

Telebit T2500
Reference Manual
90100-02 Rev. C

ARRIS EX. 1004



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Telebit T2500

Reference Manual

90100-02 Rev. C

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FCC Standards

This equipment generates and uses radio frequency energy, and if not installed and used in strict accordance with the instructions in this manual, may cause interference to radio and television reception. It has been tested and found to comply with the limits for a Class A computing device under Part 15 of the FCC Rules, which are designed to provide reasonable protection against such interference in a commercial installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the modem on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

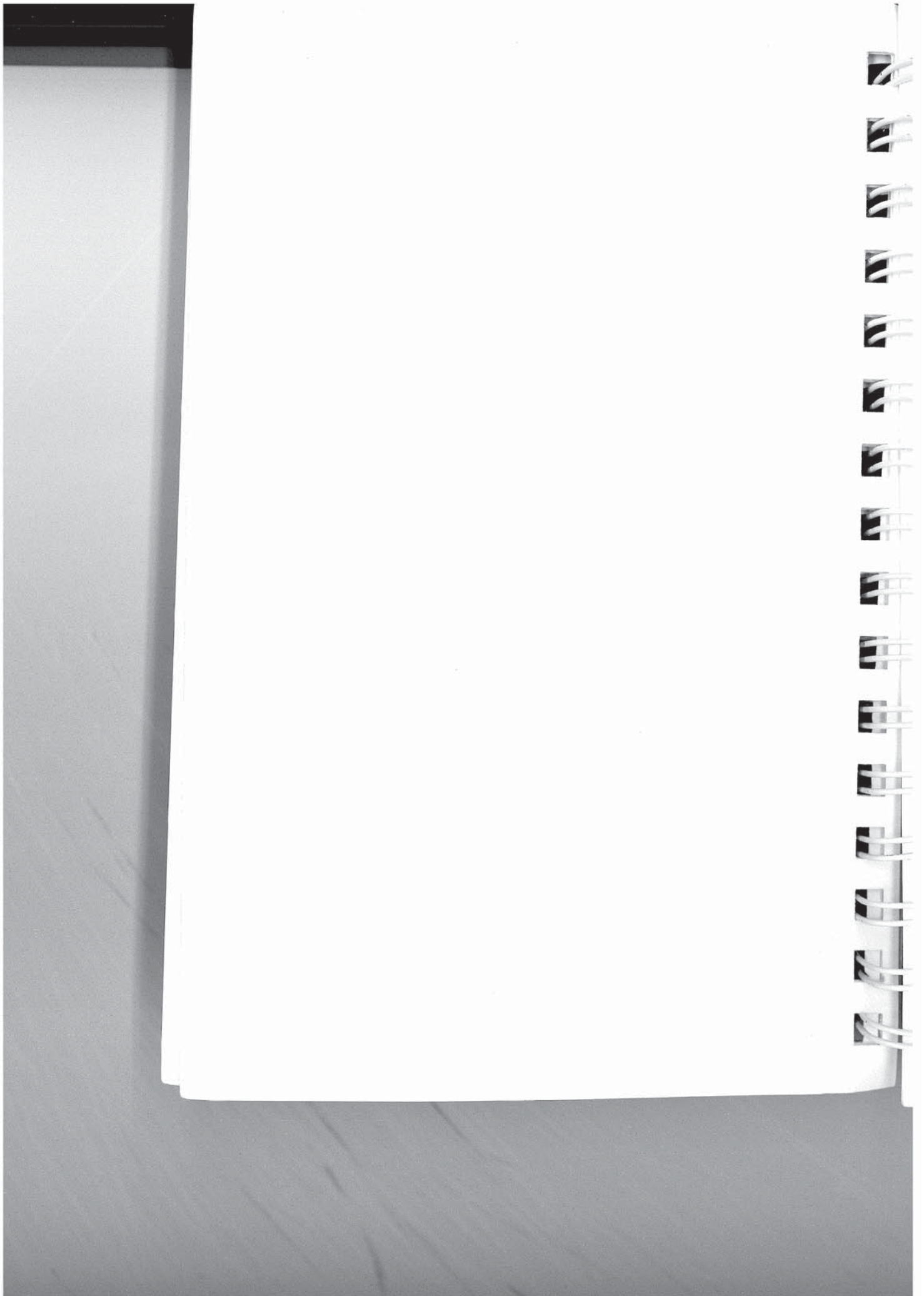
- Reorient the receiving antenna.
- Move the modem away from the receiver, or relocate the receiver with respect to the modem.
- Plug the modem into a different outlet so that the modem and receiver are on different branch circuits.

If necessary, you should talk to your dealer or any experienced radio/television technician for additional suggestions. You may find a booklet prepared by the FCC entitled "*How to Identify and Resolve Radio-TV Interference Problems*" helpful in resolving any problems. This booklet is available from the U.S. Government Printing Office, Washington DC 20402, Stock Number 004-000-00345-4.

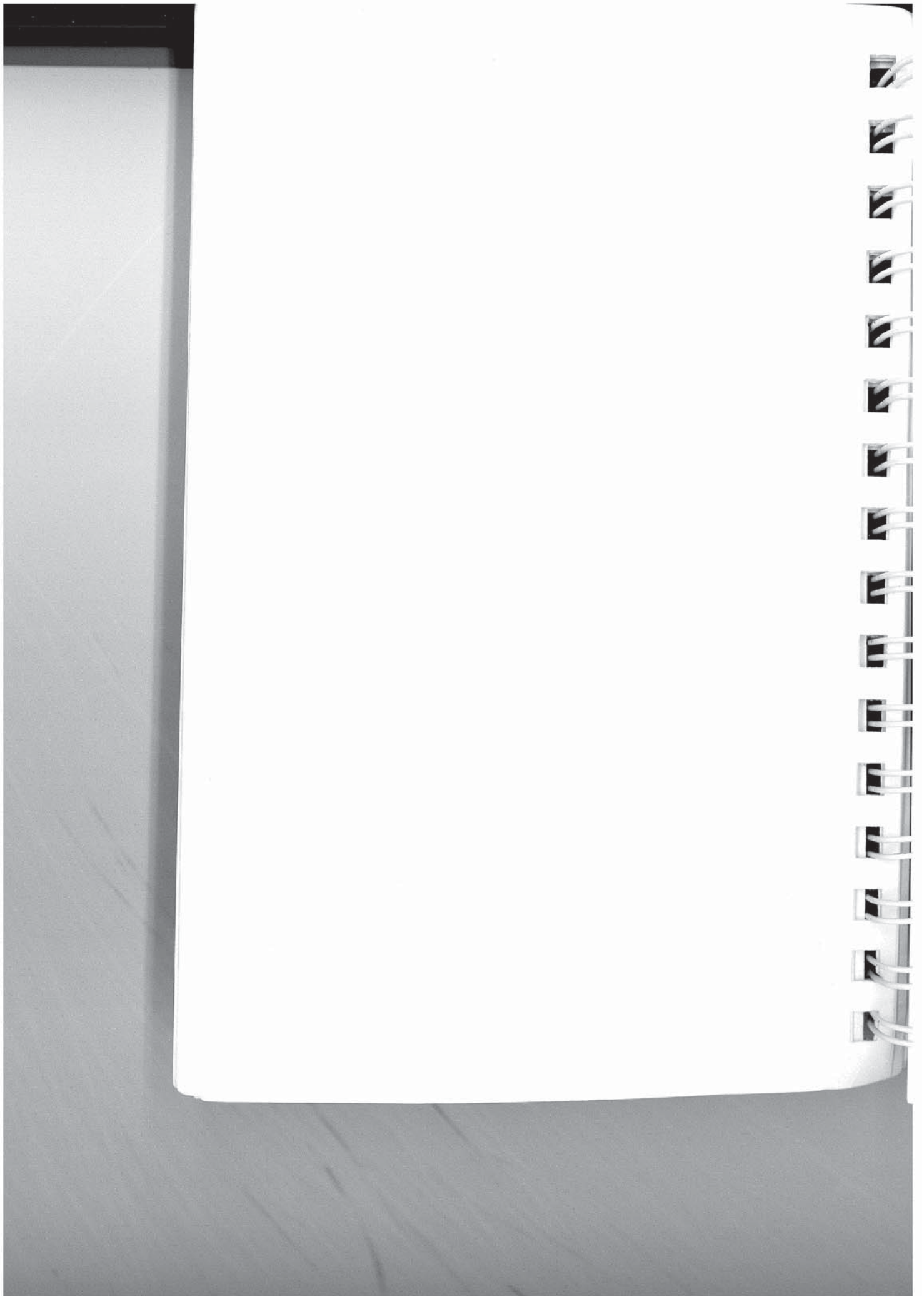
FCC Notice to Users

1. Upon request only, you must notify your telephone utility company (telco) of your intentions to install or permanently remove an FCC Part 68 registered device, and provide them with the following information:
 - The telephone number to which the equipment will be connected.
 - FCC registration number ER95W5-17716-MD-E.
 - Ringer equivalence numbers 0.2A and 0.3B.
 - Modular jack number USOC RJ11C or RJ45S.
2. The equipment may not be used on telco coin-operated telephone lines. Party lines and privately owned coin-operated telephone lines are subject to local and state regulatory policies, and possible additional state special features.
3. The telephone company has the right to make changes to their network which may affect the operation of your equipment, provided you are given adequate advance written notice to permit correct operation.
4. In the event of operational problems, disconnect your unit by removing the modular jack from the telco's termination. If your regular phone still works properly, your modem may need to be returned for repairs in or out of warranty. If after disconnecting the equipment, your regular telephone does not operate correctly, notify your telephone company that they may have a problem, and request prompt service at no cost to you the user. If a problem is found in premises wiring not telco-installed, you will be subject to an authorized service charge. If a fault is found in telco-installed wiring, you may be subject to a charge for the service call.

5. Except as instructed in the *Diagnostics and Service* chapter of this manual, the user may not under any circumstances (in or out of warranty) attempt any service, adjustments or repairs on this unit. It must be returned to the factory or authorized service agency for all such work. Refer to your *Warranty Registration and Customer Service Information* at the end of this manual for instructions on returning your modem for repair.
6. If the equipment is to be placed behind a PBX or KTS system, it comes under a special FCC category requiring the written approval of the PBX/KTS owner as well as additional FCC registration.



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Chapter 1

Introduction

This manual provides a comprehensive guide for setting up and using the Telebit T2500 modem. The manual is intended for computer and terminal users, that have a basic understanding of data communications.

You can save time by following the instructions in the *T2500 Fast Start Guide*, which is a separate booklet provided to help you get started using your modem as quickly as possible. If you have special requirements or experience any problems while using the *T2500 Fast Start Guide*, refer to this manual for additional information.

The T2500 modem overcomes the limitation of dial-up telephone lines by using Packetized Ensemble Protocol™ (PEP) modulation. PEP analyzes the quality of the connection at 511 separate frequency points and compensates for line impairments which may exist. The modem's advanced design is ideally suited for high speed file transfer operations. Accordingly, you will gain the most benefits in line costs and time savings when transferring large files.

Some of the major features offered by the T2500 modem are discussed below:

V.42 Support

The T2500 modem supports V.42 error correction and detection protocol standard that provides error-free transmission over a standard full-duplex, V.32, V.22bis, V.22, and Bell 212A connection.

1

The V.42 protocol includes the Link Access Protocol for Modems (LAP-M), the main protocol used between two V.42 modems. An alternate protocol, based on the Microcom Networking Protocol (MNP), up to class 4. The inclusion of MNP provides backward compatibility between V.42 and existing MNP modems.

V.42bis Support

The T2500 modem supports the V.24bis protocol. V.42bis is a high-performance data compression algorithm that increases the speed of data throughput by a ratio of up to 4 : 1. V.42bis data compression is possible only if a connection is established in LAP-M, and both connected modems are configured for data compression. The V.42 protocols are supported by both Conventional and Enhanced Command Modes.

MNP™ Support

The modem can be configured to support MNP Classes 1 through 5 while operating in 300-9600 bps modes. When a connection is established, the modems at each end can negotiate the highest MNP class supported by both modems.

V.32 Support

The T2500 modem can operate in either asynchronous or transparent synchronous V.32 mode. When operating in V.32 mode, the modem will utilize a speed of 9600 bps (with Trellis Coded Modulation), with a selectable fallback of 4800 bps.

Two Modes of Software Compatibility

For maximum flexibility, the modem supports two user interface modes: Conventional and Enhanced Command Modes. In Conventional Command Mode, the modem works with data communications software configured for Hayes® V-series™ modems. The Enhanced Command Mode allows you to take advantage of the modem's advanced features used by software designed for Telebit modems.

These are the Telebit TrailBlazer Plus, T1000, T1500, T2000, and T2500 modems. The Enhanced Command Mode also gives you access to both asynchronous and transparent synchronous V.32 operation.

Packetized High Speed Data Transmission

Using the PEP data communications protocol, the modem can transmit or receive asynchronous data at speeds of up to 18,000 bps over dial-up telephone lines, or up to 19,200 bps when data compression is enabled.

Compatibility with Slower Modems

For use with lower speed modems, the T2500 is compatible with the 9600 bps V.32 standard, the 2400 bps V.22bis, 1200 bps, the V.22 standards, the 1200 bps Bell 212A and 300 bps Bell 103J standards.

Automatic Transmission Mode Selection

At the time a telephone connection is made, the modem automatically selects the correct transmission speed by matching the transmission mode of the remote modem. If the remote modem is a PEP modem, the modem operates in PEP mode using the Packetized Ensemble Protocol.

This provides maximum data throughput for any given telephone connection. If the remote modem is not a PEP modem, the modem automatically determines the correct transmission mode to use while communicating with the remote modem.

Automatic Error Detection and Correction

While operating in PEP mode, the modem assembles packets of data and adds to each packet a 16-bit Cyclic Redundancy Check (CRC) for the purpose of error detection.

If the receiving modem detects an error, it requests a retransmission of data. All error detection and correction is completely transparent to the user and does not require any additional computer resources.

Adaptive Duplex™ for Maximum Throughput

In order to improve overall system performance, the modem provides an Adaptive Duplex capability while operating in PEP mode. This feature allows the modem to optimize overall throughput by dynamically varying the allocation of transmission capacity and rate of data flow between modems to match the bidirectional traffic load.

Real Time Line Analysis and Adaptation

Each time a connection is made in PEP mode, the modem performs a line analysis and determines the operating parameters of the transmission. The line characteristics are monitored by the modem during the entire connection, and operating characteristics are adjusted as required for optimum data transmission.

Self Test, Internal Diagnostics and Line Monitoring Data

Each time you turn on the modem, a series of internal logic tests, memory tests, and internal loop back checks are performed. In addition, the modem provides data transmission statistics, such as line quality analysis, signal-to-noise ratios, frequency offset measurements, data flow analysis and error rates.

Call Progress Reporting and Monitoring

After placing a call using the modem, a message provides the status of the call. The report format is selectable and can be presented in either text or numeric mode. A built-in speaker provides audio feedback of call progress.

Auto-Dial and Auto-Answer

The modem's Dial command allows you to place the modem off-hook, have it wait for a dial tone, and then automatically dial a telephone number presented by the computer or terminal.

The modem can also be configured to allow your computer or terminal to automatically dial the first number in the number directory via the DTR control signal. Both pulse and tone dialing are supported.

When configured in auto-answer mode, the modem will automatically answer an incoming call, allowing you to leave the modem unattended.

Security Features

The callback security feature protects the DTE from unauthorized access. It allows an originating modem user to dial a pre-defined number listed in a number directory of the answering modem. The answering modem prompts a password from the originating modem.

1

If the password, which is entered by the originating modem and corresponds to the password listed in the number directory, is correct, the answering modem hangs up the phone, waits 10 seconds, and calls back the appropriate number indexed in the directory. To implement the callback security feature, the answering modem's number directory is loaded with callback numbers, (0 to 9) and corresponding passwords.

Password security is also available. The originating modem calls the answering modem and prompts for a password. If the password is correct, the originating modem is immediately connected to the DTE.

Hardware and Software Flow Control

The modem lets you specify the method of data flow control when transmitting information. You can select a software protocol such as XON/XOFF and/or hardware flow control using the RS-232 RTS/CTS control signals.

File Transfer Protocol Support

The modem contains protocol support firmware to optimize file transfers while operating in PEP mode. It can be configured to support Kermit, X/Ymodem or UUCP protocols. Protocol support is negotiated between the modems at each end during the PEP initialization sequence. Both modems must agree on the protocol supported, otherwise no protocol is supported during the communications session.

SDLC Support

The T2500 modem can be configured to operate in SDLC Mode, when using PEP modulation in SNA/SDLC environments. While operating in SDLC Mode, the T2500 modem automatically determines if it is acting as an SDLC primary or secondary link station during the initial SDLC protocol sequence.

