



Telebit T1000
Reference Manual

90062-02 Rev. E

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Telebit T1000
Reference Manual

90062-02 Rev. E



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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 B computing device under Part 15 of the FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio 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 number 0.3 B.
 - Modular jack number USOC RJ11C.
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

1

This manual provides a comprehensive guide for setting up and using the Telebit T1000. It assumes that you are experienced with your computer or terminal, and that you have a basic understanding of data communications.

You can save yourself a lot of time if you start by following the instructions in the *T1000 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 *Fast Start Guide*, refer to this manual for additional information.

As you read through this manual, you will find that your T1000 is much more than a modem. In many ways it can serve as your desktop communications processor for dial-up applications.

Advanced modulation techniques used in the T1000 provide high speed data communications while ensuring error-free transmission regardless of line quality. The T1000 is capable of communicating at speeds up to four times faster than competitive modems operating at 2400 bps. It also compensates for line impairments which exist on dial-up connections. This high speed error-free transmission capability is achieved through the application of Telebit's unique Packetized Ensemble Protocol™ (PEP).

For maximum flexibility, the T1000 supports two user interface modes: Conventional and Enhanced Command Mode. In Conventional Command Mode, the T1000 works with most popular data communications software configured for Hayes® V-series™ modems. The Enhanced Command Mode allows access to an extended set of functions which are common to Telebit TrailBlazer® modems.

Some of the major features offered by the T1000 are discussed below:

1

Two Modes of Software Compatibility

The T1000 is configured at the factory to initially power-up in Conventional Command Mode. This allows the modem to be used with V-series compatible software without requiring any modifications. A special character provides access to the extra functions available in Enhanced Command Mode.

The T1000 can be easily reconfigured to operate in Enhanced Command Mode to take advantage of software designed explicitly for PEP modems, such as the Telebit TrailBlazer or T2000.

Packetized High Speed Data Transmission

Using the Packetized Ensemble Protocol (PEP), the T1000 can transmit or receive asynchronous data with a throughput of up to 9600 bps.

Compatibility with Slower Modems

For use with lower speed modems, the T1000 is compatible with the 300 bps Bell 103 and 1200 bps Bell 212A standards, as well as the 1200 bps V.22 and 2400 bps V.22bis standards.

Automatic Error Detection and Correction

While operating in PEP mode, the T1000 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.

MNP™ Support

The T1000 can be configured to support MNP Classes 1 through 5 while operating in Slow (non-PEP) mode. When a connection is established, the modems at each end automatically determine the highest MNP class supported by both modems.

1

Automatic Transmission Mode Selection

At the time a telephone connection is made, the T1000 automatically selects the correct transmission speed by matching the transmission mode of the remote modem. If the remote modem is a PEP modem, the T1000 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 T1000 automatically determines the correct transmission mode to use while communicating with the remote modem.

Adaptive Duplex™ for Maximum Throughput

In order to improve overall system performance, the T1000 provides an Adaptive Duplex capability while operating in PEP mode. This feature allows the T1000 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 T1000 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 T1000, a series of internal logic tests, memory tests, and internal loop back checks are performed. In addition, the T1000 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 T1000, 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 a call's progress.

Auto-Dial and Auto-Answer

The T1000's Dial command allows you to place the T1000 off-hook, have it wait for a dial tone, and then automatically dial a telephone number presented by the computer or terminal. The T1000 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 T1000 will automatically answer an incoming call, allowing you to leave the T1000 unattended.

Hardware and Software Flow Control

The T1000 lets you specify the method of data flow control when transmitting information. You can select a software protocol such as XON/XOFF and/or RTS/CTS flow control using the RS-232 control signals.

File Transfer Protocol Support

The T1000 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.

1



Chapter 2

Installation

2

The T1000 is designed to be used with a computer, terminal or other serial device via an asynchronous RS-232C serial interface. 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 T1000 by following the instructions in your *T1000 Fast Start Guide*, you do not need to continue this chapter.

Note

Before powering up your T1000, please carefully read Chapter 3, Using the T1000, to determine which command mode should be selected to ensure compatibility with your computer's data communications software.

Equipment Checklist

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

- The external power supply 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 Checklist

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.

- Before installing the T1000 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 *Initializing the Modem* and *Configuring the Modem* in Chapter 3.
- Verify that the modem's power switch (1/0) is turned off, then connect the external power supply. *Page 2-3.*
- Connect a shielded RS-232C cable between the modem and your equipment. *Page 2-3.*
- Connect the telephone line from the wall jack to the LINE connector on your modem. *Page 2-4.*
- If desired, connect your telephone to the PHONE connector on the modem. *Page 2-5.*
- Determine which command mode (Conventional or Enhanced) is appropriate for your specific requirements. *Page 3-3.*
- Power up and initialize the modem in either Conventional or Enhanced Command Mode. *Page 3-4.*

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.

Connecting the External Power Supply

An external 115 VAC power supply is provided with the modem. This external power supply provides the following DC voltages to the modem: +5V, +12V, and -12V.

Warning

To avoid damaging the modem, only use the external power supply provided with your T1000.

To connect the external power supply to your modem:

1. Verify that the power switch (1/0) on the rear of the modem is turned off.
2. Attach the power cord to the connector labeled PWR (power) on the rear panel of the modem.
3. Plug the other end of the power cord into a grounded AC wall outlet.

Connecting the RS-232C Cable

A DB-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 RS-232C, 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.

2

Attach one end of the provided telephone cable to the LINE connector on the rear panel of the modem. Attach the other end to your telephone wall jack.

