT V.22, as explained in Chapter 6. The **&F** command causes the modem to use the Bell 212A protocol at 1200 baud.

If You Need Help

If you need further assistance, please contact your dealer or call Quality Computers Technical Support at (313) 774-7740.

Note: Do not return any equipment to Quality Computers for service without first contacting us and obtaining a Return Materials Authorization (RMA) number.

Warranty

Quality Computers warrants this product to be free from defects in material and workmanship and to meet applicable specifications under normal use and service for a period of one year after sale to the original owner. If any parts are deemed to

be defective originally, or if these parts or equipment have become defective under normal usage rather than misuse, negligence, or accident, Quality Computers will repair or replace them without charge.

This warranty shall not apply to parts or equipment that has been repaired or altered outside of our repair facilities. Equipment that has been subjected to misuse, negligence, or accident; that has been altered or defaced; or that has the serial number missing is not covered by this warranty. Repairs that are not covered by this warranty will be billed at current shop charges for parts and labor.

Quality Computers does not assume any liability for any consequential damages caused by use of this product.

A

AT COMMAND DESCRIPTIONS

The following sections describe each Q-Modem 2400 command in detail. Be sure you have read Chapter 2 before using these commands. The commands are presented alphabetically within each of these categories:

- general commands
- phone line commands
- configuration and compatibility commands
- self test and diagnostic commands

The *Q-Modem 2400 Reference Card* provides a summary of these commands.

General Commands

AT Attention Code Command Line Prefix

Signals the beginning of a command line. The "Command Line" section and other sections in Chapter 2 explain the function of the AT command line prefix.

A/ Re-execute Last Command

Re-executes the last command line entered. *This command is NOT preceded by AT or followed by Return.* The section called "Command Line Buffer" in Chapter 2 explains how the A/ command works.

E Command Echo

Controls the echo of characters sent to your modem from your terminal when the modem is in the command mode.

- E Inhibits command echo.
- E1 Enables command echo (default).

If your software expects characters to be echoed (sometimes called duplex or full duplex), use **E1**. If you don't, your screen will not display the characters you type.

If your device does not expect characters to be echoed, use **E**. If you don't, each character you send will be duplicated on your screen; for example, **ATDT** will look like this: **AATTTDDTT**.

L Speaker Volume

Selects speaker volume.

- L** Selects low speaker volume.
- L2** Selects medium speaker volume (default).
- L3** Selects high speaker volume.

M Speaker Control

Turns the speaker on and off.

- M** Turns the speaker off.
- M1** Turns the speaker off while the modem is receiving a carrier signal from a remote source (default).
- M2** Turns the speaker on (causing it to always stay on).
- M3** Turns the speaker off while the modem is receiving a carrier signal from a remote source and the modem is dialing.

Q Enable/Disable Result Codes

Determines whether result codes are returned to acknowledge commands and actions.

- Q** Causes result codes to be returned (default).
- Q1** Keeps result codes from being returned.

Sr=n Write to S Registers

Sets the value in S register *r* to *n*. The value in *r* must be a decimal integer from 0 to 27 that represents an S register as described in Chapter 5. The value in *n* must be a decimal integer from 0 to 255.

The following example command sets the value in S register 4 to 9 and the value in S register 26 to 30:

```
AT S4=9 S26=30 [CR]
```

Chapter 5 provides additional information on using the **Sr=n** command.

Sr? Read S Registers

Displays the value in register *r* at your terminal. The value in *r* must be a decimal integer from 0 to 27 that represents an S register as described in Chapter 5.

The following example command causes the value in S register 1, 20, to be displayed on the screen.

```
AT S1? [CR]
020 (from modem)
OK (from modem)
```

Chapter 5 provides more information on using the **Sr?** command.

V Choose Verbose or Numerical Result Codes

Determines whether result codes are displayed as one- or two-digit decimal numbers or as words.

- V** Causes result codes to be displayed as numbers.
- V1** Causes result codes to be displayed as words (default).

The section called "Result Codes" in Chapter 2 explains result codes, and Appendix B provides a complete list of result codes, their word and number representations, and their meanings.

+++ Escape Code

Returns the modem to command state. The section called "Escape Code (+++)" in Chapter 2 explains the escape code in detail.

Phone Line Commands

A Answer Phone Line

Causes your modem to immediately attempt to answer a call (enter answer mode).

Dn Dial Telephone Number

Causes the modem to dial the telephone number given in *n*. That number must be an ASCII string containing numbers 0 through 9 (for pulse-phone lines) or those numbers and the characters A, B, C, D, #, and * (for touch-tone-phone lines). The length of *n* cannot

exceed the size of the command buffer (40 characters excluding the AT prefix, the Return character, and the line feed).