Chapter 2

Installation

The T2500 modem is designed to be used with a computer, terminal or other serial device via an asynchronous RS-232C serial interface port. The instructions presented in this chapter describe procedures for connecting the modem between your equipment and the telephone line.

If you have already installed the modem by following the instructions in your *T2500 Fast Start Guide*, you do not need to use this chapter.

Note: before powering up your modem, please carefully read Chapter 3, Using the Modem, to determine which command mode should be selected to ensure compatibility with your computer's data communications software.

Equipment Check List

Before installing the modem, make sure that you have the following equipment:

- An AC power cord and transformer provided with your modem.
- The seven foot telephone cable supplied with your modem.
- A shielded RS-232C cable with a DB-25 male connector for the modem. Your computer dealer can assist you in obtaining the appropriate cable for your requirements. Pin assignments for the RS-232C connectors are provided in Appendix B.
- A small flat-blade screwdriver.

If you do not have the items listed above, obtain them before proceeding.

Installation Check List

This section summarizes the sequence of steps you should follow to install the modem. For specific instructions on performing the procedures listed, refer to the specified page in this manual.

2

- Before installing the modem in its final position, you may need to first connect it to a terminal (or personal computer with a terminal emulation program), and preconfigure it for your system. See Chapter 3, *Using the Modem*.
- Verify that the modem's power switch is turned off, then connect the AC power cord. *Page 2-4*.
- Connect a shielded RS-232C cable between the modem and your equipment. *Page 2-4*.
- Connect the telephone line from the wall jack to the TO LINE connector on your modem. *Page 2-5*.
- If desired, connect your telephone to the TO PHONE connector on the modem. *Page 2-5*.
- Determine which command mode (Conventional or Enhanced) is appropriate for your specific requirements. *Page 3-7*.
- Power up and initialize the modem in either Conventional or Enhanced Command Mode. *Page 3-2*.

If you have completed the preceding check list, the modem should be ready for use. Read Chapter 3 for information on configuring and using the modem.

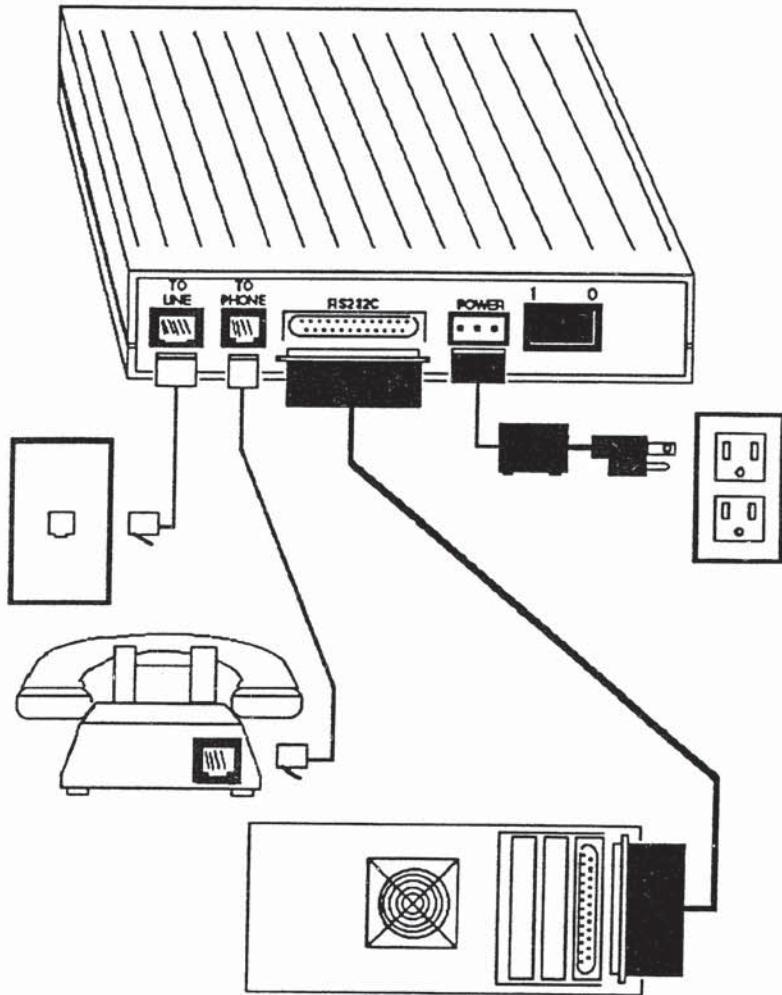


Figure 2-1. T2500 Cable Connections

Connecting the AC Power Cord

An AC power cord with a transformer assembly is supplied with the modem.

2

Warning

To avoid damaging the modem, only use the AC power cord and transformer provided with your T2500 modem. *Pour utiliser avec BASLER ELECTRIC Model BE117125BBB010 source d'alimentation.*

Refer to Figure 2-1 while connecting AC power cord to your modem:

1. Verify that the power switch (I/O) on the rear of the modem is turned off (O).
2. Attach the power cord to the connector labeled POWER on the rear panel of the modem. The beveled edge of the plug should be facing up so that it mates with the retainer clip on the connector.
3. Plug the other end of the power cord into a grounded AC wall outlet.

Connecting the RS-232C Cable

A 25 pin RS-232C connector, located on the back of the unit, is used to connect the modem to your computer or terminal. You must provide a shielded RS-232C cable. Pin assignments for the connectors are listed in Appendix B.

Refer to Figure 2-1 while connecting the RS-232C cables as described below:

1. Attach the male connector of the RS-232C cable to the female connector on the rear panel of the modem labeled RS232C, and tighten the connector screws until snug.
2. Attach the other end of the RS-232C cable to the correct RS-232C connector on your DTE equipment. Consult your equipment manual for the location of this connector.

Connecting the Telephone Line

A seven foot telephone cable is provided with your modem. You should use this cable to connect the modem to the telephone line as shown in Figure 2-1.

Attach the larger, RJ45S end of the provided telephone cable to the connector labeled LINE on the rear panel of the modem. Attach the other end to your telephone wall jack.

*Note: the modem is equipped with a special phone cable which is designed to fit tightly into the rear panel RJ-45S jack. If you substitute your own cable, be certain that it fits **tightly** into the modem's TO LINE jack before attempting to use the modem. Loose connections may affect the modem's performance.*

Connecting a Telephone

If you wish, you can connect your telephone to the modem. This allows you to make normal telephone calls while your modem is not in use. Simply connect the cord from your telephone to the connector labeled PHONE on the rear panel of the modem.

After Completing the Installation

Before powering up your T2500 modem, read Chapter 3, *Using the Modem*, to determine which command mode should be selected to ensure compatibility with your computer's data communications software.



Chapter 3

Using the Modem

3

This chapter presents a general overview of the modem's operating characteristics, and shows you how to enter commands to set parameters and control the modem's operation.

Proceed with this chapter after the modem has been installed by following the instructions in your *T2500 Fast Start Guide* or Chapter 2 of this manual.

If the modem is connected directly to a terminal, you can simply input the commands from the keyboard. When the modem is connected to a computer, you must use its data communications software or a terminal emulation program to configure and use the modem.

If you intend to use the modem with a mainframe computer or other serial device which will only be accepting incoming calls, you can use a terminal (or personal computer with a terminal emulation program) to preconfigure the modem's operating parameters and save them in non-volatile memory.

Memory Organization

Figure 3-1 shows the relationship between the active configuration, the factory defaults and the non-volatile memory. The active configuration stored in RAM defines the current operating characteristics of the modem.

The factory defaults are the operating parameters most commonly used for data communications which are permanently stored in ROM. These parameters can be restored to the active configuration by issuing an `&F(n)` command or by following the procedures described in the following section *Operational Mode Selection*. The Command `AT~&F0` will restore Enhanced Command Mode, `AT~&F1` will restore Conventional Command Mode, `AT~&F2` will restore Enhanced Command Mode, SDLC, and `AT~&F3` will restore V.32 Synchronous Mode.

The current operating parameters can be modified and saved in non-volatile memory as Profile A or Profile B via the &W command in Conventional Command Mode, or &W0 or &W1 commands, respectively, in Enhanced Command Mode.

3

When a new Profile is selected, its settings replace the current operating parameters. A new profile can also be restored by issuing an &E(n) command (n=0,1, or 2) in Enhanced Command Mode, or by issuing a Z(n) command (n=0 or 1) in Conventional Command Mode.

The S255 register determines which profile is used when the modem is powered up or reset, or when one of the above commands is issued without an (n) parameter. When S255 is set to 0, pressing the A/B switch resets the modem and loads the new profile into the active configuration.

Default Configuration Selection

The T2500 modem is supplied with four factory default configurations:

- Enhanced Command Mode - Asynchronous
- Conventional Command Mode - Asynchronous
- Enhanced Command Mode - SDLC
- Enhanced Command Mode - V.32 Synchronous

Each default set of the modem can be selected via the Talk/Data and A/B switches. The LED's provide a visual display of the modes selected.

To load a default set into the T2500, follow the steps below. Figure 3-2 shows the various LED displays encountered while selecting a default set.

Note: if you are unsure about which mode is appropriate for your application, try the Conventional Command Mode - Asynchronous first.

1. Determine the EEPROM Profile in which the selected operating mode is to be stored. If the operating mode is to be stored in Profile A, set the A/B switch to position A. If the operating mode is to be stored in Profile B, set the A/B switch to position B.

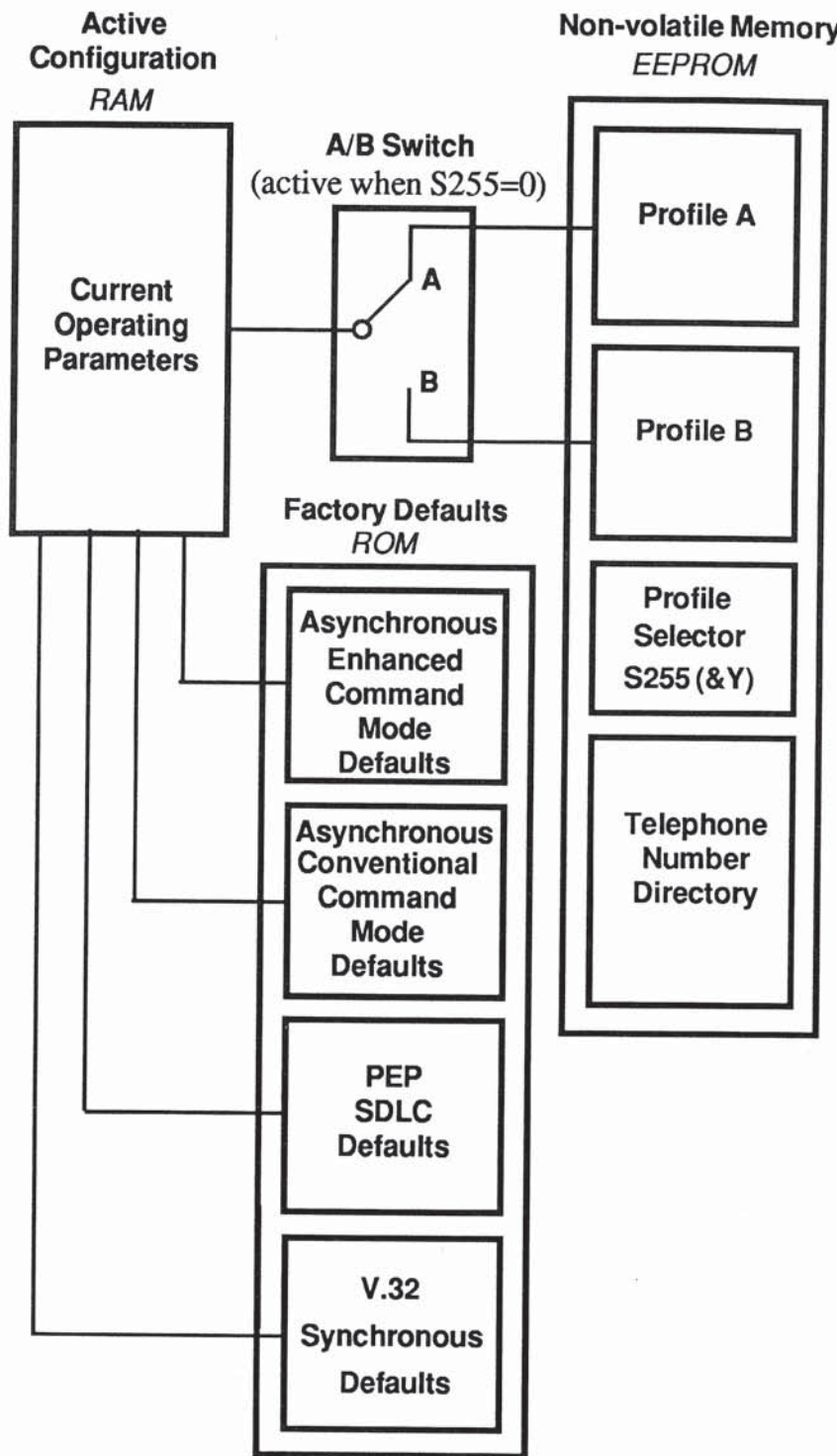
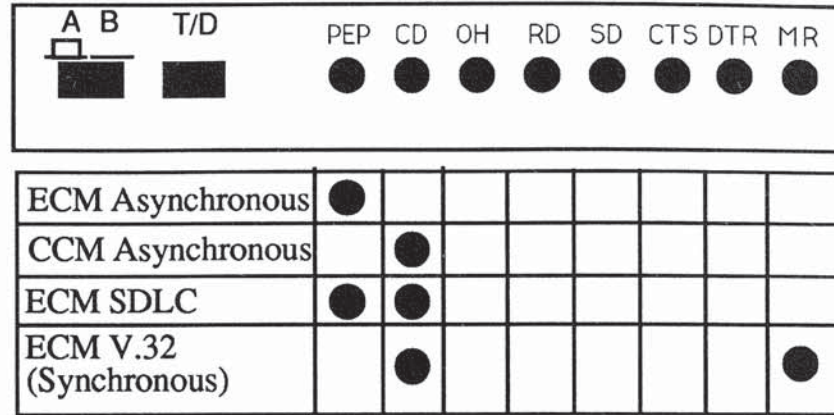


Figure 3-1. T2500 Memory Organization

3

2. Enter the configuration select mode by holding down the Talk/Data switch while turning the power on. Release the Talk/Data switch when the *PEP*, *CD*, and *MR* LED's are flashing.
3. View the operating modes by tapping the Talk/Data switch for less than two seconds. The LED's will step through the various configurations (refer to figure 3-2).

Telebit T2500 (Front Panel)



● = LED ON

Figure 3-2. Default Set Display

4. When the LED's indicate the desired operating mode, make your selection by holding down the Talk/Data switch for more than two seconds. When your choice is accepted, the LED's corresponding to the selected operating mode will flash. Release the Talk/Data switch when the LED's flash. The operating mode will be written to the Profile selected in Step 1.

Registers S0, S45, and S255 will be set automatically as follows:

S0 = 1 (Auto Answer Enabled)

S45 = 255 (Remote Access Enabled)

S255 = 0 (Default User Profile Select)

When mode selection is complete, the LED's will go out, and the *MR* LED will light. The RAM and EEPROM memory will be updated, and the modem configured for the selected operational mode.

Front Panel Switches and Indicators

The modem's front panel contains two switches and eight LED indicators which determine the current operating status of the modem (see Figure 3-2). Table 3-1 provides a functional description of the front panel control switches. The status indicators are described in Table 3-2.

3

Table 3-1. Front Panel Control Switches

A/B switch	<p>This switch is used to select one of two possible sets of operating profiles.</p> <p>When the modem is powered up or reset, Profile A or B operating parameters are loaded from the non-volatile memory depending on the position of the A/B switch. If the switch is in the A position, Profile A is loaded, whereas if the switch is in the B position, Profile B is loaded.</p> <p>Changing the position of the A/B switch resets the modem and loads the new configuration from non-volatile memory. Note that the A/B switch should not be pressed while a communications session is in progress as this will prematurely disconnect the call.</p> <p>The modem is shipped with Profiles A and B set to operate in Enhanced Command Mode (ECM). Either Profile, however, can be modified by changing the current operating parameters and saving them in non-volatile memory as Profile A or B via an &W command.</p>
------------	---

3

T/D switch	This switch controls the modem's connection to the telephone line much like the hook switch on your telephone.
	<p>If the T/D switch is pressed while the modem is on-hook (OH indicator is OFF), the modem will go off-hook and attempt to connect in either originate or answer mode depending on the setting of the S100. This allows you to manually place a call using the telephone set then switch to Data Mode when the call is established.</p> <p>If you set the S104 register to 3, pressing the T/D switch will automatically dial the first or second number in the Number Directory depending on the current setting of the A/B switch. When the A/B switch is in the A position, the first number (N0) is dialed, whereas if the switch is in the B position, the second number (N1) is dialed.</p> <p>If the T/D switch is pressed while the modem is off-hook (OH indicator is on), the modem will go on-hook allowing you to either disconnect the call, or to switch to voice communications provided the telephone handset has been lifted off-hook before the switch is pressed.</p> <p>If the T/D switch is pressed while switching on the power you enter the Configuration Selection Mode (see the section Operational Mode Selection, page 3-2).</p>

Table 3-2. Front Panel Status Indicators

PEP	PEP Mode - Indicates that the modem is operating in Fast Transmission Mode using the PEP communication protocol.
CD	Carrier Detect - Indicates that the modem has established a connection with another modem.
OH	Off Hook - Indicates that the modem is using the telephone line.
RD	Receive Data - Indicates that the terminal or computer connected to the modem is receiving data from the modem.