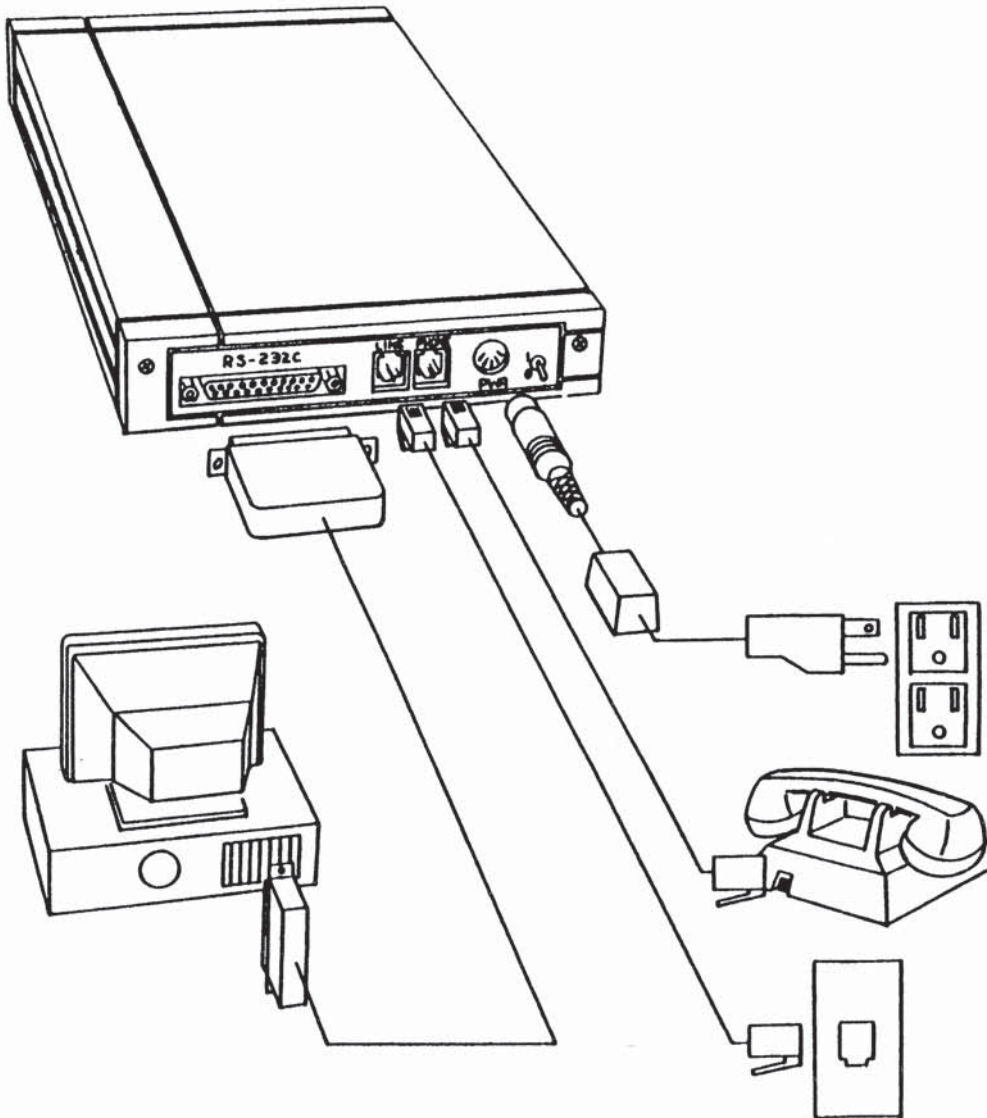


Figure 2-1. T1000 Cable Connections

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.

2

After Completing the Installation

Before powering up your T1000, read Chapter 3, *Using the T1000*, to determine which command mode should be selected to ensure compatibility with your computer's data communications software.



Chapter 3

Using the T1000

3

This chapter presents a general overview of the T1000 operating characteristics, and shows you how to enter commands to set parameters and control the modem's operation.

It is assumed that you have installed the T1000 by following the instructions in the *T1000 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 command or by reinitializing the modem as described later in this chapter.

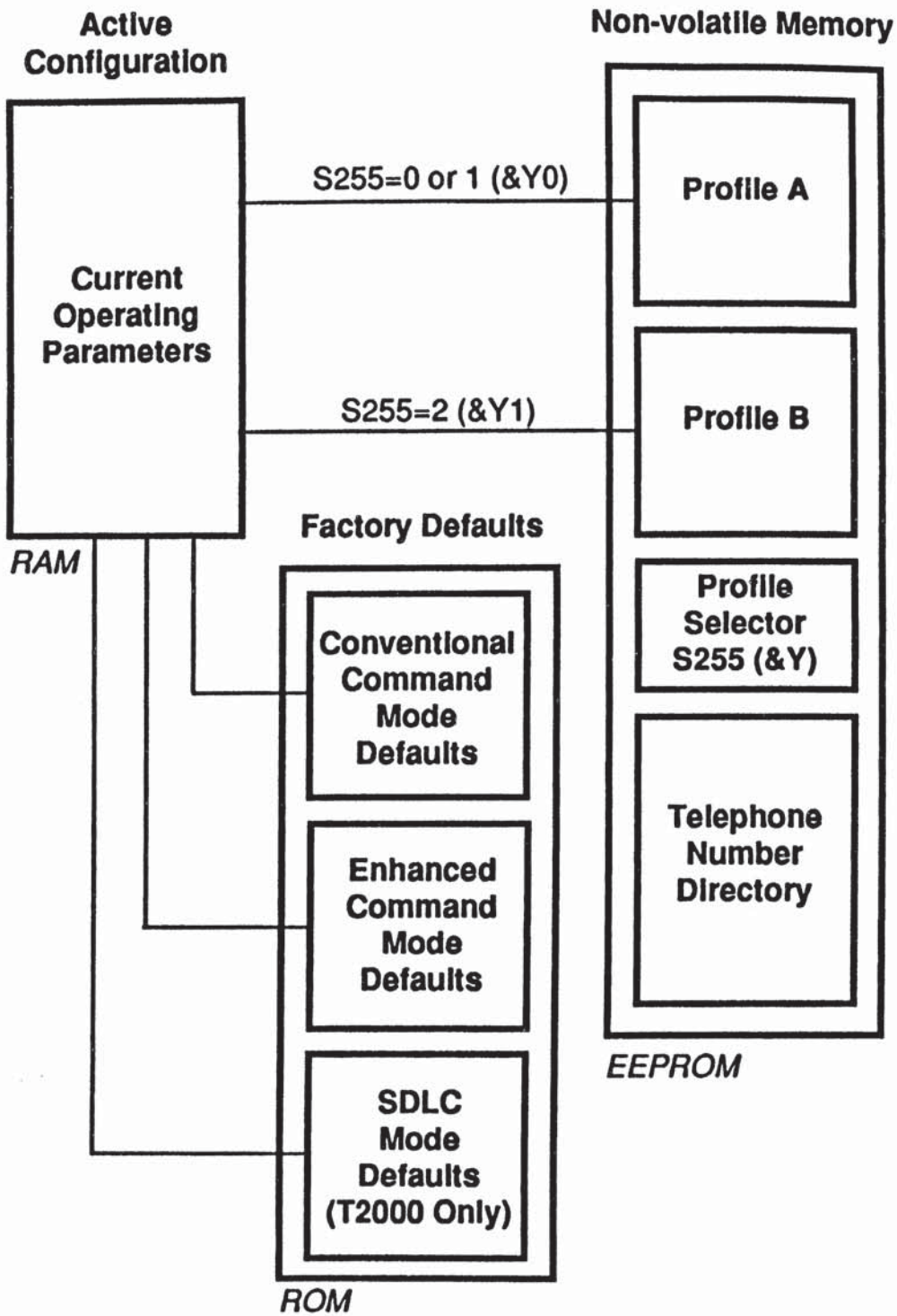


Figure 3-1. Memory Organization

The current operating parameters can be modified and saved in non-volatile memory as Profile A or Profile B via an &W(n) command. A selected profile can be restored to the active configuration by issuing an &E(n) or Z(n) command in Enhanced Command Mode, or by issuing a Z(n) command in Conventional Command Mode. When a selected profile is restored, its settings replace the current operating parameters.