The **Dn** command can be used alone or with the following modifiers:

- T** touch-tone dial
- P** pulse dial
- R** reverse mode (from originate to answer mode)
- W** wait for dial tone before processing the next symbol in the dial string
- @** wait for quiet answer
- ,** pause before processing the next symbol in the dial string
- !** flash
- ;** return to command state after dialing
- S** dial stored number

These modifiers are described below. For a thorough discussion of telephone number dialing, refer to Chapter 4.

- T** Causes the modem to touch-tone dial the numbers that follow it in the dial string.
- P** Causes the modem to pulse dial the numbers that follow it in the dial string.
- R** Causes the modem to originate the call in answer mode. **R** is used to connect to an originate-only modem, and it must be the last character in the dial string.
- W** Causes the modem to wait before dialing the numbers that follow it in the dial string. The modem waits for the amount of time in register **S7**; presumably after that time a dial tone will be present. The default value in **S7** is 30 seconds.
- @** Causes the modem to wait for the time in register **S7** for one or more rings followed by five seconds of silence (a quiet answer) before processing the next symbols in the dial string. If it does not find a quiet answer, the modem hangs up and returns the **NO ANSWER** result code to the terminal. If it detects a busy signal, the modem hangs up and returns the **BUSY** result code to the terminal.

The **@** modifier is used to access a system that does not provide a dial tone. The default value in **S7** is 30 seconds.

(Comma) Causes the modem to wait for the time in register **S8** before processing the next symbol in the dial string. Multiple commas can be used consecutively to generate longer pauses. The default setting of **S8** is 2 seconds.

To dial out from a PBX, insert the comma in the dial string after the 9 used to leave the PBX area. The comma should allow enough time for a dial tone to be established before the modem dials the phone number. (Some PBXs don't need the delay; some do.)

! Causes the modem to go on-hook for one-half second. This operation, sometimes called a hook-flash, is like briefly pressing down the button on your telephone.

; Causes the modem to return to command state after dialing. This allows you to dial long telephone numbers by issuing a dial command (**Dn**) and ending the line with a semicolon (not Return), then repeating that action as many times as necessary, ending the last dial command with Return. Chapter 4 provides an example of how this is done.

S Dials a telephone number stored using **&Zn**.

H Hook Control

Operates the telephone line relay.

- H** Causes the modem to go on-hook (hang up).
- H1** Causes the modem to go off-hook (answer phone).

O Go On Line

Causes the modem to go on line and optionally to initiate an equalizer retrain sequence if the modem is operating at 2400 bps.

- O** Causes the modem to go on line.
- O1** Causes the modem to go on line and to initiate an equalizer retrain sequence. This form of the command may be used when bit error rates are excessive to reduce errors attributed to loss of equalization. If the errors are due to some other cause, issuing this command will not improve performance. This command form only works at 2400 bps.

X Dialing and CONNECT Result Codes

Selects the type of dialing and CONNECT result codes the modem will use. The modem can either wait for a dial tone or blind dial (automatically dial regardless of whether a dial tone is present). X4 is the default.

X	blind dial:	yes
	send result code:	CONNECT
	recognize dial tone:	no
	recognize busy signal:	no
X1	blind dial:	yes
	send result code:	CONNECT, CONNECT 1200, or CONNECT 2400
	recognize dial tone:	no
	recognize busy signal:	no
X2	blind dial:	no—waits for dial tone before dialing, then dials
	send result code:	CONNECT, CONNECT 1200, or CONNECT 2400
	recognize dial tone:	yes—if doesn't detect a dial tone within five seconds, returns the NO DIALTONE result code
	recognize busy signal:	no
X3	blind dial:	yes
	send result code:	CONNECT, CONNECT 1200, or CONNECT 2400
	recognize dial tone:	no
	recognize busy signal:	yes—if detects busy signal, returns BUSY result code
X4	blind dial:	no—waits for dial tone before dialing, then dials
	send result code:	CONNECT, CONNECT 1200, or CONNECT 2400
	recognize dial tone:	yes—if doesn't detect a dial tone within five seconds, returns the NO DIALTONE result code
	recognize busy signal:	yes—if detects busy signal, returns BUSY result code

&Zn Store Telephone Number

Stores the telephone number *n* in nonvolatile memory for subsequent dialing using the D*n* command with the S modifier. The *n* must be a valid dial string as described in the D*n* command description, and cannot include the S dial command modifier. Chapter 3 provides more information on using stored telephone numbers.