SD	Send Data - Indicates that the terminal or computer is sending data to the modem.
CTS	Clear to Send - This RS-232C signal indicates whether or not the modem is ready to accept data from the terminal or computer. When the indicator is lit, the modem will accept data from the DTE for transmission.
DTR	Data Terminal Ready - This RS-232C signal indicates whether or not the terminal or computer connected to the serial port is ready to transmit or receive data.
MR	Modem Ready - Indicates that the modem is operational.

3

The power switch (1/0), mounted on the rear of the modem, is used to turn the modem ON or OFF. Each time the modem is turned on, it runs a series of power up diagnostic tests. After successfully completing the tests, the default configuration parameters previously stored in the modem's non-volatile memory are loaded into the modem's registers, and the MR (Modem Ready) indicator is turned on.

Selecting Conventional or Enhanced Command Mode

Before using your modem, you should determine which command mode will assure compatibility with your computer's data communications software.

Enhanced Command Mode enables the modem to be compatible with software designed for PEP modems. If your application provides support of the advanced features of PEP modems, such as the Telebit T1000, T2000, T2500, or TrailBlazer Plus, then Enhanced Command Mode is the preferred choice. The same holds true for data communications software that supports other PEP modems, e.g. DCA Fastlink™, Racal-Milgo RM-1822D, or Ven-Tel Pathfinder™.

Conventional Command Mode is designed for software that does not have the ability to utilize the special features of your PEP modem. This is typically indicated by the absence of modem-specific setup options, or applications that assume general Hayes® command compatibility. Conventional Command Mode should be compatible with any data communications software that supports Hayes V-series™ modems.

3

Enhanced Command Mode

To ensure that the modem is operating in Enhanced Command Mode with the A/B, you can reset the modem by performing the steps given in the section *Operational Mode Selection*, page 3-2. This stores the Enhanced Command Mode factory default settings in Profile A or B of non-volatile memory. These default settings are also loaded into the modem's current operating parameters, except that, the S45 register is set to 255, which enables remote access. This allows Technical Support to remotely access your modem. If, however, you turn the modem power off, remote access will no longer be enabled.

If you will be using data communications software which supports PEP modems such as the T1000, T2000, T2500, or TrailBlazer Plus, follow the instructions in your software manual to configure and use your modem. Configuration guidelines and descriptions of the commands and registers are presented in Chapter 4, *Conventional Command Mode*, and Chapter 5, *Enhanced Command Mode*.

Conventional Command Mode

If you have decided that Conventional Command Mode is preferable, then follow the procedure described in the section *Operational Mode Selection*, page 3-2, to load the factory default Conventional Command Set. This stores the Conventional Command Mode default settings in either Profile A or B of non-volatile memory.

These defaults are also loaded into the modem's current operating parameters except that the S0 register is set to 1 and the S45 register is set to 255.

This allows the modem to automatically answer an incoming call (S0=1) with remote access enabled (S45=255), thereby providing a means for Technical Support to remotely access your modem. However, if you turn the modem power off then on, the remote access and auto-answer functions will no longer be enabled.

To take advantage of the T2500 features which normally are not available character (~) allows you to use Enhanced Command Mode commands while remaining in Conventional Command Mode.

If you will be using data communications software which supports PEP modems such as the T1000, T2000, T2500, or TrailBlazer Plus, follow the instructions in your software manual to configure and use your modem. Configurations guidelines and descriptions of the commands and registers are presented in Chapter 4, *Conventional Command Mode*, and Chapter 5, *Enhanced Command Mode*.

PEP SDLC Mode

PEP SDLC operation allows the fastest IBM Systems Networking Architecture (SNA) SDLC synchronous dial-up connections possible, while providing the error immunity features of Packetized Ensemble Protocol™ (PEP) operation. To initialize the modem for PEP SDLC operation, refer to *Default Configuration Selection*, page 3-2.

SDLC Configuration Procedure

If you need to change the SDLC Mode operating parameters, perform the following steps :

1. Start with the modem turned off, and the A/B switch in the desired profile position.
2. Turn the modem on.

3. Issue the following command line to the modem:

AT~&F2

This allows you to access and modify the profile in the Enhanced Command Mode.

3

4. Configure the modem for your specific requirements. Refer to Table 3-3 for information on configuring your modem.
5. Save the current configuration in the desired profile by issuing the following command to the modem:

Note: When the modem is in SDLC mode, no further commands can be sent to it via the primary serial port. The secondary serial port can still be used for commands. Refer to Appendix B.

Command Mode Operation

In command mode, the modem processes data received through the serial interface port as instructions to perform various functions. The command set used by the modem is compatible with applications which expect either a Hayes V-series™ or PEP modem.

3

The modem is placed in command mode when:

- The power is turned on, and the modem has completed the power up diagnostic tests.
- A data call is disconnected and the modem is placed on-hook.
- The modem cannot successfully complete a call, or the remote modem's data carrier is dropped.
- The modem receives a defined escape sequence or break signal.
- A semicolon (;) is entered at the end of a dialing string.

You may enter a command line of up to 80 characters in upper or lower case with the first command preceded by an AT (or at) and the last command followed by a carriage return. Spaces can be inserted for readability. If you make an error when typing a command, simply backspace over the mistake then retype the line. You cannot backspace over the AT, because it is interpreted immediately after being typed.

To ensure that the modem recognizes the AT prefix, one of the following data formats should be used while issuing commands to the modem:

- 8-bit data with no parity
- 7-bit data with even/odd parity
- 7-bit data with mark/space parity

If the S63 register is set to 0, the AT should not be entered. In this case, the modem treats all characters as commands and operates on the AT as two separate commands.

Temporary switching from Conventional to Enhanced Command Mode is accomplished through a special access character (~) to allow you to make use of enhanced functions which are not normally available in Conventional Command Mode. This access character is particularly useful for selecting file transfer protocol support or for displaying PEP statistics.

Note: The modem uses only one set of active operating parameters regardless of the command mode being used. Every Conventional Command Mode function has an equivalent in Enhanced Command Mode. Changing an operating parameter in either command mode will alter its equivalent in the other mode. For example, entering &Q5 S36=1 is identical to entering ~S95=2. Appendix C summarizes the command and register equivalents.

Result Codes

Normally, result codes are sent through the modem's serial port indicating the current status of a call or the modem's response to a command. These result codes can be set to either numeric or text mode by issuing a Verbose (V) command to the modem. The text mode is intended for viewing by a person, whereas the numeric mode is better suited for use by a computer program. Appendix D shows the result codes in both formats.

In cases where it is undesirable to receive a result code, the Quiet Enable (Q) command can be used to prevent the modem from sending result codes.

Using the Dial Command

The Dial (D) command is used to place a call through the modem. When this command is issued, the modem stops processing commands, dials the number indicated, and waits for a connection. If no connection is made within a specific period of time, defined by the S7 register, the command is cancelled and the modem returns to command mode.

The following example shows you how to call another modem using tone dialing:

AT DT 555-6789

The next example shows you how to have the modem dial through a PBX using pulse dialing (DP9), wait for an outside line (W), dial a long distance telephone number, wait for 8 seconds (,,,) then switch to tone dialing (T) to charge the call to a telephone credit card:

3

AT DP9 W 0-408-555-6789,,,T123-456-7890-1234

Using the Auto Answer Feature

The modem automatically answers an incoming call after the number of rings specified by the S0 register, and waits for the remote modem to send a carrier signal. If no carrier signal is detected within the period of time defined by the S7 register, or if any character is sent from your equipment before the modems have established synchronization, the modem sends a NO CARRIER result code to the DTE (computer or terminal). If a carrier is detected, the modem sends a CONNECT XXXX result code indicating the transmission speed of the connection or the DTE interface speed depending on the X command setting. Setting the S0 register to 0 disables auto-answer.

Changing from Voice to Data Connection

If you are talking on the phone and then want to use your computer to communicate with the other party's computer, use the Dial (D) command and Answer (A) command.

1. Have the other party enter "AT D" on their system without entering a phone number.
2. Enter "AT A" on your system within a few seconds.

Both parties can then hang up the telephone. The modem sends a CONNECT result code when the connection is established.

Using the Callback Security Feature

An originating modem calls the answering modem. Up to 10 numbers and passwords can be stored in the answering modem's number directory. The answering modem prompts a password from the originating modem. If the password is correct, the answering modem hangs up, waits 10 seconds, then dials back the appropriate number. Register S46 determines the callback mode of the originating and answering modems.

3

Operating in V.42 Mode

When the modem is answering it will try to detect the data pattern which is the start of LAP-M or the start of MNP. If the modem responds with a data pattern indicating that it wants to connect in LAP-M or MNP, the following registers are used:

- S97 register disables or enables LAP-M in V.42 mode.
- S98 register determines if the modem will use data compression while operating in LAP-M mode.
- S95 register determines how the modem establishes an MNP connection.
- S96 register determines if the modem will use data compression while operating in MNP mode.
- S106 register determines if the answering modem will detect a data pattern, indicating an attempt to connect in V.42 mode.



Chapter 4

Conventional Command Mode

Proceed with this chapter after the modem has been initialized for Conventional Command Mode as described in Chapter 3. If you will be using data communications software which supports Hayes® modems, you do not need to proceed with this manual. Instead, follow the instructions in your communications software manual.

If you intend to use the modem primarily in Enhanced Command Mode to take advantage of the unique advanced features offered by PEP modems, you can skip this chapter. Chapter 5 provides detailed information for configuring and using the modem in Enhanced Command Mode.

You can use the access character (~) to select an enhanced feature such as protocol support without changing modes. For example, entering ~S111=30 enables UUCP protocol support while operating in Conventional Command Mode.

Detailed descriptions of the commands and registers used in Conventional Command Mode along with guidelines for configuring the modem are provided in this chapter. Each command and register description includes explanations of the possible parameters, the range of parameters and the factory default settings.

Configuration Guidelines

The modem is designed to interface with a wide variety of computer and data communications equipment. Since each device has its own specific requirements, the modem uses a number of registers which can be set to meet the requirements of your system. These register settings can be stored in non-volatile memory for later use when the modem is powered up or reset.

4A

The Set Register (Sn=x) command is used to set a specific register (n) to some value (x). For example, the command AT S0=5 sets the S0 register value to 5.

The Write Configuration Parameters (&W) command stores the current register settings in non-volatile memory as Profile A (&W0) or Profile B (&W1). The Reset command (Z) is used to load either Profile A (Z0) or Profile B (Z1). If no parameter is entered for the &W or Z commands, Profile A is selected.

Attended or Unattended Mode

4A

If the factory default settings for Conventional Command Mode are used, the modem is configured to operate in attended mode with auto-answer disabled (S0=0). When an incoming call is received, the modem sends a RING result code each time the telephone rings, but it will not answer the call until an Answer command (A) is issued.

To set the modem to operate in unattended mode, the following command string will typically suffice:

AT &F S0=1 &S1 &C1 &D2 &K4 E0 Q1 &W0 &Y0

This command line recalls the factory default settings (&F); sets the S0 register to answer after the first ring (S0=1); configures the modem to assert DSR and DCD when a valid data carrier is detected (&S1 &C1); hangs up when DTR is dropped (&D2); enables XON/XOFF flow control (&K4); disables command echo (E0); disables displaying result codes (Q1); saves the current configuration to Profile A in non-volatile memory (&W0); and sets Profile A as the power up default profile (&Y0).

Transmission Mode Considerations

The modem's transmission speed is negotiated with the remote modem when a connection is made. The N command and S37 register specify the transmission speeds which are acceptable to the modem during negotiation as follows:

N0 The transmission speed must be the value specified by the S37 register. If the remote modem does not support that speed, a connection will not be made.

- N1 The modem is allowed to negotiate the transmission speed up to the maximum specified by S37. The modems arrive at the correct speed by selecting the highest speed which is supported by both modems.
- S37=0 If N=0: Limit transmission to speed of last AT command.
If N=1: Limit the *highest* transmission speed to the speed of last AT command.
- S37=1-3 Limit the transmission speed to 300 bps operation (Bell 103 or V.21 mode).
- S37=4 Reserved.
- S37=5 Limit the highest transmission speed to 1200 bps maximum (Bell 212A mode if B1 command selected, or CCITT V.22 mode if B0 command selected).
- S37=6 Limit the highest transmission speed to 2400 bps maximum (CCITT V.22 bis mode).
- S37=7 Attempt to connect in PEP mode. If unsuccessful, fall back to slower speed .
- S37=8 Reserved.
- S37=9 Attempt to connect in PEP mode. If unsuccessful, fall back to slower speed .

When communicating with another modem in PEP mode, the modem can transmit error-free data with a throughput of up to 18,000 bps. The modem dynamically adjusts its speed based on the quality of the connection.

To select V.32 Mode, issue the command string **AT ~ S50=6**.

To select V.23 Mode, issue the command string **AT ~ S50=5**.

If you plan to use the modem in V.22 or V.22bis mode, be aware that some (but not all) of these types of modems use guard tones during synchronization. If you experience problems in establishing a connection try configuring the modem to use one of the following available guard tones:

- &G0 No guard tone
- &G1 Use 550 Hz guard tone
- &G2 Use 1800 Hz guard tone

Serial Port Interface Speed and Flow Control

Most communication problems occurring over the DTE-DCE interface result from a mismatch in the interface speed and/or flow control method used by the DTE and modem. Both devices must be in complete agreement on the interface speed and flow control method used. Otherwise, information may be lost or garbled.

Serial Port Interface Speed

4A

The modem examines the AT prefix of the command to automatically determine the interface speed, character length and parity setting of your DTE.

When a connection is made with a remote modem without error control, the modem changes its DTE interface speed to match the speed of the connection. The interface speed at the DTE also must be changed to match the current interface speed which is indicated by the CONNECT XXXX message sent to the DTE following a connection.

When a connection is made in error control mode, the interface speed is not changed, and flow control is used to compensate for the possible difference between the transmission speed and the interface speed.

Serial Port Flow Control

The &K command determines the method of data flow control used by the DTE and the modem when transferring data over the serial port. The flow control method specified is only valid when the modem is operating in error control mode.

The modem can be configured to use any of the following flow control methods:

- &K0 Use no flow control.
- &K1 Reserved.
- &K2 Reserved.
- &K3 Use RTS/CTS flow control. This is the factory default setting and is the preferred method of flow control.

- &K4 Use XON/XOFF flow control. The XON and XOFF characters are ASCII DC1 (Control-Q) and ASCII DC3 (Control-S), respectively.
- &K5 Use transparent XON/XOFF flow control. This method provides a way to send XON and XOFF characters as data rather than being interpreted as control characters when used with Hayes' Smartcom III™ communications software.

RS-232 Control Signal Interpretations

In order to allow the modem to interface with a variety of DTEs, the &C, &D, &R, and &S define the various ways that the modem interprets and uses the RS-232C control signals.

4A

DCD Signal Handling

The &C command determines how the modem handles the DCD (Data Carrier Detected) control signal as follows:

- &C0 The DCD (Data Carrier Detected) signal is always on.
- &C1 DCD is on when a carrier is detected from the remote modem.

DTR Signal Interpretation

The &D command and S25 register control how the modem interprets the DTR (Data Terminal Ready) control signal sent from the DTE as follows:

- &D0 The modem assumes that DTR is always true.
- &D1 The modem enters command mode when the DTR signal is switched from on to off.
- &D2 The modem disconnects a call in progress, enters command mode, and disables auto-answer when the DTR signal is switched from on to off. Auto-answer is enabled when the DTR signal is returned to an active state.
- &D3 The modem resets and enters command mode when the DTR signal is switched from on to off. This causes the modem to recall the user profile parameters designated by the &Y command.

The modem will not recognize DTR signal level changes with a duration less than the time specified by S25 register.

RTS/CTS Signal Handling

- &R0 The CTS (Clear to Send) signal tracks the RTS (Ready to Send) signal. CTS is turned ON when RTS goes from OFF to ON. Synchronous data received while CTS is OFF is ignored.
- &R1 The RTS signal is ignored. CTS is turned ON when the modem is ready to receive synchronous data.