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 a (n) parameter.

Selecting Conventional or Enhanced Command Mode

Before powering up your T1000, you should determine which command mode will assure compatibility with your computer's data communications software.

Conventional Command Mode is designed for software that does not have the ability to utilize the special features of PEP modems. This is typically indicated by the absence of modem-specific setup options, or applications that assume general Hayes command compatibility. The T1000 Conventional Command Mode should be compatible with any data communications software that supports Hayes V-series modems.

Enhanced Command Mode allows the T1000 to be compatible with software designed explicitly for PEP modems. If your application provides support of the advanced features of PEP modems, such as the TrailBlazer Plus or T2000, then the T1000 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.

Powering Up the Modem

The power switch (1/0), mounted on the rear of the modem, is used to turn the modem ON or OFF. Each time it is turned on, the modem 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.

Initializing the Modem

The modem is shipped from the factory initialized to power up in Conventional Command Mode. If you have determined that this is most appropriate for your computer's data communications software, then no special action is necessary, provided that no one has changed the non-volatile memory.

Conventional Command Mode

To ensure that the modem is operating in Conventional Command Mode, you can reset the modem after the power is turned on by performing the following steps:

1. Turn on the modem.
2. Remove the flexible plastic label on the front panel. See Figure 3-2.
3. Press the reset switch by inserting a straightened paper clip in the hole marked RESET. Be sure to hold the reset switch in until the MR indicator goes off, then turns back on.

This stores the factory defaults in Profile A of non-volatile memory, and designates Profile A as the power up default. The factory 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.

To take advantage of the modem features which normally are not accessible in Conventional Command Mode, a special access character (~) allows you to enter Enhanced Command Mode commands while remaining in Conventional Command Mode.

If you will be using data communications software which supports Hayes V-series modems, follow the instructions in your software manual to configure and use the modem. Configuration guidelines and descriptions of the commands and registers are presented in Chapter 4, *Conventional Command Mode*, and Chapter 5, *Enhanced Command Mode*.

3

Enhanced Command Mode

If you have decided that Enhanced Command Mode is preferable, then press the hidden reset switch while turning on the power as described below:

1. Start with the modem power turned off.
2. Remove the flexible plastic label on the front panel. See Figure 3-2.
3. Using a straightened paper clip, press and hold the reset switch while turning on the power. Be sure to hold the reset switch in until the MR indicator is lit.

This stores the Enhanced Command Mode default settings in Profile A of non-volatile memory, and designates Profile A as the power up default. 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 for Technical Support to remotely access your modem.

If you will be using data communications software which supports PEP modems such as the T1000, T2000 or TrailBlazer Plus, follow the instructions in your software manual to configure and use the modem. Refer to Chapter 5, *Enhanced Command Mode*, for detailed descriptions of the commands and registers used in Enhanced Command Mode.

3

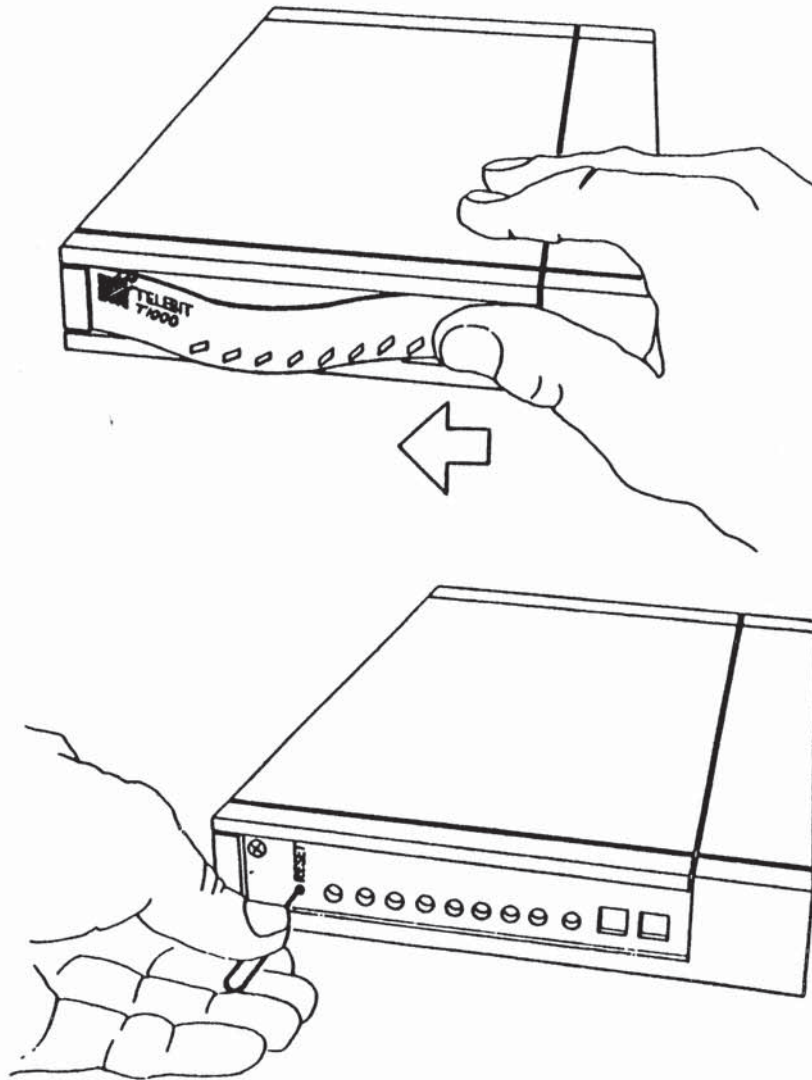


Figure 3-2. Reset Switch Location

Status Indicators

A series of LED indicators, mounted on the modem's front panel, show the current operating status of the modem. These indicators are described in Table 3-1.