Configuration and Compatibility Commands

B BELL/CCITT Protocol Compatibility

Sets the protocol for 1200 bps operation to CCITT V.22 or Bell 212A.

- B Sets the protocol to CCITT V.22.
B1 Sets the protocol to Bell 212A.

Chapter 6 provides more information on using the B command, including the default protocol.

Y Enable/Disable Long Space Disconnect

Enables or disables a long space disconnect.

- Y Disable long space disconnect (default).
Y1 Enable long space disconnect.

When the long space disconnect is enabled, the modem disconnects when one of the following things happens:

- the remote modem sends a space of 1.6 seconds or more
- an H command is issued
- the modem detects an on-to-off transition on DTR (this applies if the &D2 command has been used previously to tell the modem to disconnect if it detects an on-to-off transition on DTR)

In the last two cases, the modem sends a four-second-long space before it disconnects.

Z Reset and Load Stored Configuration

Resets the modem, loads its active configuration area with the configuration profile stored in nonvolatile memory, and performs a two-second self-test.

&C Select Behavior of Data-Carrier-Detect (DCD)

Determines the way the Data-Carrier-Detect interchange circuit (DCD)—RS-232C pin 8—behaves when it receives a data carrier from the remote modem.

- &C** Causes the modem's DCD circuit to remain on regardless of the state of the data carrier from the remote modem (default after AT&F).
- &C1** Causes the modem's DCD circuit to track the data carrier from the remote modem and switch to on when a data carrier suitable for the Q-Modem 2400 is present (setting when modem first arrives).

&D Select Modem Reaction to DTR

Determines how the Q-Modem 2400 reacts to the behavior of the Data-Terminal-Ready interchange circuit (DTR)—RS-232C pin 20. The first form of the command ignores DTR, but the other three react to an on-to-off transition in DTR. Note that when the modem is on-line, it ignores a change of state (on or off) that persists for less time than the value in register S25 (default = 5/100 seconds).

This command has four forms:

- &D** Causes the modem to ignore DTR. The TR indicator on the front of the external modem remains on regardless of DTR (default after AT&F).
- &D1** Causes the modem to assume the asynchronous command state if it detects an on-to-off transition on DTR. The TR indicator on the front of the modem is on if DTR is on and off if DTR is off.
- &D2** Causes the modem to disconnect, assume the asynchronous command state, and disable auto answer mode if it detects an on-to-off transition on DTR. The TR indicator on the front of the modem is on if DTR is on and off if DTR is off (setting when modem is first received).
- &D3** Causes the modem to assume the initialization state if it detects an on-to-off transition on DTR. Note: The initialization state causes the configuration settings stored in the nonvolatile memory to overwrite the active settings. The TR indicator on the front of the modem is on if DTR is on and off if DTR is off.

&F Load Factory Configuration Profile from ROM

Loads the modem's active configuration area with the factory configuration profile from ROM. Refer to Chapter 4 for a description of the factory configuration profile.

&G Guard Tone Selection

Controls guard tone generation (not used in the United States).

- &G** Do not generate guard tones (default).
- &G1** Generate 550 Hz guard tone.
- &G2** Generate 1800 Hz guard tone.

&J Telephone Jack Selection

Selects the type of telephone wall jack being used.

- &J** Selects RJ-11, RJ-41, and RJ-45S (default).
- &J1** Selects RJ-12 and RJ-13. This command form is currently not supported for the Q-Modem 2400.

&L Dial-up Line/Leased Line

Selects dial-up or leased line.

- &L** Selects dial-up line (default).
- &L1** Selects leased line (not supported).

&M Asynchronous/Synchronous Mode Selection

Selects asynchronous or synchronous mode. Currently, only asynchronous mode is available on the Q-Modem 2400.

- &M** Selects asynchronous mode (default).
- &M1** Selects synchronous mode (not available).
- &M2** Selects synchronous mode (not available).
- &M3** Selects synchronous mode (not available).

&P Select Make/Break Ratio for Pulse Dial

Selects make (off-hook) to break (on-hook) ratio for pulse dialing.

- &P** Selects 39%/61% make/break ratio (USA/Canada).
- &P1** Selects 33%/67% make/break ratio (UK/Hong Kong).

&R Request-to-Send (RTS)/Clear-to-Send (CTS)

In asynchronous mode, CTS is always on in both the command and on-line states and has no effect.

&S Select Action of Data-Set-Ready (DSR)

Causes the Data-Set-Ready interactive circuit (DSR)—RS-232C pin 6—to act a particular way.

&S Causes **DSR** to remain on whenever the Q-Modem 2400 is on.