4A

DSR Signal Handling

The &S command determines how the modem handles the DSR (Data Set Ready) control signal as follows:

- &S0 The DSR (Data Set Ready) signal is on when the modem is ready to accept commands or data.
- &S1 The DSR signal is turned on when the modem is connected and ready to communicate with a remote modem.

File Transfer Protocol Support

When file transfer protocol support is enabled, the modem interacts with the protocol to eliminate delays in the file transfer which normally occur with other high-speed modems. This significantly increases the data throughput rate without altering the protocol functionality.

The modem can be configured to provide protocol support for any of the following file transfer protocols when a connection is made in PEP mode only:

- | | |
|-----------|-----------|
| ■ Kermit | ■ UUCP |
| ■ X modem | ■ Y modem |

The protocol supported is negotiated between the modems at both ends during the connection initialization sequence.

Protocol support is an enhanced feature which is controlled by the S111 register. This register can be accessed in Conventional Command Mode by issuing an `~S111=n` command where `n` specifies the protocol to support.

Setting the S111 register to 255 allows the modem to support the protocol specified by the modem at the other end of the connection. Typically, if the answering modem's S111 register is left at its default setting of 255, the calling modem can then specify the protocol to support via its S111 register setting. If both modems have S111 set to 255, no protocol will be supported. If neither modem has its S111 register set to 255, then both modems must agree on the setting of the S111 register to allow protocol support.

Refer to the description of the S111 register in Chapter 5 for specific settings.

MNP Support

The modem can be configured via the `&Q5` command and S36 register to provide MNP support while operating in V.32 and low-speed modes. Classes 1 through 5 are supported. To limit MNP support to classes 1-4 (no data compression), issue an `AT~S96=0` command to the modem. When an MNP connection is made, the modem will automatically operate at the highest level supported by both modems.

If an MNP connection cannot be made, the modem will either disconnect and return a NO CARRIER result code (`S36=0`), or fall back to a normal non-error-controlled connection (`S36=1`).

Refer to the descriptions of the `&Q` command and S36 register for additional information.

4A



Command Descriptions

This section describes the commands used when operating in Conventional Command Mode. Refer to Chapter 5 for a description of the commands available in Enhanced Command Mode.

You may enter a command line of up to 80 characters in upper or lower case with the first command in the line preceded by an "AT" or "at" and the last command followed by a carriage return. If you make an error while typing a command, simply backspace over the mistake then retype the line. You cannot backspace over the AT prefix because it is interpreted immediately after being typed.

The notation "(n)" in the descriptions represents a decimal numeric option, and "(x)" represents an assigned value. The parentheses should not be typed. If a command is typed without a value when one is expected, the modem assumes a value of 0.

The option should immediately follow the command. For example, to turn off the result codes, type Q1 not Q=1. The use of the "=" is explained under the S command.

Spaces can be inserted between commands for improved readability. Entering a comma between commands will cause the modem to pause for the amount of time specified by the S8 register.

You can repeat the last command line issued by entering "A/" or "a/". Do not enter the "AT" prefix or a carriage return when using this command.

~ **Enhanced Command Mode Access Character**

A special access character allows you to enter commands which are not normally available in Conventional Command Mode. All commands following a "~" character to the end of the command line are interpreted in Enhanced Command Mode. The modem returns to Conventional Command Mode at the beginning of the next command line unless Enhanced Command Mode is selected by a ~S63=0 or ~S63=1 command.

The ASCII code for the access character to be used is stored in the S222 register which is accessible in Enhanced Command Mode only. If your keyboard does not have a "~" character, power up the modem in the Enhanced Command Mode (see *Initializing the Modem* in Chapter 3), and change the value in the S222 register to the ASCII code of the desired character.

Note: The modem uses only one set of active operating parameters regardless of the command mode being used. Every Conventional Command Mode function has an equivalent in Enhanced Command Mode. Changing an operating parameter in either command mode will alter its equivalent in the other command mode. For example, entering ~S95=2 is identical to entering &Q5 S36=1. Appendix C summarizes the command and register equivalents.

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A Answer

The A command causes the modem to connect to the phone line and issue a carrier. If you are using the established phone connection for voice communications and then want to switch your system to data mode to communicate with the other party's system, you must use this command in the following way:

1. Have the other party enter "AT D" on their system without entering a phone number.
2. Enter "AT A" on your system within a few seconds.

B(n) Bell Mode Selection

n is either 0 or 1

Factory default is 1

The B command is used to select either CCITT or Bell standards while operating at 300 or 1200 bps transmission mode.

- | | |
|----|--|
| B | Same as B0. |
| B0 | Use CCITT standard for transmission (V.21 at 300 bps, V.22 at 1200 bps). |
| B1 | Use Bell standard for transmission (103J at 300 bps, 212A at 1200 bps). |

D(n) Dial

The D command is used to place a call by sending a dialing sequence to the modem. A valid dialing sequence is composed of a D followed by the digits 0-9 and dialing options which specify the number to dial. The characters A B C D # * also may be used when tone dialing (T) is selected. These characters are ignored while pulse dialing (P). Parentheses, slashes, hyphens, periods and spaces may be used in the dialing sequence to improve readability.

The D command causes the modem to stop interpreting other commands, dial the number indicated, and wait for a connection. If no connection is made within the period of time defined by the S7 register, or if any character is sent from your equipment before the modems have established synchronization, the D command is canceled and the modem returns to command mode.

Since the modem can use either pulse or tone dialing, you must specify which you prefer or the modem will use the last mode selected. Also, the modem will default to pulse dialing when the power is turned on, unless the parameter in the non-volatile memory has been set to tone dialing.

The characters listed below are commands that are valid only within a dialing sequence.

- | | |
|---|---|
| P | Use pulse dialing. |
| T | Use tone dialing. |
| W | Wait up to the number of seconds in the S7 register for a valid dial tone. |
| , | Pause for the amount of time specified by the S8 register before continuing the dial sequence. |
| @ | Wait for five seconds of silence before continuing. If five seconds of silence is not detected within 30 seconds, the modem hangs up and sends a NO ANSWER result code. |
| ! | Initiate momentary on-hook flash, a function similar to that of rapidly pressing your telephone hook down and up. The telephone handset must be on-hook for this to work. |

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Conventional Command Mode

- ;
Remain in command mode after dialing without waiting for a connection. This option terminates the dial sequence, causing the modem to remain in command mode
- S=n
References a number string stored in the number directory. This option should be placed at the end of the dialing sequence. All subsequent characters are ignored.
- R
Switch to answer mode when finished dialing. This option must be entered at the end of the dialing sequence.

The following examples show the correct command format to make the modem dial a number using pulse dialing, wait for an outside line, and then switch to tone dialing:

**AT D P9W T408-555-6789 or
AT D P9WT4085556789**

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Either way is acceptable since the modem ignores hyphens and spaces in the dialing sequence.

- E(n) Echo ON/OFF**
n is either 0 or 1
Factory default is 1

The E command instructs the modem, while in command mode, to echo characters back to the local DTE.

- E Same as E0.
- E0 Echo OFF
- E1 Echo ON

- F(n) Echoplex ON/OFF**
Factory default is 1

The F command instructs the modem to echo data characters back to the local DTE during data transmission. The Conventional Command Mode does not support online echo.

- F Same as F0.
- F0 Returns ERROR. Does not alter setting
- F1 No Echo

H(n) Hook ON/OFF
n is either 0 or 1

The H command allows the modem to control the telephone switch hook. Both options for "n" are defined below:

- H Same as H0.
- H0 Hang up
- H1 Go off-hook

I(n) Information
n is 0 - 2

The I command requests the modem to return its product identification number, and other information used by Technical Support.

- I Same as I0.
- I0 The modem returns a product identification character string which defines the model number and revision level.
- I1 The modem returns a three-digit number used by Technical Support.
- I2 The modem responds with an OK result code.

L(n) Speaker Volume
n is 0 - 3
Factory default is 2

The L command determines the speaker volume when it is enabled.

- L Same as L0.
- L0 Low volume
- L1 Low volume
- L2 Medium volume
- L3 High volume

M(n) Speaker ON/OFF

n is 0 - 3

Factory default is 1

The M command determines when the modem's internal speaker is enabled or disabled as follows:

- M Same as M0.
- M0 Speaker Disabled
- M1 Speaker Enabled only when dialing and connecting
- M2 Speaker Enabled at all times
- M3 Speaker Enabled after dialing until carrier detected

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N(n) Transmission Speed Negotiation

n is either 0 or 1

Factory default is 1

The N command determines if the modem is allowed to negotiate the modulation standard used when the speeds of the two modems are different. When the factory default setting (N1) is used, the modem will determine the correct speed by falling back or rising up to the speed of the remote modem.

- N Same as N0.
- N0 The speed of the connection must be as specified by the S37 register. If S37 is set to 0, the connection speed must match the speed of the last AT command.
- N1 Allows a connection at any transmission speed supported by both modems up to the maximum specified by the S37 register. If S37 is set to 0, the speed of the last AT command is used.

If the selected transmission speed is 300 or 1200 bps, the modem will reference the present setting of the B command to select either the Bell or CCITT communication standards.

O(n) On-Line
n is either 0 or 1

The O command places the modem in data mode. When the modem has been forced to enter command mode via an escape sequence or because DTR is turned off with &D1 enabled, the O command resumes data communication. If the modem is off-hook but not connected, it attempts to connect in the same mode (originate or answer) as the most recent connection.

- O Same as O0.
- O0 Returns modem to data mode.
- O1 Returns modem to data mode and initiates a retrain sequence.

Q(n) Quiet Enable
n is 0 - 2
Default is 0

The Q command controls the reporting of result codes to the local modem.

- Q Same as Q0.
- Q0 Modem returns result codes.
- Q1 Modem does not return result codes.
- Q2 Modem returns result codes when originating a call, but does not return result codes when answering a call.

S(n)=(x) Set Register

The S(n)=(x) command allows the local DTE to assign register n a value of x. The modem supports a number of definable registers which are described later.

The S(n) command sets a pointer to the register specified by n. Each new S(n) command reassigns the pointer. Typing the S command without the n parameter will point to the S0 register. This means that an S? command will return the value of the S0 register.

The =(x) is a separate command which assigns a value specified by x to the register pointed to by the previous S(n) command. Therefore, any command with an =(x) used in error will change the last explicitly referenced S register. Similarly, an AT? command will display the contents of the previously selected S register.

S(n)? Read Register

The S(n)? command allows the local DTE to read the contents of register n. Remember that an S? command will set the register pointer to S0 and return the value of the S0 register. An AT? command will display the contents of the last register selected by an S(n) command.

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V(n) Verbose ON/OFF

n is either 0 or 1
Factory default is 1

The V command determines the format of the result codes. A "0" directs the modem to return numeric responses. No linefeed is sent with numeric responses. A "1" causes the modem to return a more detailed description using English words.

- V Same as V0.
- V0 Numeric Result Codes Enabled
- V1 English Descriptions of Result Codes Enabled

W(n) Negotiation Progress Reporting

n is either 0 or 1
Factory default is 0

The W(n) command enables an additional set of result codes to report the progress of the negotiation phase in error-control mode. If enabled, these messages report first the carrier speed, then the protocol.

- W Same as W0.
- W0 Error-control call progress not reported.
- W1 Error-control call progress reported provided the Xn setting is greater than 0.

In error-control mode, the CARRIER speed and CONNECT speed messages may be different. This is because of the modem's ability to communicate with a remote modem at one speed and with the local DTE at another speed.

X(n) Result Code and Dialing Capabilities

n is 0 - 4

Factory default is 4

The X(n) command is used to select result codes and enable dialing capabilities as follows:

- X Same as X0.
- X0 Basic Result Codes (0 - 4) Enabled - The modem blindly dials and sends a CONNECT result code when the connection is made. Dial tone and busy signals are not recognized.
- X1 Result Codes 0 - 5, 10 - 12 and 14 Enabled - The modem blindly dials and sends the appropriate CONNECT XXXX result code when the connection is made. Dial tone and busy signals are not recognized.
- X2 Result Codes 0 - 6, 10 - 12 and 14 Enabled - The modem waits for a dial tone before dialing and sends the appropriate CONNECT XXXX result code when the connection is made. The NO DIALTONE result code is sent if a dial tone is not detected within 5 seconds. The busy signal is not recognized.
- X3 Result Codes 0 - 5, 7, 10 - 12 and 14 Enabled - The modem blindly dials and sends the appropriate CONNECT XXXX result code when the connection is made. The BUSY result code is sent if a busy signal is detected. The dial tone is not detected.

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- X4 Result Codes 0 - 7, 10 - 12 and 14 Enabled - The modem waits for a dial tone before dialing and sends the appropriate CONNECT XXXX result code when the connection is made. The NO DIALTONE result code is sent if a dial tone is not detected within 5 seconds. The BUSY result code is sent if a busy signal is detected.

See Appendix D for result code definitions.

- Y(n) Disconnect on Break**
n is either 0 or 1
Factory default is 0

The Y command, for non-PEP connections only, determines if the modem will respond to a disconnect signal.

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- Y Same as Y0.
- Y0 Modem does not respond to a disconnect signal.
- Y1 If the modem receives a continuous break signal from the remote modem for a period greater than or equal to 1.6 seconds, it disconnects. If the H0 command is issued or DTR is turned off while &D2 is selected, the modem transmits a four second break signal then disconnects (goes on-hook).

- Z(n) Reset**
n is either 0 or 1

The Z command disconnects the phone line and restores the command and register settings to the appropriate user profile values stored in non-volatile memory.

- Z Same as Z0.
- Z0 Modem resets and recalls User Profile A.
- Z1 Modem resets and recalls User Profile B.

&C(n) Data Carrier Detect Control

n is either 0 or 1

Factory default is 0

The &C command defines the DCD signal interpretation. It can be set to keep DCD active at all times or to track the state of the data carrier from the remote modem.

&C Same as &C0.

&C0 DCD is always on.

&C1 DCD is on when the carrier from the remote modem is detected.

&D(n) Data Terminal Ready Interpretation

n is 0 - 3

Factory default is 0

The &D command defines the DTR signal interpretation. The modem responds to changes in the DTR signal as follows:

&D Same as &D0.

&D0 Modem ignores changes in the DTR signal.

&D1 Modem enters command mode when an on-to-off transition of DTR is detected.

&D2 Modem hangs up, enters command mode, and disables auto-answer when an on-to-off transition of DTR is detected. Auto-answer is enabled when DTR is turned on.

&D3 Modem performs a hard reset and enters command mode when an on-to-off transition of DTR is detected. Note that a hard reset recalls the user profile designated as the default by an &Y command.

4B

&F Recall Factory Configuration Parameters

This command restores the Conventional Command Mode factory default configuration parameters to the operating registers.

To restore one of the other factory defaults, refer to the list below:

- ~&F0 Enhanced Command Mode Parameters
- ~&F1 Conventional Command Mode Parameters
- ~&F2 Enhanced Command Mode, SDLC Parameters
- ~&F3 V.32 Transparent Synchronous Mode Parameters

4B

&G(n) Guard Tone Selection

n is 0 - 2

Factory default is 0

In V.22 or V.22 bis mode, the answer modem uses this command to determine if a guard tone is required, and what type of guard tone to send.

- &G Same as &G0.
- &G0 No guard tone (typical U.S. operation).
- &G1 Use 550 Hz guard tone.
- &G2 Use 1800 Hz guard tone.

&J(n) Jack Type Selection

n is either 0 or 1

Factory default is 0

The &J command designates how the modem utilizes available telco leads.

- &J0 Auxillary telco leads disabled
- &J1 A/A1 control selected

&K(n) Flow Control

n is 0 - 5

Factory default is 3

The &K command determines the method for controlling the flow of data between the local DTE and modem when the modem is configured to operate in error-control mode (&Q5).

&K Same as &K0.

&K0 No flow control is used.

&K1 Reserved.

&K2 Reserved.

&K3 Use RTS/CTS flow control. The modem will not send data to the local DTE while RTS is off. When the modem wants to stop the flow of data from the local DTE, it turns off CTS. When the modem is ready to accept data from the local DTE, it turns on CTS.

&K4 Use XON/XOFF flow control. When the modem receives an XOFF character from the local DTE, it stops sending data to the DTE until it receives an XON. Similarly, if the modem wants to stop the flow of data from the local DTE, it will send an XOFF to the DTE. When it is ready to accept data from the DTE, it will send an XON. This method should not be used if XON or XOFF characters are contained in the data stream. The XON and XOFF characters are ASCII characters DC1 and DC3 respectively.

&K5 Use transparent XON/XOFF flow control. This method is used by Hayes Smartcom III communication software to provide a way to send XON/XOFF characters as data rather than control characters.

&L(n) Line Type Selection

n is either 0 or 1

Factory default is 0

The modem can be configured for either two-wire dial-up or leased line operation.