Table 3-1. Status Indicators

FST	Fast Mode - Indicates that the modem is operating in fast transmission mode using the Packetized Ensemble Protocol (PEP).
SLW	Slow Mode - Indicates that the modem is operating in Bell 103, Bell 212A, V.22 or V.22 bis mode.
OH	Off Hook - Indicates that the modem is using the telephone line. The OH indicator flashes on and off when a ringing signal is detected.
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 computer or terminal. When the indicator is lit, the modem will accept data from the terminal or computer 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 establish communications.
MR	Modem Ready - Indicates that the modem is operational.

Command Mode Operation

In command mode, the modem processes data received through the serial interface port as instructions to perform various commands. The command set used by the T1000 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.
- The modem cannot successfully complete a call, the remote modem's data carrier is dropped, or the telephone line is disconnected.
- 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 T1000 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 &Q5 S36=1 is identical to entering ~S95=2. Appendix C summarizes the command and register equivalents.

3

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 canceled 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:

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

Note that the hyphens in the above examples are optional since the modem ignores hyphens, parentheses, slashes, periods and spaces in the Dial command.

Using the Auto Answer Feature

The modem automatically answers an incoming call after a 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.

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

Chapter 4

Conventional Command Mode

This chapter assumes that you have initialized the modem 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 T1000 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

Conventional Command Mode

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

A

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.

If you have initialized the modem by pressing the reset switch while the power is on, 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.

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 command is set to N0, use speed of last AT command. If N command is set to N1, 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 mode).
- S37=4** Reserved.
- S37=5** Limit the 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 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 when the N command is set to N1.
- S37=8** Reserved.
- S37=9** Attempt to connect in PEP mode. If unsuccessful, fall back to slower speed when the N command is set to N1.

When communicating with another modem in PEP mode, the modem can transmit error-free data with a throughput of up to 9600 bps. The modem dynamically adjusts its speed based on the quality of the connection.

Conventional Command Mode

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:

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

Serial Port Interface Speed and Flow Control

A

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

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.

4A

RS-232 Control Signal Interpretations

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

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.

Conventional Command Mode

- &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.

A

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 always on.
- &S1** The DSR signal is turned on when the modem is connected and ready to communicate with a remote modem.

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.

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:

- Kermit
- X/Ymodem
- UUCP

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

Setting the S111 register to 255 allows the modem to support the protocol specified by the remote modem. 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.

MNP Support

The modem can be configured via the `&Q5` command and S36 register to provide MNP support while operating in Slow (Non-PEP) mode. Classes 1 through 5 are supported. To limit MNP support to Classes 1 through 4 (no 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.

A

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.

Conventional Command Mode

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, reinitialize the modem in 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.

B

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) 1200 bps Mode Selection

n is either 0 or 1

Factory default is 1

The B command is used to select either CCITT V.22 or Bell standards while operating at 1200 bps transmission mode.

- B Same as B0.
- B0 Use CCITT V.22 standard for 1200 bps transmission.
- B1 Use Bell 212A standard for 1200 bps transmission.

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

4B 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

- 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.

4B

- 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

Conventional Command Mode

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

4B 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 1200 bps, the modem will reference the present setting of the B command to select either the Bell 212A or CCITT V.22 communication standard.

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.

4B

Conventional Command Mode

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.

B

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 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.
- 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.

4B

Conventional Command Mode

Y(n) Disconnect on Break

n is either 0 or 1

Factory default is 0

The Y command determines how the modem will respond to a break signal when connected in Slow (non-PEP) mode.

Y Same as Y0.

Y0 Modem does not respond to a break 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).

B

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 parameters in the operating registers. ~&F restores the Enhanced Command Mode factory defaults.

&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

Factory default is 0

The &J command designates the type of jack used to connect the modem to the telephone. Since the modem's hardware only supports RJ-11 jacks, the modem will not accept any &J command other than &J0.

&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).

B

&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.

&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.

4B**&M(n) Communication Mode Selection**

The &M command determines the operating mode (asynchronous or synchronous) of the modem. Since the modem only supports asynchronous mode, the modem will not accept any &M command other than &M0. The &M0 command is equivalent to &Q0.

&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.

Conventional Command Mode

&Q(n) Communication Mode Selection

n is either 0 or 5

Factory default is 5

The modem can be configured for either normal asynchronous mode or error control mode.

&Q Same as &Q0.

&Q0 Normal Asynchronous Mode. This command is equivalent to &M0.

&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 on 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.

&R(n) RTS/CTS Signal Interpretation

n is either 0 or 1

Factory default is 0

This command is provided for synchronous operation which is not supported by the modem. Although the modem will accept an &R0 or &R1 command, it always reports &R0 in response to an &V command. CTS is always on except when RTS/CTS flow control is in use.

4B

&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 turned ON when an 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.

&T(n) Test Function

n is 0 - 8

Factory default is 4

4B

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.

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- &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.
- &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.

4B

&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

4B

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.

&X Transmit Clock Source

Factory default is 0

This command is provided for synchronous operation which is not supported by the modem. Attempting to change this command setting will result in an ERROR.

Conventional Command Mode

&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 that an **&F** command will not change the setting of this register.

&Z(n)=(x) Set Number Directory n is 0 - 3

B

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. Entering a space between **&Z(n)** and the equal sign will cause an ERROR.

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: 0

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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 doesn't 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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The only ways to disconnect a call when the escape code is disabled and the Y command (Disconnect on Break) is set to Y0 are to: unplug the phone line; have the remote modem hang up; turn off the modem; or if the &D command is set to &D2, turn off the DTR signal.

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.

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S4 Line Feed Character

Range: ASCII Code 0 - 255

Default: ASCII Code 10

The S4 register contains the code to be interpreted 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.

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. 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.

C 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).

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.

S26 - 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.

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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

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. 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 Mode).
- 4 Reserved.
- 5 Limit speed to 1200 bps maximum (Bell 212A or V.22 Mode).
- 6 Limit speed to 2400 bps maximum (V.22 bis Mode).
- 7 Attempt to connect in PEP Mode.
- 8 Reserved.
- 9 Attempt to connect in PEP Mode.