&S1 Causes **DSR** to operate according to the EIA RS-232C specification.

&W Write Active Configuration to Nonvolatile Memory

Stores the active configuration profile in nonvolatile memory. These settings are then restored whenever the modem is turned on or when the **Z** command is given. Chapter 4 provides a list of the registers that are saved, and this chapter provides further information on the **&W** command.

&X Synchronous Transmit Clock

Determines synchronous transmit clock (currently not supported).

&X Modem generates transmit clock.

&X1 Terminal derives transmit clock while in slave operation.

&X2 Modem derives transmit clock from receive carrier while in slave operation.

Self Test and Diagnostic Commands

I Request Product Code I.D. or ROM Checksum

I Requests your modem's product code I.D. The modem responds by displaying the product code as a three-digit ASCII string in the form $24r$ where r is the revision letter of your modem. It follows the product code with Return and a line feed character.

I1 Requests a checksum computed on the firmware ROM. The modem sends three ASCII numeric characters followed by Return and a line feed character.

I2 Requests a checksum computed on the firmware ROM. The modem returns either **OK** or **ERROR** to indicate the results of the checksum. It follows the result code with Return and line feed character.

&T Test Modem

&T Terminates any test currently in progress. This command must be the last one in the command line.

&T1 Starts a local analog loopback test according to CCITT Recommendation V.54.

&T3 Starts a local digital loopback test.

&T4 Causes the local modem to grant a request from the remote modem for a remote digital loopback test.

&T5 Prohibits local modem from granting a request from the remote modem for a remote digital loopback test.

&T6 Starts a remote digital loopback test.

&T7 Starts a remote digital loopback with self-test according to CCITT Recommendation V.54. During the test phase, an internally generated data pattern of alternate binary ones and zeros at the selected bit rate is applied to the scrambler. An error detector capable of identifying errors in a stream of reversals is connected to the output of the descrambler.

&T8 Starts a local analog loopback with self-test according to CCITT Recommendation V.54. During the test phase, an internally generated data pattern of alternate binary ones and zeros at the selected bit rate is applied to the scrambler. An error detector capable of identifying errors in a stream of reversals is connected to the output of the descrambler.

Chapter 7 provides examples of **&T**, **&T1**, and **&T8**.

B

RESULT CODE DESCRIPTIONS

<u>Result Code</u>	<u>Number</u>	<u>Meaning</u>
OK	Ø	Acknowledges execution of a command line.
BUSY	7	Modem has detected a busy signal.
CONNECT	1	Modem has connected at 300 baud.
CONNECT 1200	5	Modem has connected at 1200 baud.
CONNECT 2400	10	Modem has connected at 2400 baud.
ERROR	4	Invalid command or incorrect checksum in response to I command.
NO ANSWER	8	The @ dial command modifier was issued, and 5 seconds of silence was not detected.
NO CARRIER	3	Failure to connect or loss of carrier.
NO DIALTONE	6	The W dial command modifier was issued and a dial tone was not detected within the period specified by S7 (default = 30 seconds) or the X2 or X4 command has been used and a dial tone is not detected within 5 seconds of going off hook.
RING	2	Ring detected.

C

S REGISTER DESCRIPTIONS

The following sections describe the S registers in detail.

S Ø **Number of Ring to Answer** (default = Ø)

Contains the number of rings the modem waits for before it answers. A value from 1 to 255 enables the modem's auto answer mode (refer to Chapter 4 for more information about auto answer). A value of Ø disables auto answer.

The AA light on the front of the external modem acts differently if auto answer is enabled or disabled. When auto answer is enabled, AA is usually lit but goes off during an incoming call's rings. When auto answer is disabled, AA is usually off but goes on during an incoming call's rings.

S 1 **Ring Counter** (default = Ø)

Holds the current number of telephone rings. This register is used to count the number of telephone rings and is set back to zero if it detects no rings for eight seconds.

S 2 **Escape Code** (default = 43 "+")

Contains the ASCII value of the escape code. This register can be set to any value from Ø to 255, but values greater than 127 will cause the escape code to be disabled. Chapter 2 provides additional information on the escape code.

S3 Carriage Return
(default = 13)

Contains the ASCII value of the Return control character. This character serves as the command line terminator and the result code terminator. If the data terminal is non-standard, a value other than 13 can be used in this register.

S4 Line Feed
(default = 10)

Contains the ASCII value of the line feed control character.

S5 Backspace
(default = 8)

Contains the ASCII value of the backspace control character (8). The value in this register must be from 0 to 33.