&L Same as &L0.

&L0 Dial-up line.

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Conventional Command Mode

&L1 Leased line. To make a connection over a leased line, after entering &L1, one modem should originate the call with the D command and the other modem should answer the call with an A command. When connecting the modem to a four-wire private line, a two-wire to four-wire hybrid is required.

&M(n) Communication Mode Selection

n is 0-3

Factory default is 0

The &M command determines the operating mode (asynchronous or synchronous) of the modem.

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&M0 Asynchronous Mode. This mode uses asynchronous communications for commands and data. Dialing options are specified in ECM register S104.

&M1 Synchronous Mode 1. The modem operates in asynchronous mode until a connection is established, at which time the modem switches to synchronous mode. This transition is signalled by the OFF to ON transition of DCD (if enabled), or by the CONNECT message. All result codes and messages are sent asynchronously. After DCD is true, the modem waits the number of seconds specified in S25 and checks DTR status. If DTR is ON, data connection is completed. If DTR is OFF, the modem hangs up and reverts to asynchronous mode. Changing the state of the DTR signal will cause the action specified in the Enhanced Command Register S52 to occur. This may include going to asynchronous command state or terminating the call. To drop a connection when in the Data Mode, press the Talk/Data switch, disconnect the phone line, or drop DTR (if ECM register S52 is set appropriately). Once the modem hangs-up it reverts to asynchronous mode.

&M2 Synchronous Mode 2. This mode is similar to &M1, but includes the ability to dial a pre-designated number and to disconnect a call via the DTR signal. When DTR is ON, the modem dials the number stored in location 0 of the phone number directory.

Result codes and messages are sent in asynchronous mode. After a connection is established, signalled by DCD true, the serial port changes to synchronous mode. ECM register S52 is set to a value of 4 when this mode is initiated. This value causes a call to be disconnected when the user drops DTR for longer than the time specified in S25. The call can also be dropped by pressing the Talk/Data switch or by losing carrier. When DTR is OFF the modem will not auto-answer.

&M3 Synchronous Mode 3. This mode is similar to &M1, but adds the ability to have DTR control modem actions. When DTR is sensed, the modem goes off-hook and attempts to establish a connection. Result codes and messages are in asynchronous mode. After DCD is true, the synchronous mode is used. In establishing a connection, the modem will look at register S1. If S1 is non-zero, the modem will attempt to answer the call. If S1=0, the modem will attempt to originate the call without dialling a number. ECM register S52 is set to 4 when this mode is initiated. This causes a call to be disconnected when the user drops DTR for longer than the time specified in S25. The call can also be dropped by pressing the Talk/Data switch or by losing carrier. When DTR is OFF the modem will not auto-answer.

4B

&P(n) Pulse Dialing Make/Break Ratio

n is either 0 or 1

Factory default is 0

The &P command is used to select the make/break ratio used when pulse dialing.

&P Same as &P0.

&P0 39% Make/61% Break ratio. US timing.

&P1 33% Make/67% Break ratio. UK timing.

&Q(n) Communication Mode Selection

n is 0 - 3, 5

Factory default is 5

The modem can be configured for asynchronous, synchronous, or error correction mode.

Conventional Command Mode

- &Q Same as &Q0.
- &Q0 Asynchronous Mode. This command is equivalent to &M0.
- &Q1 Synchronous Mode 1. This command is equivalent to &M1.
- &Q2 Synchronous Mode 2. This command is equivalent to &M2.
- &Q3 Synchronous Mode 3. This command is equivalent to &M3.
- &Q5 Asynchronous Error Control Mode. When a carrier is established, the modem attempts to establish an MNP connection. If an MNP connection cannot be made, the modem either drops the connection or falls back to a normal non-error-controlled connection depending of the setting of the S36 register.

If S36 is set to 0, the modem will drop the connection and send a NO CARRIER result code if an MNP connection cannot be made within 18 seconds of establishing carrier.

If S36 is set to 1, the modem will fall back to a normal non-error-controlled connection if an MNP connection cannot be made within 4 seconds of establishing carrier.

4B

&R(n) RTS/CTS Signal Interpretation

n is either 0 or 1

Factory default is 1

This command determines how the CTS signal will behave in response to RTS signal changes. In Asynchronous Mode, the CTS signal is always ON.

- &R Same as &R0
- &R0 CTS tracks RTS. When the modem is ready to receive synchronous data, CTS is turned ON in response to an OFF-to-ON transition of the RTS signal, after the delay specified by register S26.
- &R1 RTS is ignored. CTS is turned ON when the modem is ready to receive Synchronous data.

&S(n) Data Set Ready Interpretation

n is either 0 or 1
Factory default is 0

The &S command defines how the modem interprets the Data Set Ready (DSR) signal.

- &S Same as &S0.
- &S0 DSR is always ON.
- &S1 DSR is ON when the modem is ready and connected with another modem. DSR is turned ON when the answer tone is detected from the remote modem, while originating a call, or when the modem begins transmitting an answer tone while answering a call.

4B**&T(n) Test Function**

n is 0 - 8
Factory default is 4

The &T command is used to determine if a communications problem is caused by the local modem or DTE, the remote modem or DTE, or the connections between the two sites. When the modem is performing a test function, its MR indicator blinks at a rate of approximately once per second.

To perform tests after establishing a connection, you must return to command mode by issuing the escape sequence (+++).

Issue the appropriate &T command while in command mode.

- &T Same as &T0.
- &T0 Terminate the test in progress. You may need to issue the escape sequence (+++) to return to command mode prior to issuing an &T0. Entering the H0 (hang-up) or Z (reset) command will also terminate the test. The S18 register can be set to automatically terminate a test after a specific amount of time.
- &T1 This test checks the path between the local modem and DTE. Issue an &T1 command and type a few sentences.

If the modem echoes your keyboard input as you type, the local DTE and modem are operating correctly. Terminate the test by issuing an escape sequence and &T0 command.

&T3 This test checks the communication link and the remote modem. During this test the local modem sends incoming data directly back to the remote modem. Establish a connection with a remote modem, then issue an escape sequence and &T3 command. Ask the person at the remote system to type a few sentences. If the data is sent back to the remote system without errors, the remote modem and communication link are functioning correctly.

&T4 Allows the local modem to grant a test request from the remote modem.

&T5 Causes the local modem to deny a test request from the remote modem.

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&T6 This test checks the operation of both modems, the local DTE, and the telephone connection by commanding the remote modem to loop back data received from the local modem. Establish a connection with the remote modem, then issue an escape sequence and &T6 command. After the command has been accepted, the modem will go back on-line. Type a few sentences. They will be sent directly back to your terminal without appearing on the remote terminal's screen. If the modem echoes your keyboard input as you type it, the modem is operating correctly.

&T7 The local modem sends a self test pattern to the remote modem which returns the test pattern to the local modem. The local modem examines the received test pattern and increments a counter each time an error is detected. Establish a connection with the remote modem, then issue an escape sequence and &T7 command. When the test is terminated, a three-digit number is sent to the local DTE indicating the number of errors. If the error count is 000, the modems and telephone network passed the test. An error count of 255 indicates that 255 or more errors were detected.

&T8 The modem performs a local self test. This test may be performed without establishing a connection with another modem. When the test is terminated, a three-digit number is sent to the local DTE indicating the number of errors.

If the error count is 000, the modem passed the test. An error count of 255 indicates that 255 or more errors were detected.

&V View Active Configuration and User Profiles

The &V command displays the active configuration and user profiles A and B. The first four telephone numbers are also displayed. This command should be issued on a line by itself.

A “~” in the display indicates that a parameter has been set through Enhanced Command Mode that is not normally used in Conventional Command Mode. For example, a ~S58=5 (use ENQ/ACK flow control) causes &K~ to be displayed when an &V command is issued.

&W(n) Write Configuration Parameters n is either 0 or 1

This command stores the active configuration parameters in non-volatile memory as one of two user-defined profiles.

&W Same as &W0.

&W0 Writes active configuration parameters to User Profile A.

&W1 Writes active configuration parameters to User Profile B.

The speed at which the &W command is issued determines the speed at which the modem initially attempts to report result codes when the corresponding profile is recalled. Since the modem automatically adjusts its speed to match the speed of the AT command, the stored speed associated with the user profiles is only significant when operating in unattended auto-answer mode.

4B

&X(n) Synchronous Transmit Clock Source

n is 0 - 2

Factory default is 0

&X Same as &X0.

&X0 The modem generates the transmit clock signal, and applies it to pin 15 of the RS-232C connector.

&X1 The DTE (Data Terminal Equipment) generates the clock signal, and applies it to pin 24 of the RS-232C connector.

&X2 The modem derives the transmit clock signal from incoming data signals, and applies the clock signal to pin 15 of the RS-232C connector (slave operation).

4B &Y(n) Default User Profile Selection

n is either 0 or 1

The &Y command designates which user profile to recall when the modem is powered up.

&Y Same as &Y0.

&Y0 Recall User Profile A after power up.

&Y1 Recall User Profile B after power up.

Note: an &F command will not change the setting of this register.

&Z(n)=(x) Set Number Directory

n is 0 - 3

The &Z(n)=(x) command allows you to store phone numbers for later use in the modem's number directory in non-volatile memory. The string of digits and dialing control characters, x, is limited to 50 characters and will be stored at the number location defined by n where n may equal 0 through 3.

Any commands encountered in the dial string that are not valid dialing options will cause an ERROR and the directory entry will not be changed.

Register Descriptions

You may change any of the modem's registers by using the Set Register Command $S(n)=(x)$. For example, the command $S0=5$ will set register 0's value to 5. The modem is reset to the values stored in the non-volatile memory if the power is turned OFF then ON, the modem is reset by a Z command, or the DTR signal is turned off when &D is set to 3.

All unused register numbers and parameters outside of the defined range are reserved for future expansion and may cause undesirable results if used.

The remainder of this section describes each of the modem's Conventional Command Mode registers. All numeric values are in decimal.

S0 Answer on Ring Number

Range: 0 - 255

Default: 1

The S0 register determines the number of rings after which the modem answers a call. Setting S0 to 0 disables auto-answer.

S1 Count of Rings

Range: 0 - 255

The S1 register contains the number of incoming rings that have occurred. If the modem does not answer, and more than eight seconds have elapsed since the last ring, the count is reset to 0.

S2 Escape Character

Range: ASCII Code 0 - 255

Default: ASCII Code 43 (+)

The S2 register contains the code to be interpreted as the escape character. Setting this register to a value greater than 127 disables the recognition of the escape character by the modem. Note, this register is restored to the factory default setting when the modem is powered up or reset.

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S3 Carriage Return Character

Range: ASCII Code 0 - 96, 123 - 127

Default: ASCII Code 13

The S3 register contains the code to be interpreted as the carriage return character when in command mode. This register is restored to the factory default setting when the modem is powered up or reset. If the S3 register value is between 97 and 122 or greater than 127, the carriage return is not recognized.

S4 Line Feed Character

Range: ASCII Code 0 - 255

Default: ASCII Code 10

The S4 register contains the code to be output as the line feed character when in command mode. This register is restored to the factory default setting when the modem is powered up or reset.

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S5 Backspace Character

Range: ASCII Code 0 - 96, 123 - 127

Default: ASCII Code 8

The S5 register contains the code to be interpreted as the backspace character when in command mode. Setting this register to a value greater than 127 disables the recognition of the backspace character by the modem. The preferred values for this register are ASCII Codes 0 through 32 or 127. This register is restored to the factory default setting when the modem is powered up or reset. If the S5 register value is between 97 and 122 or greater than 127, the backspace is not recognized.

S6 Wait Time Before Dialing

Range: 2 - 255

Default: 2 seconds

The S6 register contains the length of time in seconds that the modem will wait after going off-hook before dialing. This allows the central telephone office time to detect the off-hook condition and apply a dial tone. The value of S6 is only relevant when the X0, X1 or X3 commands are in effect.

S7 Wait For Carrier/Dial Tone Time

Range: 1 - 255

Default: 30 seconds

The S7 register contains the time in seconds that the modem will wait for a valid carrier tone to be sent from the remote modem. This register also sets the duration of the W modifier in the Dial command.

4C**S8 Pause Time for Comma**

Range: 0 - 255

Default: 2 seconds

The S8 register contains the time in seconds that the modem will wait when it encounters a comma in the dialing sequence.

S9 Carrier Detect Time

Range: 1 - 255

Default: 6 (600 msecs.)

The S9 register contains the length of time that the modem will wait before connecting to the phone line after a carrier has been detected. Each count represents 100 milliseconds.

S10 Carrier Loss to Disconnect Time

Range: 1 - 255

Default: 14 (1.4 seconds)

The S10 register contains the amount of time the modem will wait after the carrier has been lost before disconnecting the line. Each count represents 100 milliseconds. This register value should always be set higher than that of S9 in order for carrier detection to operate correctly.

S11 Touch Tone Timing

Range: 50 - 255

Default: 95 msec.

The S11 register contains the time in milliseconds of the duration and spacing of tones when tone dialing. The S11 register does not affect pulse dialing which is fixed at 100 milliseconds per pulse.

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S12 Escape Sequence Guard Time

Range: 0 - 255

Default: 50 (1 second)

The escape sequence guard time is the time delay required immediately before and after entering the escape sequence. The guard time is in units of 20 milliseconds (1/50 second).

S13 - S15 Reserved

S18 Test Termination Timer

Range: 0 - 255

Default: 0

This register determines the length of time in seconds a diagnostic test will run before being automatically terminated. If the register is left at its factory default setting of 0, the timer will expire after one hour.

S19 - S24 Reserved**S25 DTR Delay Timing**

Range: 0 - 255

Default: 5 (50 msec.)

The modem ignores DTR level changes with a duration of less than the value specified by the S25 register. Each unit represents 10 milliseconds. When the modem is in Synchronous Mode 1, S25 determines the number of milliseconds after a data connection has been synchronized before the modem looks at the DTR line. If DTR is TRUE at that time, the data connection will be established. If DTR is FALSE, the call will be dropped and the modem will return to Asynchronous Mode.

S26 RTS to CTS Delay Interval

Range: 0 - 255

Default: 1 (100 milliseconds)

4C

This register affects synchronous operation only. When the &R0 option (the factory default) is in effect, and the modem detects an OFF-to-ON transition of the RTS signal, the modem delays a period of time specified by this register before turning the CTS signal ON. The values in this register represents units of 100 milliseconds.

S27 - S35 Reserved**S36 Negotiation Failure Treatment**

Range: 0 - 1

Default: 1

When error control mode is specified (&Q5) and an MNP connection cannot be made, this register determines whether to drop the connection or to fall back to a normal connection without error control.

Conventional Command Mode

Possible contents for this register are:

- 0 If an error control connection cannot be made within 18 seconds of establishing carrier, the connection is dropped and NO CARRIER is reported.
- 1 If an error control connection cannot be made within 4 seconds of establishing carrier, the modem falls back to normal connection without error control.

Any characters sent to a non-MNP modem from its DTE during the 4 second interval in which the modem was unsuccessfully attempting to establish a connection will be lost. In addition, if the answer modem does not support MNP, it will receive a burst of characters from the originating modem during the first 4 seconds of the call as the originating modem attempts to make an MNP connection.

S37 Transmission Mode

Range: 0 - 9

Default: 0

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This register determines the transmission speed between modems. If the N command is set to N0, the speed specified by this register is the only speed at which the modem will connect. If the N command is set to N1, the modem attempts to connect at the highest speed which does not exceed the value specified by this register, and fallback is enabled. Possible contents for this register are:

- 0 Attempt to connect at speed of last AT command.
- 1-3 Limit speed to 300 bps operation (Bell 103 or V.21 Mode).
- 4 Reserved.
- 5 Limit highest speed to 1200 bps maximum (Bell 212A or V.22 Mode).
- 6 Limit highest speed to 2400 bps maximum (V.22 bis Mode).
- 7 Attempt to connect in PEP Mode. Limit highest speed to PEP Mode Maximum. If unsuccessful in connecting, fall back to V.32 and other Low Speed Modes.
- 8 Reserved.
- 9 Attempt to connect in PEP Mode. If unsuccessful in connecting, fall back to V.32 and other Low Speed Modes.

S38 Delay Before Disconnecting

Range: 0 or 255

Default: 0 - Enhanced, 20 - Conventional

When the modem receives a command to hang up while in the error control mode, it waits the amount of time in seconds specified by this register before disconnecting. This is required in error control mode to ensure that data in the modem's buffers is sent before the connection is terminated. If the timeout occurs before the buffered data is sent, a NO CARRIER result code is sent to the DTE indicating that data has been lost. If all data is transmitted before the timeout, an OK response is sent.

If S38 is set to 255, the modem does not timeout and continues to send data until the connection is lost or the buffers are empty.