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S38 Delay Before Disconnecting

Range: 0 - 255

Default: 20 seconds

When the modem receives a command to hang up, 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.

Chapter 5

Enhanced Command Mode

This chapter assumes that you have initialized the modem as described in Chapter 3. If you selected Enhanced Command Mode and are using data communications software which supports PEP modems such as the TrailBlazer Plus, T2000 or T1000, you do not need to proceed with this manual. Instead, follow the instructions in your communications software manual.

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.

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.

5A

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.

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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

~&F	Restore Enhanced Command Mode defaults to ensure that the modem is in a normalized state before changing parameters.
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: 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.

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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	Assert DSR when a valid data carrier is detected.
S131=1	Assert DCD when a valid data carrier is detected.
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 9600 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)
- S50=2 1200 bps operation (Bell 212A or V.22)
- S50=3 2400 bps operation (V.22bis)
- S50=254 Match speed of last AT command
- S50=255 Operate in PEP mode

A 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 212A or CCITT V.22 answer tones for 1200 bps operation as follows:

- S90=0 Use Bell 212A answer tones
- S90=1 Use CCITT V.22 answer tones

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

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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.

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 Slow (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 Slow 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.

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.

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- 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.

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.

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When XON/XOFF flow control is used, recognition of the XON and XOFF characters is controlled by the S56, S57 and S48 registers. 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, 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 S52, S104 and S25 register control how the modem interprets the DTR (Data Terminal Ready) control signal sent from the DTE as follows:

- 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 except that 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. The modem does not recognize DTR level changes with a duration less than the time specified by the S25 register.
- S52=4 Same as S52=3 except that 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=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.

DSR Signal Handling

The S130 register determines how the modem handles the DSR (Data Set Ready) control signal as follows:

- S130=0 DSR is always on.
- S130=1 DSR is turned on when an answer tone is detected while originating a call or when an answer tone is transmitted while answering a call.
- S130=2 DSR is turned on when the modem is ready to accept commands or data.

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- S130=3 DSR is turned on when the modem is ready to accept commands or data. When the carrier is lost DSR is turned off for the amount of time specified by the S47 register.
- 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.

DCD Signal Handling

The S131 register determines 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 off for the amount of time specified by S47.

5A

CTS Signal Handling

The S67 register determines how the modem uses 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.

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 ignores the break signal.

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.

5A

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.

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

A

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 Slow (Non-PEP) Mode. 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:

<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.
1 or 2	1	MNP 3, 4 and 5 enabled.

A

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.

5B

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.

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 Slow Mode. 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 # * 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, but are not required.

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 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.

B

The characters listed below 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.

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 Slow Mode.

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Enhanced Command 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

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

5B

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.

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 Mode
1200	Connected in Bell 212A or V.22 Mode
2400	Connected in V.22bis 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.

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Enhanced Command Mode

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.

A "4" causes the modem to return the negotiated (currently active) values for the following registers:

- S95 MNP Operating Mode
- S96 MNP Data Compression Enable
- S110 Data Compression Enable
- S111 File Transfer Protocol Support
- S121 Echo Suppressor Compensation

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

J Reserved

This command is reserved for factory use only.

5B 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\
```

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:

```
AT N1=555-6789\S7=10
```

N(n)? Display Number

n is 0-9

5B

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.

O On-Line

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 (4 for Rackmount Version)

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

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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. The modem will return OK and ERROR result codes in command mode.

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.

5B

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.

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 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.

B

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:

- X Same as X0.
- 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
- X13 Result Codes 0 - 5, 7, 10 -12 and 14 Enabled
- X14 Result Codes 0 - 7, 10 -12 and 14 Enabled

See 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 break signal when connected in Slow (non-PEP) mode.

- Y Same as Y0.
- Y0 Modem does not respond to a break 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).

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Enhanced Command 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.

&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.

B *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.

&F(n) Recall Factory Configuration Parameters
n is 0 - 1

This command restores the factory default parameters to the operating registers. The modem accepts any of the following &F commands:

- &F Same as &F0.
- &F0 Restore Enhanced Command Mode factory defaults.
- &F1 Restore Conventional Command Mode factory defaults.

&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.

Enhanced Command Mode

&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.

&R(n) Force Retrain or Renegotiate

n is either 0 or 1

This command either (1) forces the modem to re-evaluate the condition of the connection and adjust its data rate accordingly, or (2) causes the modem to renegotiate the protocol supported based on the current setting of the S111 register 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 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 &R1 command is issued while connected in PEP Mode, the modem immediately returns an OK response and begins renegotiating the protocol supported as described in the S111 register description. Once the renegotiation is completed, the modem returns a CONNECT FAST message. When X3 is selected, the CONNECT message will indicate which protocol (if any) is currently being supported.

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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 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 (+++).

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.

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Enhanced Command Mode

- &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. 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.

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&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.

% 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.

5B

Enhanced Command Mode

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:

```
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.

For information on enabling a modem for remote access, see the description for the S45 register in Section 5C, *Register Descriptions*.

5B

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 and cannot be set otherwise. 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.

5C

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. 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.

The only ways to disconnect a call when the escape code is disabled and S54 (Break Signal Interpretation) is non-zero are to: unplug the phone line; have the remote modem hang up; turn off the modem; or if S52=1, turn off the DTR signal.

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 interpreted as the line feed character when in command mode.

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 S5 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 32 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 before checking for a dial tone when the W character is used in a D (Dial) command or before blind dialing the first digit in a dialing sequence. Refer to Appendix D for an explanation of when blind dialing is used.

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 Slow 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 Slow mode. Each count represents 100 milliseconds.

5C

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.



S25 DTR Delay Timing

Range: 0 - 255

Default: 5 (50 msec.)

If S52 (DTR Interpretation) is set to 3 or 4, the modem ignores DTR level changes with a duration of less than the value specified by the S25 register. Each unit represents 10 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.

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.

5C**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 for details on how to use remote access.

S47 DSR/DCD Delay Time

Range: 0 - 255

Default: 4 (200 msec.)

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.

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.

S49 Product Identification String

Range: 0 or 1

Default: 0

The S49 register defines the product ID number reported by the I0 command. Possible contents for this register are:

- 0 The I0 command may report one of the following ID numbers:
 - 961 Model RA12C
 - 962 Model RA12E
 - 963 Model RM12C
 - 964 Model T18PC, CellBlazer PC, or T1PC
 - 965 Model T18SA, T2SAA, T2SAS, or CellBlazer
 - 966 Model T18RMM
 - 967 Model T2MC
 - 968 Model T1SA
 - 971 Model T25SA
 - 972 Model T25RM
- 1 I0 command reports "123" as Product ID number.