S6 Time to Wait for Dial Tone
(default = 2, units = seconds)

Holds a value indicating the maximum time to wait for a dial tone after going off-hook before dialing a telephone number. The modem will dial the number as soon as it has detected a dial tone, or it will return the NO DIALTONE result code if it does not detect a dial tone within the period specified in S6. This register is only used with the X2 and X4 commands.

S7 Time to Wait for Ring-back/Carrier
(default = 30, units = seconds)

Holds a value from 1 to 30 indicating the maximum time the originating modem waits for one of the following before hanging up:

- a ring-back (the ringing that occurs on your end after dialing a telephone number)
- a carrier from the remote modem

The Q-Modem 2400 looks for a carrier even if a ring-back is not detected before the time limit; if no carrier appears, this may cause a wait of up to twice the value in S7. This only applies when the X3 or X4 commands have been used.

S8 Pause Time for Dial Command Comma Modifier
(default = 2, units = seconds)

Holds a value from 0 to 255 that represents the length of the pause caused by a comma in the dial command string (Dn).

S9 Time to Wait Before Recognizing Carrier
(default = 6, units = 1/10 seconds)

Holds a value from 0 to 255 that represents the length of time after a carrier first appears that the modem should wait to recognize that carrier as valid and turn on the Data-Carrier-Detect (DCD) interchange circuit. This delay allows the Q-Modem 2400 to ignore spurious signals that are the same frequency as the carrier tone. As the time is increased, there is less chance of a false carrier being detected.

S10 Time to Wait for Remote Carrier to Return
(default = 14, units = 1/10 second)

Holds a value from 1 to 255 that represents the amount of time after the remote modem hangs up that the Q-Modem 2400 waits for a valid carrier before disconnecting. A long enough time allows the remote modem's signal to momentarily disappear without causing the Q-Modem 2400 to disconnect.

The actual time the Q-Modem 2400 will wait for a lost carrier to appear after it disappears is the difference between S9 and S10. A value of 255 causes the Q-Modem 2400 to act as though a carrier were always present, whether one is or not.

S11 Reserved

S12 Escape Code Guard Time
(default = 50, units = 1/50 second)

Holds a value that represents the delay required before and after entering the escape code. The maximum value is 255 (5.1 seconds).

S13 Reserved

S14 Bit Mapped Options

Bit	Use	Settings
Ø	Reserved	
1	Command echo (see E command)	Ø = No echo 1 = Echo (default)
2	Result codes (see Q command)	Ø = Enabled (default) 1 = Disabled
3	Result code words or numbers (see V command)	Ø = Number result codes 1 = Word result codes (default)
4	Dumb/smart (not saved)	Ø = Smart (default) 1 = Dumb
5	Dial method (see T and P dial modifiers)*	Ø = Tone dial 1 = Pulse dial
6	Reserved	
7	Originate/Answer (see A and Dn, commands, R dial command modifier, and register SØ)	Ø = Answer 1 = Originate (default)

* If the dial command (Dn) is used without a T or P modifier, the modem assumes the dial method set in bit 5.

S15 Reserved

S16 Diagnostic Test Modes (default = Ø)

Bit	Use	Setting
Ø	Local analog loopback L3 (see &T1 command)	Ø = Disabled (default) 1 = Enabled
1	Reserved	

2	Local digital loopback (see &T3 command)	Ø = Disabled (default) 1 = Enabled
3	Remote digital loopback test (see &T4 and &T5 commands)	Ø = Loopback off (default) 1 = Loopback in progress
4	Initiate a remote digital loopback L2 (see &T6 command)	Ø = Disabled (default) 1 = Enabled
5	Initiate a remote digital loopback L2 with test message and error count (see &T7 command)	Ø = Disabled (default) 1 = Enabled
6	Local analog loopback L3 with self test (see &T8 command)	Ø = Disabled (default) 1 = Enabled
7	Reserved	

Note the following:

- Only one of the above tests can be performed at one time.
- The &T command terminates any test in progress and sets S16 to Ø.

S17 Reserved

S18 Test Timer (default = Ø, units = seconds)

Holds a value between 1 and 255 that represents the duration of modem diagnostic tests. A value of Ø disables the test timer. When a test is active for a period equal to the value in this register, the modem automatically cancels the test. A test can be terminated from the command state at any time by issuing the &T command.