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Chapter 5

Enhanced Command Mode

Proceed with this chapter after the modem has been initialized, as described in Chapter 3. If you selected Enhanced Command Mode and are using data communications software which supports Telebit modems such as the TrailBlazer Plus, T1000, T1500, T2000, or T2500, you do not need to proceed with this manual. Instead, follow the instructions in your communications software manual.

Detailed descriptions of the commands and registers used in Enhanced Command Mode along with guidelines for configuring the modem are provided in this chapter. Each command and register description includes explanations of the possible parameters, the range of parameters and the factory default settings.

If you have initialized the modem to operate in Conventional Command Mode, you can use the access character (~) to select an enhanced feature such as protocol support without changing modes. For example, entering ~S111=30 enables UUCP protocol support while operating in Conventional Command Mode.

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Configuration Guidelines

The modem is designed to interface with a wide variety of computer and data communications equipment. Since each device has its own specific requirements, the modem uses a number of registers which can be set to meet the requirements of your system. These register settings can be stored in non-volatile memory for later use when the modem is powered up or reset.

The Set Register (Sn=x) command is used to set a specific register (n) to some value (x). For example, the command AT S0=5 sets the S0 register value to 5.

The Write Configuration Parameters (&W) command stores the current register settings in non-volatile memory as Profile A (&W1) or Profile B (&W2). The Recall EEPROM Operating Parameters (&E) command is used to load either Profile A (&E1) or Profile B (&E2) from non-volatile memory. If no parameter is entered in a &W or &E command, the default profile specified by the S255 register is used.

Attended or Unattended Mode

The modem can be configured for either attended or unattended operations. Table 5-1 is a listing of typical commands and register settings used to configure the modem to interface with a terminal, personal computer or other attended DTE. Table 5-2 lists those commands typically used to configure the modem to operate in unattended answer mode.

Table 5-1. Attended Mode Configuration

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~&F	Restore Enhanced Command Mode defaults to ensure that the modem is in a normalized state before changing parameters.
S51=n	<p>Set the interface speed to the highest possible speed supported by the DTE. The speed setting of the DTE must match the speed specified by this register setting where n is equal to:</p> <ul style="list-style-type: none"> 0 300 bps 1 1200 bps 2 2400 bps 3 4800 bps 4 9600 bps 5 19200 bps
S66=1	Lock the interface speed to the current setting of the S51 register. This allows the host equipment to use the same interface speed between itself and the modem, regardless of the transmission speed between the modem and the remote modem. Flow control is used to handle the difference between the transmission speed and the interface speed.

Table 5-2. Unattended Answer Mode Configuration

~&F	Restore Enhanced Command Mode defaults to ensure that the modem is in a normalized state before changing parameters.
S45=255	Enable remote access to allow convenient reconfiguration after connecting the modem to the host equipment.
S51=n	Set the interface speed to the highest possible speed supported by the DTE. The speed setting of the DTE must match the speed specified by this register setting where n is equal to: <ul style="list-style-type: none"> 0 300 bps 1 1200 bps 2 2400 bps 3 4800 bps 4 9600 bps 5 19200 bps
S52=1	The modem will not answer an incoming call if DTR is off, and disconnects a call if DTR is dropped.
S54=3	Disable the break signal interpretation so that the modem does not go into command mode when a break is detected. The break signal is passed on to the remote site in sequence with the data stream.
S55=3	Disable the escape character sequence interpretation so that the modem does not go into command mode when it encounters an escape sequence. The escape characters are passed on to the remote site in sequence with the data stream.
S64=1	Ignore data sent by the local DTE while answering a call.
S66=1	Lock the interface speed to the current setting of the S51 register. This allows the host equipment to use the same interface speed between itself and the modem, regardless of the transmission speed between the modem and the remote modem. Flow control is used to handle the difference between the transmission speed and the interface speed.
S67= 1	When a carrier is detected, the modem asserts CTS 200 milliseconds after RTS goes active.
S130=5	When a valid data carrier is detected, DSR is asserted.
S131=1	When a valid data carrier is detected, DCD is asserted.
Q4	Do not send unsolicited result codes to the local DTE.
E0	Do not echo back commands to the local DTE.

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Transmission Mode Considerations

The modem's transmission speed is determined by the current setting of the S50 register. When communicating with another modem in PEP mode, the modem can transmit error-free data with a throughput of up to 19,200 bps. The modem dynamically adjusts its speed based on the quality of the connection.

To accommodate communicating with slower modems, the modem can be configured via the S50 register to operate in any of the following modes:

S50=0	Automatic speed determination
S50=1	300 bps operation (Bell 103 or V.21)
S50=2	1200 bps operation (Bell 212A or V.22)
S50=3	2400 bps operation (V.22bis)
S50=4	Operate in V.21 mode only (300 bps)
S50=5	Operate in V.23 mode only (1200/75 bps)
S50=6	Operate in V.32 mode only (9600 bps)
S50=254	Match speed of last AT command
S50=255	Operate in PEP mode only

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When a connection is made in Automatic Speed Determination mode (S50=0), the answering modem steps through several different answering tones in sequence to allow the calling modem to synchronize on the appropriate one. In general, the modem starts with the highest transmission speed and works down toward the lowest speed. Therefore, if a slower speed modem is calling, it may need to extend the time that it waits to detect carrier.

If you prefer, you can set the S92 register to 1 which causes the modem to issue the PEP answer tones at the end of the search sequence rather than at the beginning. This allows connections with slower speed modems which are adversely affected by the PEP answer sequence. Refer to the S92 register description for additional information.

The S90 register determines if the modem issues Bell or CCITT modulations for 300 or 1200 bps operation as follows:

S90=0 Use Bell 103/212A

S90=1 Use CCITT V.21/V.22

If you plan to use the modem in V.22 or V.22bis mode, be aware that some but not all of these types of modems use guard tones during synchronization. If you experience problems in establishing a connection, try configuring the modem to use one of the two available guard tones:

S91=1 Use 1800 Hz guard tone

S91=2 Use 550 Hz guard tone

Serial Port Interface Speed and Flow Control

Most communication problems occurring over the DTE-DCE interface result from a mismatch in the interface speed and/or flow control method used by the DTE and modem. Both devices must be in complete agreement on the interface speed and flow control method used. Otherwise, information may be lost or garbled.

Serial Port Interface Speed

To allow the DTE to communicate with the modem, the interface speed used by both the DTE and the modem must match. For maximum data throughput, the interface speed between the DTE and the modem should be set to the highest possible speed supported by both devices. Registers S51 and S66 govern the serial interface speed of the modem.

The interface speed of the modem can be set either manually or automatically. To manually set the modem's interface speed, the S51 register should be set to one of the following values:

S51=0 300 bps

S51=1 1200 bps

S51=2 2400 bps

S51=3 4800 bps

S51=4 9600 bps
S51=5 19200 bps

For automatic speed selection, the S51 can be set to one of the following three values:

S51=252 for automatic speed selection with type-ahead not permitted
S51=254 for automatic speed selection with type-ahead permitted and a default speed of 19200 bps
S51=255 for automatic speed selection with type-ahead permitted and a default speed of 9600 bps

All three methods require the AT prefix when entering commands. The modem uses the "A" in the prefix to determine the serial interface speed.

When S51 is set to 252, the current interface speed is determined after each command line, and a new command line cannot be entered until the result code from the previous command is displayed. If no command lines have been entered after a power-up, the speed at which the default profile was saved will be the speed used to send RING and CONNECT messages when an incoming call is received.

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When S51 is set to 254 or 255, the modem only checks the interface speed on the first AT prefix after one of the following events occur:

- The modem is powered up or reset.
- The S51 register is set to 254 or 255.
- A break signal is detected from the DTE when not connected to another modem.
- A data call is disconnected, and the modem is placed on-hook.
- A NO CARRIER condition is detected due to connect time expiration, dial command being aborted, or the loss of carrier.

Since the interface speed is not determined after every command line, multiple command lines can be entered without waiting for the results of previous command lines. Some communications programs may not wait for result codes when setting up the modem and will require this type-ahead capability.

If no command lines have been entered after a power-up, the modem will use 19200 bps (S51=254) or 9600 bps (S51= 255) to send RING and CONNECT messages when an incoming call is received.

When the modem is connected to a remote modem in PEP mode, the interface speed between the modem and the DTE remains at the same speed used in command mode and flow control is used to compensate for the difference between the line transmission speed and the DTE interface speed.

When the modem is connected to a remote modem in Low Speed (non-PEP) Mode, the S66 register determines whether or not the modem will change interface speed and use flow control as described below:

- S66=0 The modem changes its interface speed to match the line transmission speed following a connection in Low Speed Mode. No flow control is used.
- S66=1 The interface speed remains at the same speed used in command mode. Flow control is used.
- S66=2 If a non-MNP connection is established, the modem will change its interface speed to match the line transmission speed. When an MNP connection is established, the interface speed will remain at the same speed used in command mode and flow control is used.

Serial Port Flow Control

To avoid loss of data, the flow control method used by the DTE and the modem must be established. The S58 and S68 registers determine the method of data flow control used by the DTE and the modem when transferring data over the serial interface.

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There are times when the flow control used for data entering the modem from the serial interface must differ from the flow control method used for data leaving the modem over the interface. The S58 register governs the method of flow control used by the DTE to control the flow of data coming from the modem:

- S58=0 No flow control is used.
- S58=1 RTS/CTS flow control in half duplex mode is used.
- S58=2 RTS/CTS flow control in full duplex mode is used.
- S58=3 XON/XOFF flow control is used.
- S58=4 Both RTS/CTS and XON/XOFF flow control is used.
- S58=5 ENQ/ACK flow control is used.
- S58=6 Both ENQ/ACK and XON/XOFF flow control is used.
- S58=7 Transparent XON/XOFF flow control is used.

The S68 register controls the flow of data from the DTE to the modem:

- S68=0 No flow control is used.
- S68=2 RTS/CTS flow control in full duplex mode is used.
- S68=3 XON/XOFF flow control is used.
- S68=4 Both RTS/CTS and XON/XOFF flow control is used.
- S68=5 ENQ/ACK flow control is used.
- S68=6 Both ENQ/ACK and XON/XOFF flow control is used.
- S68=255 Same flow control as specified by S58 is used.

For more information about flow control schemes, refer to the *Register Descriptions* sections of this manual.

The flow control methods specified by the S58 and S68 registers are only valid when the modem is operating in command or PEP mode, or when the S66 register is set to use flow control as described earlier.

When XON/XOFF flow control is used, recognition of the XON and XOFF characters is controlled by the S56, S57 and S48 registers.

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The S56 and S57 registers specify the ASCII code to be used for the XON and XOFF characters, respectively. The S48 register determines how an incoming character should be treated when compared with the contents of S56 and S57.

If S48 is set to 0, the modem only examines the lower seven data bits to detect an XON or XOFF character. This means that if the DTE is using an eight bit data format, characters with a decimal value greater than 127 could be misinterpreted as an XON or XOFF character. To avoid this condition, the S48 register should be set to 1 when the DTE is using eight bit characters.

The primary reason for selecting RTS/CTS flow control is to allow non-ASCII text data to be transferred without unintentionally detecting an XON or XOFF. It may be necessary to also disable recognition of the ESC character by setting the S55 register to 3.

RS-232 Control Signal Interpretations

In order to allow the modem to interface with a variety of DTEs, registers S25, S26, S47, S52, S67, S104, S130, and S131 define the various ways that the modem interprets and uses the RS-232C control signals.

DTR Signal Interpretation

The S25, S52, and S104 registers control how the modem interprets the DTR (Data Terminal Ready) control signal sent from the DTE as follows:

- S25=n The modem will ignore DTR level changes with a duration of less than the value specified by the S25 register. Each unit "n" represents 10 milliseconds.
- S52=0 The modem assumes that DTR is always true.
- S52=1 The modem will not answer an incoming call if DTR is off, and disconnects a call if DTR is dropped.
- S52=2 Same as S52=1 and the modem recalls the default profile parameters when DTR is dropped.

- S52=3 The modem enters command mode when the DTR signal is switched from on to off.
- S52=4 The modem disconnects a call in progress, and disables auto-answer before entering command mode. Auto-answer is enabled when the DTR is returned to an active state.
- S104=0 Automatic dialing via the DTR signal is disabled.
- S104=1 The modem automatically dials the first number (N0) in the number directory when an off-to-on transition of the DTR signal is detected.
- S104=4 When the DTR signal is asserted, the modem will assume the originate mode if the setting of register S1 is less than that of register S0. If the setting of register S1 is greater than or equal to that of register S0, the modem will assume the answer mode.

DSR Signal Handling

The S47 and S130 registers determine how the modem handles the RS-232 DSR (Data Set Ready) control signals as follows:

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- S130=0 DSR is always on.
- S130=1 DSR is turned on when an answer tone is detected while originating a call or transmitted when answering a call.
- S130=2 DSR is turned on when the modem is ready to accept commands or data.
- S130=3 DSR is turned on when the modem is ready to accept commands or data. When the carrier is lost DSR is turned back off for the amount of time specified by the S47 register, then on.
- S130=4 DSR is turned on when the modem is off-hook.
- S130=5 DSR is turned on when a valid carrier is detected from the remote modem.
- S130=6 The DSR signal will be raised if the DTR signal is raised while the modem is not online, or if a connection is made to another modem and the DTR signal was already asserted before the modem was reset.

DCD Signal Handling

The S47 and S131 registers determine how the modem handles the DCD (Data Carrier Detected) control signal as follows:

- S131=0 DCD is always on.
- S131=1 DCD is turned on when a valid carrier is detected from the remote modem.
- S131=2 DCD is turned on when the modem is ready to accept commands or data.
- S131=3 DCD is turned on when the modem is ready to accept commands or data. When the carrier is lost, DCD is turned back off for the amount of time specified by S47, then on.
- S131=4 DCD is the inverse of CTS in command and online modes. Recommended for use in transparent synchronous mode only.

CTS Signal Handling

The S26 and S67 registers determine how the modem interprets the CTS (Clear to Send) control signal as follows:

- S67=0 If RTS/CTS flow control is not used, CTS is always on. If RTS/CTS flow control is used, the modem turns CTS on and off to control the flow of data from the DTE. When CTS is on, the modem will accept data from the DTE.
- S67=1 CTS is held off until a valid carrier is detected. When a carrier is detected, CTS is turned on 200 milliseconds after RTS goes active. If RTS/CTS flow control is used, CTS is used to control the flow of data from the DTE.
- S67=2 CTS is turned ON in response to an OFF-to-ON transition of RTS after a delay specified by register S26.

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Break Signal and Escape Sequence Handling

The modem's default action upon receiving a break signal or escape sequence is to enter command mode. The modem can be configured to pass the break signal on to the remote end by changing the setting of the S54 register. Similarly, the S55 register setting controls the modem's response to an escape sequence.

The S54 register determines how the modem handles a break signal as follows:

- S54=0 The modem switches to command mode when a break signal is received.
- S54=1 Reserved.
- S54=2 The modem immediately sends a break to the remote end.
- S54=3 The modem sends a break in sequence with the data stream.
- S54=4 The modem discards the break signal.

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The S55 register determines how the modem processes escape characters as follows:

- S55=0 The modem switches to command mode when an escape sequence is received. An escape sequence consists of three consecutive escape characters (defined by register S2) bordered by the proper guard time (specified by register S12).
- S55=1 The modem discards its buffered data and passes the escape character to the remote end.
- S55=2 The modem immediately passes the escape character to the remote end.
- S55=3 The modem sends the escape character in sequence with the data stream.

Note that if both the S54 and S55 registers are set to some value other than 0, there is no way to enter command mode during a connection. Since the main use of command mode is to establish a connection, this may not be an important consideration.

If an escape sequence is received from the remote site and the DTE is echoing data transmissions, the modem could inadvertently be placed in command mode when the DTE echoes the escape sequence. Since the escape sequence could conceivably appear in the data stream, use of the break signal is the preferred method for switching to command mode during a connection.

Packetized Ensemble Protocol™ Data Compression

The S110 register determines if the modem will use data compression while operating in PEP Mode. The use of data compression for improved data throughput is negotiated between the modems at both ends during the PEP initialization sequence. Both modems must support data compression for it to be used.

The S110 register's default setting of 255 allows the remote modem to specify whether or not data compression will be used. If the remote modem's S110 register is set to 1 when a connection is made in PEP Mode, data compression is enabled; whereas if the remote modem's S110 register is set to 0, data compression will not be used. If both modems have the S110 register set to 255, data compression will not be supported. If neither modem has its S110 register set to 255, then both modems must have the S110 register set to 1 to enable data compression.

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File Transfer Protocol Support

When file transfer protocol support is enabled, the modem interacts with the protocol to eliminate delays in the file transfer which normally occur with other high-speed modems. This significantly increases the data throughput rate without altering the protocol functionality.

The modem can be configured via the S111 register to provide support for any of the following file transfer protocols when a connection is made in PEP mode:

- Kermit
- X/Ymodem
- UUCP

The protocol supported is negotiated between the modems at both ends during the connection initialization sequence.