S50 Transmission Mode

Range: 0 - 3, 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 Mode)
- 2 1200 bps operation (Bell 212A or V.22 Mode)
- 3 2400 bps operation (V.22 bis Mode)
- 254 Attempt to connect at speed of last AT command
- 255 FAST operation (PEP Mode)

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.

5C

Enhanced Command Mode

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 S91 registers, the modem will go through one of the following search sequences to arrive at the correct data transmission method:

<u>S90</u>	<u>S91</u>	<u>Search Sequence</u>
0	X	PEP, V.22 bis, 212A, 103
1	0	PEP, V.22 bis, V.22 with no guard tone
1	1	PEP, V.22 bis, V.22 with 1800 Hz guard tone
1	2	PEP, V.22 bis, V.22 with 550 Hz guard tone

Note that 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. Refer to the S92 register description for additional information.

If the S50 register is set to 1, the modem operates in Bell 103 mode.

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.

If the S50 register is set to 3, the modem operates in V.22 bis mode.

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When the S50 register is set to either 2 or 3, the modem checks the S91 register to determine if and what type of guard tone should be transmitted with the data in answer mode. The V.25 answer sequence is used while in V.22 or V.22 bis mode. Refer to the descriptions of the S90 and S91 registers for more information.

If the S50 register is set to 254, the modem will automatically search for the correct transmission speed starting with the speed of the last AT command. For example, if the last AT command was entered at 2400 bps, the modem would attempt to connect at 2400 bps followed by 1200 bps and finally 300 bps. A PEP connection would only be attempted if the last AT command was issued at a speed greater than 2400 bps.

If the S50 register is set to 255, the modem uses the Packetized Ensemble Protocol to establish a connection in PEP mode.

S51 Interface Speed

Range: 0 - 5, 252, 254 or 255

Default: 255 - Enhanced, 252 - Conventional

The S51 register determines the data rate between the modem and the local DTE.

When the connection is made in Slow mode and flow control is not enabled (S66=0 or S66=2 and a non-MNP connection is established), the local DTE must be set to match the modem's transmission speed indicated by the CONNECT XXXX result code. Failure to do so will result in erroneous data. When the connection is terminated, the speed reverts to that specified by S51, unless S51 is set to 252, 254 or 255 (auto speed select).

Possible contents for this register are:

0	300 bps
1	1200 bps
2	2400 bps
3	4800 bps
4	9600 bps
5	19200 bps
252	Automatic speed select; type-ahead not permitted
254	Automatic speed select; type-ahead permitted; default to 19200 bps
255	Automatic speed select; type-ahead permitted; default to 9600 bps

5C

One of the following data formats should be used:

8-bit data with no parity

7-bit data with even/odd parity

7-bit data with mark/space parity

Enhanced Command Mode

When S51 is set to 252, the modem examines each AT prefix to derive the current interface speed, and a new command line may not be entered until the result code from the previous command is displayed. If no command lines have been entered after powering on, 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.

When the modem is reset and S63=2 (Conventional Command Mode) in the selected user profile of non-volatile memory, the S51 register is forced to 252.

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 on or reset.
- S51 is set to 254 or 255 while in command mode.
- A break is sent to the modem from the local DTE while the modem is 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: time to connect has expired, dial command is aborted, or the carrier is lost.

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Since the interface speed is not checked after each command line, multiple command lines can be entered without waiting for the results from the previous command.

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

S52 DTR Interpretation

Range: 0 - 4

Default: 0

The S52 register defines the interpretation of the Data Terminal Ready (DTR) signal.

Possible contents for this register are:

- 0 Modem assumes that DTR is always true.
- 1 Modem hangs up if DTR is turned off. Modem will not auto-answer if DTR is off.
- 2 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 the S255 register. Modem will not auto-answer if DTR is off.
- 3 Modem enters command mode when an on-to-off transition of DTR is detected.
- 4 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.

If S52 is set to 3 or 4, the modem will ignore DTR level changes with a duration of less than the time specified by the S25 register.

S54 Break Signal Interpretation

Range: 0 - 4

Default: 0 - Enhanced, 3 - Conventional

The S54 register defines the modem's response when a break signal is transmitted by the local DTE. When the modem is operating in PEP mode, its response to a break signal is as follows:

- 0 If the modem is in data mode, it switches to command mode. If it is already in command mode, it remains in command mode.
- 1 Reserved.
- 2 The modem immediately sends a break signal to the remote DTE.
- 3 If the modem is in data mode, it sends a break signal to the remote DTE in sequence with the data stream. If it is in command mode, it immediately sends the break signal.
- 4 The modem discards the break signal.

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Enhanced Command Mode

If the modem is operating in Slow mode, and S54 is set to 0 or 4, the modem responds the same as in PEP mode. Otherwise, when the local DTE sends a break signal, the modem sends a break to the remote DTE.

Regardless of the setting of the S54 register, when the remote modem receives a break over the phone lines in PEP mode, it discards the data buffered to send to the local modem.

The length of the break signal sent to the remote DTE is controlled by the remote S62 register.

S55 Escape Character/Sequence Interpretation

Range: 0 - 3

Default: 0

The S55 register defines the modem's response when you enter an escape sequence or the escape character defined in the S2 register. An escape sequence is a series of three consecutive escape characters and is used only while in data mode to enter command mode. The following cases describe the action taken by the modem when the local DTE sends the escape character.

- 0 The modem enters command mode only after the escape sequence with the proper guard time (defined by the S12 register) has been entered. It also sends each of the escape characters to the remote DTE. If the modem is already in command mode, it remains in command mode.
- 1 The modem discards data in its data buffers and sends the escape *character* to the remote DTE.
- 2 The modem immediately sends the escape *character* to the remote DTE.
- 3 The modem sends the escape *character* to the remote DTE in sequence with the data stream. If the modem is in command mode, it immediately sends the escape *character* to the remote DTE.

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S56 XON Character

Range: ASCII Code 0 - 255

Default: ASCII Code 17 (CTRL-Q)

The S56 register defines the character to be used for resuming data flow when S58 or S68 is set to 3, 4 or 6. If S48=0, setting this register to a value greater than 127 disables the recognition of the XON character by the modem.