S19 Reserved

S20 Reserved

S21 Bit Mapped Options
(default = 0)

<u>Bit</u>	<u>Use</u>	<u>Settings</u>
0	telephone jack (see &J command)	0 = RJ-11/RJ-41/ RJ-45S (default) 1 = RJ-12/RJ-13 (currently not supported)
1	Reserved	
2	Clear-to-Send (CTS)/ Request-to Send (RTS) (synchronous only; see R command)	0 = CTS follows RTS (default) 1 = CTS follows carrier signal
4, 3	Data-Terminal- Ready (DTR) (see &D command)	0, 0 = Modem ignores DTR (default) 0, 1 = Modem goes to command state if on-to-off transition of DTR 1, 0 = Modem hangs up with on-to-off transition of DTR (factory setting) 1, 1 = Modem re-initial- izes if on-to-off transition of DTR
5	Data-Carrier- Detect (DCD) (see &C command)	0 = DCD always on (default) 1 = DCD on when carrier is present (factory setting)
6	Data-Set-Ready (DSR) (see &S command)	0 = DSR always on (default) 1 = When DSR on, modem is off-hook, in data mode, and not in self-test mode
7	Long space disconnect (see Y command)	0 = Disabled (default) 1 = Enabled

S22 Bit Mapped Options

<u>Bit</u>	<u>Use</u>	<u>Settings</u>
1, 0	Speaker volume (see L command)	0, 0 = Undefined 0, 1 = Low 1, 0 = Medium (default) 1, 1 = High
3, 2	Speaker control (see M command)	0, 0 = Disabled 0, 1 = On until carrier detected (default) 1, 0 = Always on 1, 1 = Off during dialing and then on until carrier detected
6, 5, 4	Result code options (see X command)	0, 0, 0 = X command 1, 0, 0 = X1 command 1, 0, 1 = X2 command 1, 1, 0 = X3 command 1, 1, 1 = X4 command (default)
7	Make/break ratio (see &P command)	0 = 39/61 U.S./Canada (default) 1 = 33/67 U.K./Hong Kong

S 23 Bit Mapped Options (default = 7)

<u>Bit</u>	<u>Use</u>	<u>Settings</u>
Ø	Obey request from remote modem for remote digital loop-back (see &T4 and &T5 commands)	Ø = Disabled 1 = Enabled (default)
2, 1	Communication rate (see AT command line prefix)	Ø, Ø = Ø to 300 bps Ø, 1 = 600 bps 1, Ø = 1200 bps 1, 1 = 2400 bps
3	Reserved	
5, 4	Parity option (see AT command line prefix)	Ø, Ø = Even Ø, 1 = Space 1, Ø = Odd 1, 1 = Mark/None
7, 6	Guard tones (see &G command)	Ø, Ø = Disabled (default) Ø, 1 = 550 Hz tone 1, Ø = 1800 Hz tone 1, 1 = Not used

Note: The default settings for S register 23 vary depending on your computer's RS-232 port settings. Specifically, your baud rate and parity defaults may be different than those listed here. You can avoid S register 23 by setting your baud rate and parity using your telecommunications software or AT commands.

S 24 Not Used

S 25 Delay to DTR (default = 5, units = 1/100 second)

Holds a value from Ø to 255 that serves as the shortest length of a Data-Terminal-Ready (DTR) interchange circuit change (on-to-off or off-to-on) that the modem recognizes.

This affects the way the &D commands influence the modem. Specifically, if you use the &D2 command to cause the modem to hang up when it detects an on-to-off transition on DTR, the modem will not hang up if an on-to-off transition on DTR is shorter than the value in S25. For more information, refer to the &D command description in Appendix A.

S 26 RTS/CTS Delay (default = 1, units = 1/100 second)

Holds a value from Ø to 255 representing the delay after an off-to-on transition of RTS before CTS is asserted.

S 27 Bit Mapped Options

<u>Bit</u>	<u>Use</u>	<u>Settings</u>
1, Ø	Asynchronous/synchronous	Ø, Ø = Asynchronous (default) Ø, 1 = Reserved 1, Ø = Reserved 1, 1 = Reserved
2	Reserved	
3	Reserved	
5, 4	Reserved	
6	1200 bps protocol (see B command)	Ø = CCITT V.22 1 = Bell 212A (default)
7	Reserved	

D

RS-232C PIN ASSIGNMENTS

Summary of Pin Assignments

<u>Pin</u>	<u>Abbrev.</u>	<u>Source</u>	<u>Description</u>
1	shield	n/a	protective ground
2	TD	terminal	transmit data
3	RD	modem	receive data
4	RTS	terminal	request to send
5	CTS	modem	clear to send
6	DSR	modem	data set ready
7	GND	n/a	signal ground
8	DCD	modem	data carrier detect
12	SS	modem	select alternate rate
15	TxC	modem	transmit clock (synch. only)
17	RxC	modem	receive clock (synch. only)
20	DTR	terminal	data terminal ready
22	RI	modem	ring indicator
23	SI	modem	select alternate rate
24	XTCLK	terminal	transmit clock (synch. only)

Detailed Circuit Descriptions

1 Protective Ground

This pin is electrically bonded to the Q-Modem 2400 shell.