The S111 register's default setting of 255 allows the modem to support the protocol specified by the modem at the other end of the connection. Typically, if the answering modem's S111 register is left at its default setting of 255, the calling modem can then specify the protocol to support via its S111 register setting. If both modems have the S111 set to 255, no protocol will be supported. If neither modem has its S111 register set to 255, then both modems must agree on the setting of the S111 register to allow protocol support.

MNP Support

The modem can be configured via the S95 and S96 registers to provide MNP support while operating in V.32 and Low Speed Modes . MNP classes 1 through 5 are supported. When an MNP connection is made, the modem will automatically operate at the highest level supported by both modems as specified below:

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<u>S95</u>	<u>S96</u>	<u>MNP Level Supported</u>
0	0 or 1	MNP disabled.
1 or 2	0	MNP 3 and 4 enabled (error correction).
1 or 2	1	MNP 3, 4 and 5 enabled (error correction and data compression).

SDLC Support

When SDLC Mode is selected, both modems must be operating in PEP Mode and set to provide SLDC support. Note that only point-to-point SDLC configurations are supported; multi-point support is not provided.

If the S150 register is set to 0, the modem operates in the Asynchronous Mode, and the contents of registers S151 through S164 are ignored. However, if S150 is set to 1, SDLC Mode is selected, only PEP connections are allowed, and the contents of registers S151 through S164 define the operating characteristics of the modem. The following registers are ignored while operating in SDLC Mode: S12, S47, S50, S51, S54, S55, S58, S62, S65, S67, S68, S111, S130, and S131.

Transparent Synchronous Support

If S150 is set to 2, the modem operates in the Transparent Synchronous Mode, and the contents of registers S151 through S153, and S155 through S164 are ignored. The modem can use this mode when communicating in Bell 212A, V.22, V.22bis, and V.32 modulations.

The contents of the S150 register determines if the modem will operate in Asynchronous, Transparent Synchronous, or SDLC Mode when it is powered up or reset via a Z command, an &T command, or a change in the A/B switch setting.

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Command Descriptions

This section describes the commands used when operating in Enhanced Command Mode. Refer to Chapter 4 for a description of the commands available in Conventional Command Mode.

You may enter a command line of up to 80 characters in upper or lower case with the first command in the line preceded by an "AT" or "at" and the last command followed by a carriage return. If the S63 register is set to 0, you should not enter the "AT" at the beginning of the command line.

If you make an error while typing a command, simply backspace over the mistake then retype the line. You cannot backspace over the AT prefix because it is interpreted immediately after being typed.

The notation "(n)" in the descriptions represents a decimal numeric option, and "(x)" represents an assigned value. The parentheses should not be typed. If a command is typed without a value when one is expected, the modem assumes a value of 0.

The option should immediately follow the command. For example, to turn off the result codes, type Q1 not Q=1. The use of the "=" is explained in the S command description.

You can repeat the last command line issued by entering "A/" or "a/". Do not enter the AT prefix or a carriage return when using this command.

A **Answer**

The A command causes the modem to connect to the phone line and issue a carrier. If you are using the established phone connection for voice communications and then want to switch your system to data mode to communicate with the other party's system, you must use this command in the following way:

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1. Have the other party enter "AT D" on their system without entering a phone number.
2. Enter "AT A" on your system within a few seconds. Both parties can hang-up the phone. The modem sends a CONNECT result code when the connection is made.

C(n) Turn Carrier ON/OFF
n is either 0 or 1

The C command is used to turn the carrier ON or OFF while operating in the following modulations: 103J, 212A, V.21, V.22, V.22bis, and V.23. A "0" selects OFF while a "1" selects ON.

- C Same as C0.
- C0 Carrier OFF
- C1 Carrier ON

D(n) Dial

The D command is used to place a call by sending a dialing sequence to the modem. A valid dialing sequence is composed of a D followed by the digits 0-9 and dialing options which specify the number to dial. The characters A B C D # * may also be used when tone dialing (T) is selected. These characters are ignored while pulse dialing (P). Parentheses, slashes, hyphens, periods and spaces may be used in the dialing sequence to improve readability, but are not required.

To use the D command, dial the number indicated and wait for a connection. If no connection is made within the period of time defined by the S7 register, or if any character is sent from your equipment before the modems have established synchronization, the D command is canceled and the modem returns to command mode.

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Since the modem can use either pulse or tone dialing, you must state which you prefer or the modem will use the last mode selected. Also, the modem will default to pulse dialing when powered on, unless the parameter in the non-volatile memory has been set to tone dialing.

The following characters listed are commands that are valid only within a dialing sequence.

All but the last can appear multiple times in the dialing sequence.

- P Use pulse dialing.
- T Use tone dialing.
- W Wait up to the number of seconds in the S6 register for a valid dial tone.
- N(n) Reference a number string stored in the number directory.
- , Pause for the amount of time specified by the S8 register before continuing the dial sequence.
- @ Wait for five seconds of silence before continuing. If five seconds of silence is not detected within 30 seconds, the modem hangs up and sends a NO ANSWER result code.
- ! Initiate momentary on-hook flash, a function similar to that of rapidly pressing your telephone hook down and up. The telephone handset must be on-hook for this to work.
- ; Remain in command mode after dialing without waiting for a connection. The ";" terminates the dial sequence, causing the modem to remain in command mode.

The "\ (backslash) symbol indicates to the modem that a number defined by a name in the number directory is to be dialed. That name is defined at the time the number is placed in the number directory. For example,

AT DT 408 N1 or AT DT 408\Test Call

will dial the telephone number previously stored in the number directory.

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Enhanced Command Mode

The following character can only be used at the end of a dialing sequence:

- R Switch to answer mode when finished dialing. This option should be used only in Low Speed Mode.

The following examples show the correct command format to make the modem dial a number using pulse dialing, wait for an outside line, and then switch to tone dialing:

```
AT D P9W T408-555-6789 or
AT D P9WT4085556789
```

Either way is acceptable since the modem ignores hyphens in the dialing sequence.

- E(n) Echo ON/OFF**
n is either 0 or 1
Factory default is 1

The E command instructs the modem, while in command mode, to echo characters back to the local DTE.

- E Same as E0.
- E0 Echo OFF
- E1 Echo ON

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- F(n) Echoplex ON/OFF**
n is either 0, 1, or 2
Factory default is 1

The F command instructs the modem to echo data characters back to the local DTE during data transmission.

- F Same as F0.
- F0 Echo
- F1 No Echo
- F2 Send a linefeed after a carriage return is echoed.

G Go To Voice

The G command informs the modem that you want to use the telephone for voice communication and that the modem should cease use of the connection until further notice. The telephone handset must be lifted off-hook before this command is entered.

H(n) Hook ON/OFF
n is either 0 or 1

The H command allows the modem to control the telephone switch hook.

Both options for "n" are defined below:

- H Same as H0.
- H0 Hang up
- H1 Go off-hook

I(n) Information
n is 0 - 4

The I command requests the modem to return its product identification number, internal diagnostic status, current transmission mode, current revision level, or the values of those registers which are negotiated at the beginning of a connection.

A "0" causes the modem to return a product identification character string which defines the model number. See the S49 register description for model number options.

A "1" causes the modem to return any error code status generated by summing the numbers associated with failed tests.

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Enhanced Command Mode

A "2" causes the modem to respond with the current transmission mode as follows:

<u>Response</u>	<u>Meaning</u>
0	Not Connected
300	Connected in Bell 103 or V.21 Mode
1200	Connected in Bell 212A or V.22 Mode
1275	Connected in V.23 Mode
2400	Connected in V.22bis Mode
9600	Connected in V.32 Mode
FAST	Connected in PEP Mode

If the X command is set to 2 or higher, and the modem is connected in MNP mode, then /REL will also be reported.

If the X command is set to 3 or higher, and the modem is connected in PEP mode with file transfer protocol support and/or data compression enabled, then /KERM, /XMDM, /UUCP and/or /COMP will also be reported.

A "3" causes the modem to respond with the version level of the installed firmware.

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A "4" causes the modem to return the negotiated (currently active) values, which will remain after a connection is dropped, for the following registers:

S95	MNP Operating Mode
S96	MNP Data Compression Enable
S97	LAPM Enable
S98	V.42bis Data Compression
S110	Data Compression Enable
S111	File Transfer Protocol Support
S121	Echo Suppressor Compensation
S150	Asynchronous/ Synchronous Mode Selection

A "5" causes the modem to display in ASCII, the last number dialed by the modem.

A "6" causes the modem to respond with the hardware platform determination.

Note: The values returned may not be the same as the register settings.

J **Reserved**

This command is reserved for factory use only.

M(n) **Speaker ON/OFF** n is 0 - 3 Factory default is 1

The M command controls the modem's internal speaker as follows:

- M Same as M0.
- M0 Speaker Disabled
- M1 Speaker Enabled only when dialing and connecting
- M2 Speaker Enabled at all times
- M3 Speaker Enabled after dialing until carrier detected

N(n)=(x) **Set Number Directory** n is 0-9

The N(n)=(x) command allows you to store phone numbers for later use in the modem's number directory in non-volatile memory. The string of digits and dialing control characters, x, will be stored at the number location defined by n where n may equal "0" through "9".

In addition to the numbers stored in the number directory, you may define alpha character names to be used for later reference in initiating calls.

To define a name for a particular telephone number, you must precede and follow the name by a "\" (backslash) symbol. Each directory number may contain up to 50 alpha-numeric characters. For example,

```
AT N1=555-6789\Test Call\
```

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If the N command is to be followed by other commands on the same line, then the N command must be terminated with a name (which can be empty). For example:

ATN1=555-6789\S7=10

N(n)? Display Number

n is 0-9

The N(n)? command instructs the modem to display the contents of the directory address defined by n.

**N? Display Number Directory
and S Registers**

The N? command allows the entire contents of the number directory, the current settings of the S registers and the firmware version number to be displayed. Colons (:) mark those registers which are not at the factory default settings for Enhanced Command Mode.

O On-Line

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The O command places the modem in data mode. When the modem has been forced to enter command mode via the break signal or the escape character, the O command resumes data communication. If the modem is off-hook but not connected, it attempts to connect in the same mode (originate or answer) as the most recent connection.

Q(n) Quiet Enable

n is 0 - 9

Default is 0

The Q command controls the reporting of result codes to the local modem, and to the remote modem in response to commands received from the remote modem via the % command. A summary of the modem's result codes is provided in Appendix D.

Possible parameter values and the modem's response are listed below:

<u>Parameter</u>	<u>Remote Quiet</u>	<u>Local Quiet</u>
0	No	No
1	No	Yes
2	Yes	No
3	Yes	Yes
4	No	Partial 1
5	Yes	Partial 1
6	No	Partial 2
7	Yes	Partial 2
8	No	Partial 3
9	Yes	Partial 3

The partial quiet modes are defined as follows:

- Partial 1 The local modem will not report the RING result codes and it will not report NO CARRIER, CONNECT, BUSY or RRING unless the connection was initiated with an ATD or ATA command.
- Partial 2 The local modem will not report RING result codes and it will not report NO CARRIER, CONNECT, BUSY or RRING during a connection in which the local modem is in answer mode.
- Partial 3 The local modem returns result codes when originating a call, but does not return result codes when answering a call.

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S(n)=(x) Set Register

The S(n)=(x) command allows the local DTE to assign register n a value of x. The modem supports a number of definable registers which are described later.

The S(n) command sets a pointer to the register specified by n. Each new S(n) command reassigns the pointer. Typing the S command without the n parameter will point to the S0 register. This means that an S? command will return the value of the S0 register. The =(x) is a separate command which assigns a value specified by x to the register pointed to by the previous S(n) command.

Therefore, any command with an =(x) used in error will change the last explicitly referenced S register. Similarly, an AT? command will display the contents of the previously selected S register.

S(n)? Read Register

The S(n)? command allows the local DTE to read the contents of register n. Remember that an S? command will set the register pointer to S0 and return the value of the S0 register. An AT? command will display the contents of the last register selected by an S(n) command.

U Update Password

The U command allows the user to change the password. When the command U is entered, the user is asked for the old password, the new password and a confirmation of the new password.

V(n) Verbose ON/OFF

n is either 0 or 1
Factory default is 1

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The V command determines the format of the result codes. A "0" directs the modem to return numeric responses. No linefeed is sent with numeric responses. A "1" causes the modem to return a more detailed description using English words.

- V Same as V0.
- V0 Numeric Result Codes Enabled
- V1 English Descriptions of Result Codes Enabled

W(n) Negotiation Progress Reporting

n is either 0 or 1

Factory default is 0

The W(n) command enables an additional set of result codes to report progress of the negotiation phase in error-control mode. If enabled, these messages report first the carrier speed, then the protocol.

W Same as W0.

W0 Error-control call progress not reported.

W1 Error-control call progress reported provided X11 - X14 is selected.

In error-control mode, the CARRIER speed and CONNECT speed messages may be different. This is because of the modem's ability to communicate with a remote modem at one speed and with the local DTE at another speed.

X(n) Result Code Basic/Extended

n is 0 - 3, 10 - 14

Factory default is 1 for Enhanced Command Mode; 14 for Conventional Command Mode

The X(n) command is used to select either basic or extended result codes as follows:

- X0 Basic Result Codes (0 - 4) Enabled
- X1 Extended Result Codes (0 - 52) Enabled
- X2 MNP Extended Result Codes Enabled
- X3 MNP and PEP Extended Result Codes Enabled
- X10 Basic Result Codes (0 - 4) Enabled
- X11 Result Codes 0 - 5, 10 -12 and 14 Enabled
- X12 Result Codes 0 - 6, 10 -12 and 14 Enabled

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Enhanced Command Mode

X13 Result Codes 0 - 5, 7, 10 -12 and 14 Enabled

X14 Result Codes 0 - 7, 10 -12 and 14 Enabled

Refer to Appendix D for an explanation of the result code sets listed above.

Y(n) Disconnect on Break

n is either 0 or 1

Factory default is 0

The Y command determines if the modem will respond to a disconnect signal, for non -PEP connections only.

Y Same as Y0.

Y0 Modem does not respond to a disconnect signal.

Y1 If the modem receives a continuous break signal from the remote modem for a period greater than or equal to 1.6 seconds, it disconnects. When commanded to hang up, the modem transmits a four second break signal then disconnects (goes on-hook).

Note: Y(n) only works in Emulation Mode.

Z(n) Reset

n is 0 - 2

Factory default is 0

The Z command disconnects the phone line and restores the active configuration to the appropriate user profile values stored in non-volatile memory.

Z Same as Z0.

Z0 Modem resets and recalls default user profile specified by the S255 register.

Z1 Modem resets and recalls User Profile A.

Z2 Modem resets and recalls User Profile B.

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&B Blind Command

The &B command disables the command processor within the modem, causing the modem to ignore any local commands. The modem will still return result codes if it isn't in quiet mode (Q0), and will continue to echo commands if the echo command is enabled (E1). If remote access is enabled (register S45 set to 255), the modem will process remote commands.

Since the modem no longer accepts local commands when in blind mode, the only way to exit blind mode is to turn the modem off and then on again. The blind option setting is not saved in the non-volatile memory.

&E(n) Recall EEPROM Operating Parameters

n is 0 - 2

This command loads the operating parameters stored in non-volatile memory into the operating registers. If the EEPROM checksum is incorrect, the modem will note the error and leave the operating parameters at the current settings.

The modem accepts any of the following &E commands:

- &E Same as &E0.
- &E0 Retrieve default user profile specified by the S255 register.
- &E1 Retrieve User Profile A.
- &E2 Retrieve User Profile B.

5B**&F(n) Recall Factory Configuration Parameters**

This command restores the factory default configuration parameters to the operating registers, according to the n value as follows:

- &F Same as &F0
- &F0 Enhanced Command Mode parameters
- &F1 Conventional Command Mode parameters
- &F2 Enhanced Command Mode, SDLC parameters
- &F3 V.32 Synchronous Mode with full duplex operation on switched (dial) lines.

&N(n) Display EEPROM Operating Parameters

n is 0 - 2

This command displays the operating parameters which are stored in non-volatile memory. The actual operating parameters will not be changed. If the EEPROM checksum is incorrect, the modem will note the error.

The modem accepts any of the following &N commands:

- &N Same as &N0.
- &N0 Display default user profile specified by the S255 register.
- &N1 Display User Profile A.
- &N2 Display User Profile B.

&P(n) Pulse Dialing Make/Break Ratio

n is either 0 or 1

Factory default is 0

The &P command is used to select the make/break ratio used when pulse dialing.

- &P Same as &P0.
- &P0 39% Make/61% Break ratio. US timing.
- &P1 33% Make/67% Break ratio. UK timing.