S57 XOFF Character

Range: ASCII Code 0 - 255

Default: ASCII Code 19 (CTRL-S)

The S57 register defines the character to be used for suspending data flow when S58 or S68 is set to 3, 4 or 6. If S48=0, setting this register to a value greater than 127 disables the recognition of the XOFF character by the modem.

**S58 Flow Control Used by DTE
(Data Terminal Equipment)**

Range: 0 - 7

Default: 3 - Enhanced, 2 - Conventional

The S58 register determines the method of flow control used by the local DTE to control the flow of data coming from the modem when operating in PEP mode, or when S66=1 or S66=2 and an error-control connection (PEP or MNP) is established.

A similar register, S68, controls the flow of data in the opposite direction i.e. from the local DTE to the modem.

Possible contents of this register are:

- 0 No flow control is used. (Not recommended.)
- 1 Use RTS/CTS flow control in half duplex mode. When the local DTE turns on RTS, the modem responds by turning on CTS. The modem will receive data from the local DTE. When the local DTE turns off RTS, the modem turns off CTS and will send buffered data to the local DTE.

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Enhanced Command Mode

- 2 Use full duplex RTS/CTS flow control. When RTS is off, the modem will not send data to the local DTE. When RTS is on, the modem will send data to the local DTE.
- 3 Use XON/XOFF flow control. If an XOFF is received by the modem, it will stop sending data to the local DTE until an XON is received. The XON and XOFF characters used for flow control are defined by the S56 and S57 registers, respectively. The S48 register defines how the modem determines if an XON or XOFF is received when a eight bit data format is used.
- 4 Use both XON/XOFF flow control and full duplex RTS/CTS flow control. If an XOFF is received or if RTS is off, the modem will stop sending data to the local DTE. Sending is resumed when RTS is turned on or an XON is received.
- 5 Use ENQ/ACK flow control. Note that this option is intended for use with some Hewlett Packard computers in PEP mode only. To operate correctly, the remote modem's S68 register must also be configured to use ENQ/ACK flow control. When an ENQ is received from the remote modem and sent to the local DTE, the modem will stop sending data to the local DTE until an ACK is received from the local DTE. The ACK from the local DTE is not passed to the remote modem.

In Slow (non-PEP) mode, no flow control is used and ENQ/ACKs are passed to the remote modem.
- 6 Use ENQ/ACK and XON/XOFF. The modem will stop sending data to the local DTE if an ENQ is received from the remote modem and passed on to the local DTE, or if an XOFF is received from the local DTE. The modem will not resume sending data to the local DTE until an ACK has been received for any outstanding ENQ and an XON has been received for any previously received XOFF.

When connected in Slow (Non-PEP) mode, only XON/XOFF flow control is used. ENQ/ACKs are passed to the remote modem.
- 7 Use transparent XON/XOFF flow control. This method provides a way to send XON/XOFF characters as data rather than being interpreted as control characters when Hayes' Smartcom III software is used. Register S68 should be set to 255 when this option is selected.



S59 Prompt Character

Range: ASCII Code 0 - 255

Default: 0

The S59 register contains the character which is used as a prompt character when in command mode. If no prompt is desired, a 0 should be entered.

S61 Speaker Volume

Range: 0 - 255

Default: 150

The index specified in this register will determine the speaker volume when it is enabled. When S61 is set to 0, the speaker is turned off. The speaker volume is low at 1-99, medium at 100-199, and high at 200-255.

S62 Break Length Time

Range: 2 - 255

Default: 3 (150 msec.)

The contents of the S62 register determines the length of time a break signal will be placed on the Receive Data (RD) line when received from the remote modem. Each count represents 50 milliseconds.

S63 Command Mode Selection

Range: 0 - 2

Default: 1 - Enhanced, 2 - Conventional

The S63 register is used to select either Conventional or Enhanced Command Mode, or to disable the requirement for the AT attention code. This register can only be accessed in Enhanced Command Mode or by entering an ~S63=n command in Conventional Command Mode.

5C

Enhanced Command Mode

Changes to this register take effect immediately. This means that an $\sim S63=0$ or 1 command will cause the modem to process any subsequent commands contained in the same line in Enhanced Command Mode. Similarly, any commands contained in the same line following an $S63=2$ will be processed in Conventional Command Mode.

Possible contents for this register are:

- 0 AT prefix not allowed and Enhanced Command Mode selected.
- 1 AT prefix required and Enhanced Command Mode selected.
- 2 AT prefix required and Conventional Command Mode selected.

If the content of the S63 register is a 0, the modem treats all characters as commands and operates on the "AT" as two separate commands. The repeat last command (A/ or a/) option cannot be used when $S63=0$. If the content of the register is a 1 or 2, the modem will require the "AT" or "at" to be entered at the beginning of each command line.

When selecting a primary command mode for compatibility with your computer's data communications software, there are several other associated parameters that must also be changed. The best way to accomplish this is via the initialization procedures. However, you can initialize the modem using commands as described below.

5C

To initialize the modem for Enhanced Command Mode enter:

```
AT ~&F &W1 &W2
```

To initialize the modem for Conventional Command Mode enter the following command line:

```
AT ~&F S63=2 &F &W0 &W1 &Y0
```

When the modem is reset and S63 is set to 2 in the selected user profile of non-volatile memory, the S51 register is forced to 252.

S64 Dial/Answer Sequence Abort

Range: 0 or 1

Default: 0

The S64 register controls whether or not the modem will abort a dialing or answering sequence if characters are transmitted by the local DTE before a connection is established.

Possible contents for this register are:

- 0 Abort the dialing or answering sequence if characters transmitted by the local DTE before a connection is established.
- 1 Ignore any characters sent by the local DTE while dialing or answering a call.

S65 XON/XOFF Fallsafe

Range: 0 or 1

Default: 0

The S65 register allows the modem to reissue one or more XOFF control characters over the serial interface if the local DTE continues to transmit data after an XOFF has been issued.

Possible contents for this register are:

- 0 Use normal XON/XOFF flow control.
- 1 Use failsafe XON/XOFF flow control. The modem will issue an XOFF when the flow control threshold is reached, and once again for every five characters subsequently sent by the local DTE.

Note that this register is only valid when the modem is using XON/XOFF flow control. The S68 register must be set to 3, 4, 6 or 255 (when S58 is set to 3, 4 or 6).