2 Transmit Data (TD)

Your terminal sends the modem serial data on this pin.

3 Receive Data (RD)

The modem transmits data to your terminal on this pin.

4 Request-to-Send (RTS)

In asynchronous mode, the Q-Modem 2400 ignores this circuit.

5 Clear-to-Send (CTS)

In asynchronous mode, this circuit is constantly on.

6 Data-Set-Ready (DSR)

The Q-Modem can be programmed to keep DSR on at all times, or to cause DSR to operate according to EIA RS-232C specifications where this circuit being on indicates the Q-Modem 2400 is off-hook—in data mode and not in self-test or diagnostic mode.

In originate mode, DSR on also indicates that dialing is complete and the remote modem has answered. In answer mode, DSR on indicates the modem has started to answer. The &S command description in Appendix A contains more information.

7 Signal Ground (GND)

Pin 7 is a common reference for all signals on the connector.

8 Data-Carrier-Detect (DCD)

The Q-Modem can be programmed to keep DCD on regardless of data carrier (default), or to cause DCD to indicate the presence of a suitable data carrier from the remote modem. The &C command description in Appendix A has more information.

12 Alternate Rate Select (SS)

The Q-Modem 2400 turns this circuit on to indicate 2400 baud has been selected. This pin is connected internally to pin 23.

15 Transmit Clock (TxC) (Synchronous Only)

17 Receive Clock (RxC) (Synchronous Only)

20 Data-Terminal-Ready (DTR)

The Q-Modem can be programmed one of four ways: to ignore DTR, to assume command state if an on-to-off transition on DTR, to go on-hook and disable auto answer if an on-to-off transition on DTR, or to initialize if an on-to-off transition on DTR. The &D command description in Appendix A has more information.

22 Ring Indicator (RI)

The modem turns this circuit on during an incoming ring.

23 Alternate Rate Select (SI)

The Q-Modem 2400 turns this circuit on to indicate 2400 baud has been selected. This pin is connected internally to pin 12.

24 Transmit Clock Source (XTCLK) (Synchronous Only)

E

BELL/CCITT AND DUMB/SMART SELECTION

Three settings can be changed by physically moving "jumpers" on the Q-Modem 2400 board: the communications protocol used at 300 baud (Bell or CCITT), dumb/smart mode. Chapter 1 can help you determine if you need to change these settings. This appendix explains how to change them if you do need to.

You must remove the modem board from its case before making the changes. We recommend the following procedure for removing the modem board most efficiently.

1. Unscrew and remove the two screws from the bottom of the modem case.
2. Pop the modem's front plate off so it rests on the ON/OFF button. Do not unscrew the ON/OFF button, and do not remove the front plate entirely from the modem.
3. Pull the modem board (and face plate) out of the front of the case. If necessary, remove the modem's back plate and push the modem board and face plate out of the case front.

The header labeled B-C determines whether the modem uses Bell 103 or CCITT V.21. If the jumper is next to the B, the modem uses Bell 103; if next to the C, it uses CCITT V.21. The illustration below shows the two settings.

The header labeled D-S determines whether the modem is in dumb or smart mode. If the jumper is next to the D, the modem is in dumb mode; if next to the S, it is in smart mode.

F

Q-MODEM 2400 SPECIFICATIONS

- Compatible with the following asynchronous modem types:
 - CCITT V.21 and Bell 103 at 300 bps
 - CCITT V.22 at 600 bps
 - CCITT V.22 and Bell 212A at 1200 bps
 - CCITT V.22bis at 2400 bps

- Asynchronous data formats:

<u>start bits</u>	<u>data bits</u>	<u>parity</u>	<u>stop bits</u>
1	7	even or odd	1 or more
1	7	none	2
1	7	mark or space	1 or more
1	8	none	1 or more

- Test and diagnostic facilities:

- local digital loopback
- remote digital loopback
- local analog loopback
- remote digital loopback with self test
- programmable test timer
- local analog loopback with self test

- Call progress monitoring features:

- wait for dial tone before dialing (sends NO DIALTONE result code)
- detect busy (sends BUSY result code)
- wait for silence after answer
- detect answer tone

- Dial features:

- touch-tone or pulse dial
- ability to dial stored telephone number
- programmable pauses
- wait for dial tone before dialing
- wait for silence after answer
- originate call from modem that's in auto answer mode
- hook-flash
- touch tone (DTMF) tone symbols Ø, 1, 2, 3, 4, 5, 6, 7, 8, 9, #, *, A, B, C, D

- Result codes:

- | | | |
|----------------|----------------|---------------|
| - OK | - CONNECT | - CONNECT 600 |
| - CONNECT 1200 | - CONNECT 2400 | - RING |
| - NO CARRIER | - BUSY | - ERROR |
| - NO DIALTONE | - NO ANSWER | |

G

FCC RULES

The Q-Modem 2400 has been tested and found to comply with the limits for a Class B computing device according to the specifications in the Federal Communications Commission (FCC) rules Part 68. As an owner and/or operator of a registered modem like the Q-Modem 2400, you must comply with these rules:

- Before installing the Q-Modem 2400, you must notify your telephone company that you are going to install an FCC registered device. When you contact them, you must provide the FCC registration number and ringer equivalence number (REN) for your modem; these numbers are listed below.
- You cannot connect the Q-Modem 2400 to a party line or to a coin telephone line.
- You must only connect your modem to a standard modular telephone jack, type RJ-11.
- If your Q-Modem 2400 needs repairs, you must arrange for Quality Computers to make them if you are to keep the modem's FCC registration valid.
- You must use a shielded RS-232C cable to connect your external modem to your terminal.

This equipment, like other electronic equipment, generates and uses radio frequency energy. If not installed and used according to the instructions in this manual, this equipment may cause interference with your radio and television reception.

If you believe that this equipment is causing interference with your radio or television reception, try turning the equipment off and on. If the interference problems stop when the equipment is switched off, then the equipment is probably causing the interference. You may be able to correct the problem by doing one or more of the following:

- Adjust the position of the radio or TV antenna.
- Move the modem away from the radio or TV.
- Plug the modem into a different wall outlet than the one the radio or TV uses.

If necessary, consult your dealer or an experienced radio or television technician for additional suggestions. You may find the following booklet helpful: "How to Identify and Resolve Radio and TV Interference Problems"—Stock No. 004-000-00345-4. This booklet was prepared by the Federal Communication Commission and is available from the U.S. Government Printing Office, Washington, DC 20402.

See individual modems for FCC ID and registration numbers.

- Command buffer that holds 40 characters
- User-modifiable, nonvolatile RAM that stores these modem configuration settings:
 - baud rate
 - parity
 - telephone number
 - tone/pulse dial
 - speaker control
 - speaker volume
 - guard tone selection
 - make/break ratio
 - DCD behavior
 - DSR behavior
 - delay to DTR
 - number of ring after which to answer
 - dialing action/result code sent
 - result codes enabled/disabled
 - Bell/CCITT communication protocols
 - modem behavior on transition of DTR
 - long space disconnect enabled/disabled
 - automatic answer mode
 - command echo/no echo
 - word/number result codes
 - duration-of-test timer
 - obey request for test
- One-inch speaker with programmable volume control for monitoring call progress
- Programmable escape code sequence for going from on-line to command state without hanging up
- Separate telephone line and telephone set connectors
- Data encoding:
 - 2400 bps (V.22bis)—Quadrature Amplitude Modulation (QAM): Sixteen possible symbols consist of combinations of 12 phase angles and 3 amplitudes. Each symbol conveys 4 bits of information (quadsbits). Signalling rate is 600 symbols per second.
 - 1200 bps (V.22 and Bell 212A)—Differential Phase Shift Keying (DPSK): Four possible symbols consist of 1 of 4 phase angles. Each symbol conveys 2 bits of information (dibits). Signalling rate is 600 symbols per second.
 - 0 to 300 bps (V.21 and Bell 103)—Frequency Shift Keying (FSK): One bits and zero bits are assigned specific frequencies in the transmit and receive directions. Signalling rate equals bit rate.
- Equalization:
 - fixed compromise equalization in the transmitter
 - adaptive equalization in the receiver
- Power consumption: External Q-Modem 2400 2.5 watts
- Size: 1" x 4-5/8" x 6-1/2"

Additional External Modem Features

The Q-Modem 2400 also features the following:

- Power pack 120 VAC - 60 Hz; 9 VAC output
- RS-232C terminal interface
- Indicator lights:
 - High Speed (HS)
 - Off-Hook (OH)
 - Terminal Ready (TR)
 - Auto Answer (AA)
 - Receive Data (RD)
 - Modem Ready (MR)
 - Carrier Det. (CD)
 - Send Data (SD)

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