5B

&R(n) Force Retrain or Renegotiate

n is either 0 or 1

This command either: (a) forces the modem to re-evaluate the condition of the connection and adjust its data rate accordingly, or (b) causes the modem to renegotiate data compression and/or protocol support based on the current settings of the S110 and S111 registers at each end of the connection.

The modem will accept any of the following &R commands:

- &R Same as &R0.
- &R0 Force Retrain
- &R1 Renegotiate data compression and protocol support in PEP Mode only.

Any retrain that occurs within a minute of a previous retrain may cause the modem to reduce its data rate or to drop the carrier.

When an &R command is issued in V.22 bis mode, the modem will attempt to retrain its equalizer.

When an &R command is issued in V.32 mode, the modem will attempt to retrain.

When an &R1 command is issued while connected in PEP Mode, the modem immediately returns an OK response and begins renegotiating data compression and/or the protocol supported as described in the S110 and S111 register descriptions. Once the renegotiation is completed, the modem returns a CONNECT FAST message. When X3 is selected, the CONNECT message will indicate if data compression is enabled and which protocol (if any) is currently being supported.

The &R1 command should only be performed when the serial buffers are empty and there is no data transfer operation in process. Any data stored in the serial buffers while the renegotiation is in progress will be discarded.

The modem will return an ERROR in response to an &R1 if the remote modem's firmware does not provide data compression or protocol support; or a renegotiation is already in progress.

&T(n) Test Function n is 0 - 8

The &T command is used to determine if a communications problem is caused by the local modem or DTE, the remote modem or DTE, or the connections between the two sites. When the modem is performing a test function, its MR indicator blinks at a rate of approximately once per second.

To perform tests after establishing a connection, return to command mode by issuing the escape sequence (+++).

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Issue the appropriate &T command while in command mode.

- &T Same as &T0.
- &T0 This command disconnects the phone line and initiates the same internal diagnostic routines that are executed when the modem is turned ON. The results of the tests are displayed at the end of the tests, and can also be displayed by entering the I1 command. At the end of the tests, all parameters are restored to the values saved in the default user profile of non-volatile memory.

If the EEPROM checksum is incorrect, the factory default settings are used.
- &T1 This test checks the path between the local modem and DTE. Issue an &T1 command and type a few sentences. If the modem echoes your keyboard input as you type, the local DTE and modem are operating correctly. Terminate the test by issuing an escape sequence and &T2 command.
- &T2 Terminate the test in progress. You may need to issue the escape sequence (+++) to return to command mode prior to issuing an &T2. Entering the H0 (hang-up) or Z (reset) command will also terminate the test. The S18 register can be set to automatically terminate a test after a specific amount of time.
- &T3 This test checks the communication link and the remote modem. During this test the local modem sends incoming data directly back to the remote modem. Establish a connection with a remote modem, then issue an escape sequence and &T3 command. Ask the person at the remote system to type a few sentences. If the data is sent back to the remote system without errors, the remote modem and communication link are functioning correctly.
- &T4 Grant a test request from the remote modem.
- &T5 Deny a test request from the remote modem.
- &T6 This test checks the operation of both modems, the local DTE, and the telephone connection by commanding the remote modem to loop back data received from the local modem. The remote must be set to grant a test request (&T4). Establish a connection with the remote modem, then issue an escape sequence and &T6 command. After the command has been accepted, the modem will go back on-line. Type a few sentences.

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They will be sent directly back to your terminal without appearing on the remote terminal's screen. If the modem echoes your keyboard input as you type it, the modem is operating correctly.

&T7 The local modem sends a self test pattern to the remote modem which returns the test pattern to the local modem. The local modem examines the received test pattern and increments a counter each time an error is detected. The remote must be set to grant a test request (&T4). Establish a connection with the remote modem, then issue an escape sequence and &T7 command. When the test is terminated, a three-digit number is sent to the local DTE indicating the number of errors. If the error count is 000, the modems and telephone network passed the test. An error count of 255 indicates that 255 or more errors were detected.

&T8 The modem performs a local self test. This test may be performed without establishing a connection to another modem. When the test is terminated, a three-digit number is sent to the local DTE indicating the number of errors. If the error count is 000, the modem passed the test. An error count of 255 indicates that 255 or more errors were detected.

&W(n) Write Configuration Parameters

n is 0 - 2

This command stores the current operating parameters in the non-volatile memory for use when the modem is subsequently reset or powered off and on.

The modem accepts any of the following &W commands:

&W Same as &W0.

&W0 Writes current settings to profile specified by the value of the S255 register.

&W1 Writes current settings to Profile A.

&W2 Writes current settings to Profile B.

5B

% Remote Modem Access

This command allows a user to send commands to a remote modem as if the commands had been entered by the remote DTE. Remote access is only allowed if enabled on the remote modem (S45=255) and when operating in PEP transmission mode.

All commands following a “%” character to the end of the command line are directed to the remote modem. For example, the command:

AT%N?

reads the remote modem’s number directory and S Registers.

Responses from the remote modem are preceded by a “%” character and are controlled by the setting of the remote modem’s Q, V and X commands. If remote access is disabled on the remote modem (S45=0), the remote modem ignores the commands and no response is received from the remote modem. Note that the local modem responds with an OK to acknowledge that it has sent the remote command.

Local and remote commands can be entered on the same line. For example, to get the line noise data and frequency offset of the local modem, followed by the same information for the remote modem, enter:

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ATS76?S77?%S76?S77?

Remember that all commands following the “%” remote command prefix to the end of the command line are directed to the remote modem.

The local modem first processes the local commands and displays the local data. It then sends the remote commands to the remote modem, and displays an OK indicating that the command line has been processed. The remote modem processes the command and sends back the requested data. Completion of the remote command is signalled by a %OK response from the remote modem.

Once a remote command is issued, another remote command cannot be sent until the remote modem has finished processing the previous command.

Register Descriptions

You may change any of the modem's registers by using the Set Register Command $S(n)=(x)$. For example, the command $S0=5$ will set register 0's value to 5. The modem is reset to the values stored in the non-volatile memory if the power is turned OFF then ON, the modem is reset by a Z or &T command, or the DTR signal is turned off when the S52 register is set to 2.

Certain registers are applicable only to the PEP transmission mode. These consist of registers S45, S51 (unless S66 is set to 1), S54 (value 1 or 2), S70 through S76, and S121. See the S50 register description for an explanation of when the modem is in PEP mode.

All unused register numbers and parameters outside of the defined range are reserved for future expansion and may cause undesirable results if used.

The remainder of this section describes each of the Enhanced Command Mode registers. All numeric values are in decimal.

S0 Answer on Ring Number

Range: 0 - 255

Default: 0- Conventional, 1- Enhanced

The S0 register determines the number of rings after which the modem answers a call. The modem counts the number of rings and answers the call on the count contained in this register. $S0=0$ is used to disable auto-answer.

S1 Count of Rings

Range: 0 - 255

The S1 register contains the number of incoming rings that have occurred. If the modem does not answer, and if more than eight seconds have elapsed since the last ring, the count is reset to 0.

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- S2 Escape Character**
Range: ASCII Code 0 - 255
Default: ASCII Code 43 (+)

The S2 register contains the code to be interpreted as the escape character. See registers S12 and S55. If S48=0, setting this register to a value greater than 127 disables the recognition of the escape character by the modem.

- S3 Carriage Return Character**
Range: ASCII Code 0 - 96, 123 - 127
Default: ASCII Code 13

The S3 register contains the code to be interpreted as the carriage return character when in command mode. If the value stored in S3 is between 97 and 122 or greater than 127, the character will not be recognized by the modem.

- S4 Line Feed Character**
Range: ASCII Code 0 - 255
Default: ASCII Code 10

The S4 register contains the code to be output as the line feed character when in command mode.

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- S5 Backspace Character**
Range: ASCII Code 0 - 96, 123 - 127
Default: ASCII Code 8

The S5 register contains the code to be interpreted as the backspace character when in command mode. If the value stored in S3 is between 97 and 122 or greater than 127, the character will not be recognized by the modem. The preferred values for this register are ASCII Codes 0 through 31 or 127.

S6 Dial Tone Wait Time

Range: 2 - 255

Default: 2 seconds

The S6 register contains the length of time in seconds that the modem will wait for a dial tone when the W character is used in a D (Dial) command or before dialing the first digit in a dialing sequence.

S7 Wait For Carrier Time

Range: 1 - 255

Default: 40 - Enhanced, 30 - Conventional

The S7 register contains the time in seconds that the modem will wait for a valid carrier tone to be sent from the remote modem.

S8 Pause Time for Comma

Range: 0 - 255

Default: 2 seconds

The S8 register contains the time in seconds that the modem will wait when it encounters a comma in the command line.

S9 Carrier Detect Time

Range: 1 - 255

Default: 6 (600 msecs.)

The S9 register contains the length of time that the modem will wait before connecting to the phone line after a carrier has been detected in Low Speed Mode. Each count represents 100 milliseconds.

S10 Carrier Loss to Disconnect Time

Range: 1 - 255

Default: 7 - Enhanced, 14 - Conventional

The S10 register contains the amount of time the modem will wait after the carrier has been lost before disconnecting the line when in Low Speed Mode. Each count represents 100 milliseconds.

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S11 Touch Tone Timing

Range: 50 - 255

Default: 70 - Enhanced, 95 - Conventional

The S11 register contains the time in milliseconds of the duration and spacing of tones when tone dialing. The S11 register does not affect pulse dialing which is fixed at 100 milliseconds per pulse.

S12 Escape Sequence Guard Time

Range: 0 - 255

Default: 50 (1 second)

The escape sequence guard time is the time delay required immediately before and after entering the escape sequence. The guard time is in units of 20 milliseconds (1/50 second).

S18 Test Termination Timer

Range: 0 - 255

Default: 0

This register determines the length of time in seconds a diagnostic test will run before being automatically terminated. If the register is left at its factory default setting of 0, the timer will expire after one hour.

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S25 DTR Delay Timing

Range: 0 - 255

Default: 5 (50 msec.)

The modem ignores DTR level changes with a duration of less than the value specified by the S25 register. Each unit represents 10 milliseconds. When the modem is in Synchronous Mode 1, S25 determines the number of milliseconds after a data connection has been synchronized before the modem looks at the DTR line.

If DTR is TRUE at that time, the data connection will be established. If DTR is FALSE, the call will be dropped and the modem will return to Asynchronous Mode.

S26 RTS to CTS Delay Interval

Range: 0 - 255

Default: 0

This register affects synchronous operation only. When the S67=2 option is in effect, and the modem detects an OFF-to-ON transition of the RTS signal, the modem delays a period of time specified by this register before turning the CTS signal ON. The values in this register represents units of 100 milliseconds.

S38 Delay Before Disconnecting

Range: 0 - 255

Default: 0 - Enhanced, 20 - Conventional

When the modem receives a command to hang up in error control mode, it waits the amount of time in seconds specified by this register before disconnecting. This is required in error control mode to ensure that data in the modem's buffers is sent before the connection is terminated. If the timeout occurs before the buffered data is sent, a NO CARRIER result code is sent to the DTE indicating that data has been lost. If all data is transmitted before the timeout, an OK response is sent.

If S38 is set to 255, the modem does not timeout and continues to send data until the connection is lost or the buffers are empty.

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S41 Inactivity Timer

Range: 0 - 255

Default: 0

The S41 register specifies the amount of time in tenths of hours (six minutes per count) that the modem will allow the connection to be idle. If no data is received by either modem within the time specified by this register, the modem will disconnect the call. This prevents hung connections from running up an expensive connection cost. The register default setting of 0 disables the inactivity timer.

S45 Remote Access Enable

Range: 0 or 255

Default: 0

The S45 register enables or disables access to the control functions of the modem from a remote modem. When S45 is set to 0, remote access is disabled. To enable remote access, set S45 to 255. The remote access capability is only allowed when operating in PEP transmission mode. See % Remote Modem Access in Section 5B, *Enhanced Command Mode Descriptions*, for details on how to use remote access.

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S46 Callback Security

Range: 0 - 3

Default: 0

The S46 register determines the callback mode of the originating and answering modems. Possible contents of this register are the following:

- 0 Callback security disabled
- 1 Callback security enabled

- 2 Callback security enabled with password reverification
- 3 Pass through security enabled, no callback needed

When S46 register is set to 1, the modem prompts the caller for a password. If the password entered by the caller corresponds with a password listed in the number directory, the answering modem hangs up the phone, waits 10 seconds, and calls back the appropriate number indexed in the number directory.

When S46 is set to 2, the modem prompts the caller for a password. If the password is correct, the modem hangs up and re-dials the appropriate number and again prompts the original caller for the password. If the password is verified, the modem connects the caller to the DTE.

If S46 is set to 3, the modem prompts the caller for a password. If the password is correct, the caller is immediately connected to the DTE.

S47 DSR/DCD Delay Time

Range: 0 - 255

Default: 4 (200 msecs.)

The S47 register specifies the amount of time that DSR or DCD is held off when carrier is lost and S130 or S131 is set to 3. Each count represents 50 milliseconds. Refer to option 3 of the S130 and S131 register descriptions for additional information.

5C

S48 Eight Bit Comparison

Range: 0 or 1

Default: 0

The S48 register controls how the modem determines if a character sent by the local DTE is an XON, XOFF, or escape character.

Possible contents for this register are:

- 0 The most significant bit of the eight bit character received is set to 0 before comparing it with the value in the S2, S56, and S57 registers to determine if the character is an escape, XON or XOFF character, respectively.

As a result, if S2, S56 or S57 is set to a decimal value greater than 127, recognition of the character specified by the register is disabled.

- 1 All eight bits are compared with the value in the S2, S56 or S57 registers to determine if the character is an escape, XON or XOFF character. This register setting should only be used when the local DTE is using eight data bits with or without parity.

Note that if the local DTE is using a data format of seven data bits plus parity, The S48 register should be Set to 0 to mask the eighth bit when testing for escape, XON or XOFF. This permits end-to-end parity checking between DTEs, as well as allowing the modem to recognize Escape, XON and XOFF.

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S49 Product Identification String

Range: 0 - 2

Default: 0

The S49 register defines the product identification number reported by the IO command.

Possible contents for this register are:

- 0 The I/O command may report one of the following ID numbers:

961	Model RA12C
962	Model RA12E
963	Model RM12C
964	Model T18PC
965	Model T18SA , T2SAA or T2SAS
966	Model T18RMM
967	Model T2MC
968	Model T1SA
971	Model T25SA
972	Model T25RM

- 1 IO command reports "123" as Product ID number.
- 2 IO command returns 965ID code to make the modem appear as a TrailBlazer Plus to current software application programs.

S50 Transmission Mode

Range: 0 - 6, 254 - 255

Default: 0 - Enhanced, 254 - Conventional

The S50 register determines the data transfer method between modems. Possible contents for this register are:

- | | |
|-----|--|
| 0 | Automatic speed determination |
| 1 | 300 bps operation (Bell 103 or V.21 Mode) |
| 2 | 1200 bps operation (Bell 212A or V.22 Mode) |
| 3 | 2400 bps operation (V.22 bis Mode) |
| 4 | 300 bps operation (V.21 Mode) |
| 5 | 1200/75 bps operation (V.23 Mode) |
| 6 | 9600 bps operation (V.32 Mode) |
| 254 | Attempt to connect at speed of last AT command |
| 255 | FAST operation (PEP Mode) |

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If S94 is set to 0, the modem will connect only at the speed specified by the S50 register, whereas if the S94 register is set to 1, it will attempt to connect at any speed up to the maximum specified by the S50 register. The S94 register is ignored if the S50 register is set to 0 or 255.

If the S50 register is set to 0, the modem will automatically determine the appropriate data transmission method. Depending on the contents of the S90 and S92 registers, the modem will go through one of the following search sequences to arrive at the correct data transmission method:

S90=1 (CCITT Mode) S92=0

PEP
V.25 answer tone
V.32
V.22bis*
V.22*
V.21
V.23

S90=0 (Bell Mode) S92=0

PEP
V.25 answer tone
V.32
V.22bis*
Bell 212
Bell 103

*use of guard tones with V.22 mode depends on the contents register S91. If S91=0, no guard tone will be used. If S91=1, an 1800 Hz guard tone is used. If S91=2, a 550 Hz guard tone is used.

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Note: If the answering modem's S92 register is set to 1, the PEP answer tones will be presented at the end of the search sequence rather than the beginning. This allows the modem to connect with slower speed modems which are adversely affected by the PEP answer sequence. If S92=2, an additional V.25 answer tone will precede the sequence shown above. Refer to the S92 register description for additional information.

If the S50 register is set to 1, the modem checks the contents of the S90 register to determine whether Bell 103 or V.21 mode is used, and starts any search sequence at 300 bps.

If the S50 register is set to 2, the modem checks the contents of the S90 register to determine whether Bell 212A or V.22 mode is used, and starts any search sequence at 1200 bps.