5C

S66 Lock Interface Speed

Range: 0 - 2

Default: 0 - Enhanced, 2 - Conventional

The S66 register controls whether or not the DTE interface speed is maintained and flow control is performed in 103, 212A, V.22 or V.22 bis mode. This register should be configured before attempting to connect in Slow mode. Possible contents for this register are:

- 0 Change interface speed to match connection and do not use flow control when a connection is made in Slow mode.
- 1 Lock interface speed and use flow control in Slow mode.
- 2 Lock interface speed and use flow control in Slow mode if MNP connection is established. Do not use flow control in command mode. For non-MNP connections, the interface speed will change to match the speed of the connection and no flow control will be used.

If S66 is set to 0 and a connection is made in Slow mode, the modem forces the serial interface speed to match the speed of the connection (300, 1200 or 2400 bps) and does no flow control. The local DTE interface must also be change to match the speed of the connection or data will be garbled. If S66 is set to 1 or 2, the local DTE must support the flow control method specified by the S58 and S68 register; otherwise data will be lost.



**S67 Clear to Send (CTS)
Signal Interpretation**

Range: 0 or 1

Default: 0

The S67 register defines how the modem uses Clear To Send (CTS) in relationship to Request To Send (RTS) and carrier detected. This register allows you to make the RTS-CTS signals behave like that of a conventional non-intelligent modem. This register's effect on the CTS signaling depends on the setting of the S58 and S68 registers.

If S58 is set to 1, the content of the S67 register is ignored, and the modem operates in half duplex mode. Refer to the S58 register description for information on half duplex operation.

If S58 is set to some value other than 1, then the content of the S67 register determines how the modem generates the CTS control signal:

- 0 If full duplex RTS/CTS flow control is used, CTS is used to control the data flow as described for the S68 register. If full duplex RTS/CTS flow control is not used, CTS is always on.
- 1 CTS turns on 200 milliseconds after the RTS signal goes active provided a carrier is present. If the carrier is dropped, CTS will turn off. If full duplex RTS/CTS flow control is used, CTS is used for data flow control as described for the S68 register.

Full duplex RTS/CTS flow control is used when S68 is set to either 2 or 4; or when S68 is set to 255 and S58 is set to 2 or 4.

**S68 Flow Control Used by DCE
(Data Communications Equipment)**
Range: 0, 2 - 6, or 255
Default: 255

The S68 register determines the method of flow control used by the modem. This register, in conjunction with the S58 register, controls the flow of data from the local DTE to the modem when operating in PEP mode, or when S66=1 or S66=2 and an error-control connection (PEP or MNP) is established.

If S58 is set to 1, the content of the S68 register is ignored, and the modem operates in half duplex mode. Refer to the S58 register description for information on half duplex operation. If S58 is set to 7 (transparent XON/XOFF flow control), this register should be set to 255.

5C

Enhanced Command Mode

Possible contents of the S68 register are:

- 0 No flow control is used. (Not recommended.)
- 2 Use RTS/CTS flow control. CTS is turned off by the modem when it wants to stop the flow of data to it. CTS is turned on when the modem will accept data.
- 3 Use XON/XOFF flow control. An XOFF is issued by the modem when it wants to stop the flow of data to it. An XON is issued to resume the flow of data. The XON and XOFF characters used for flow control are defined by the S56 and S57 registers, respectively.
- 4 Use both XON/XOFF and RTS/CTS flow control.
- 5 Use ENQ/ACK flow control. Note that this option is intended for use with some Hewlett Packard computers in PEP mode only. To operate correctly, the remote modem's S58 register must also be configured to use ENQ/ACK flow control. When an ENQ is issued by the local DTE, the modem will return an ACK to the local DTE when the modem can accept at least 2000 bytes of data. The ENQ is passed on to the remote modem.

In Slow (non-PEP) mode, no flow control is used and ENQ/ACKs are passed to the remote modem.

- 6 Use ENQ/ACK and XON/XOFF flow control. The modem always send an ACK in response to an ENQ from the local DTE, and uses XON/XOFF to control the flow of data from the local DTE to the modem. The ENQ is passed on to the remote modem.

When connected in Slow (Non-PEP) mode, only XON/XOFF flow control is used. ENQ/ACKs are passed to the remote modem.

- 255 Use the flow control specified by S58.



S69 XON Signal Handling

Range: 0 - 2

Default: 0

The S69 register determines how the XON character is treated when XON/XOFF flow control is used by the local DTE.

Possible contents for this register are:

- 0 XON character is processed and consumed by the modem and is not passed to the remote modem.
- 1 XON character is processed by the local modem and passed on to the remote modem.
- 2 If the modem has been previously XOFFed, the XON character is processed by the modem and is not passed on to the remote modem. If the modem has not been XOFFed, the XON character is not processed, but is passed on to the remote modem.

Registers S70 through S78 provide statistical information and cannot be set by the user. Registers S70 through S76 pertain only to the Packetized Ensemble Protocol.

S70 Instantaneous Transmit Rate

The S70 register indicates the instantaneous rate at which data is being transmitted to the remote modem in bits per second. It represents the present data transmission capacity of the dial-up lines. This register does not contain the actual data throughput. S70 is a read only register and contains either the current data if communication is currently active or the last sample made if the connection is broken. Any new connection attempt will reinitialize this register.

5C**S71 Transmit Bits Per Channel**

The S71 register contains the number of transmit bits assigned to each channel at 511 frequency points in the current telephone connection. All 511 values are displayed at the time this read only register is accessed.

S72 Instantaneous Receive Rate

The S72 register indicates the instantaneous rate at which data is being received from the remote modem in bits per second. It represents the present data transmission capacity of the dial-up lines. This register does not contain actual data throughput. S72 is a read only register and contains either the current data rate if communication is currently active or the last sample made if the connection is broken. Any new connection attempt will reinitialize this register.

S73 Receive Bits Per Channel

The S73 register contains the number of receive bits assigned to each channel at 511 frequency points in the current telephone connection. All 511 values are displayed at the time this read only register is accessed.

S74 Received Packets Retransmitted

The S74 register contains a count of the number of received packets requiring retransmission since the current connection was made. When the connection is broken, the register will retain the count until the next connection is attempted. S74 is a read only register.



S75 Packets Accepted

The S75 register contains a count of the number of acceptable packets received since the current connection was made. When the connection is broken, the register will retain the count until the next connection is attempted. S75 is a read only register.

S76 Equivalent Line Noise Profile

The S76 register contains the noise level in dBm to the nearest tenth observed at 511 frequency points in the current telephone connection. All 511 values are displayed at the time this read only register is accessed.

S77 Frequency Offset

The S77 register contains the observed frequency offset of the communication channel in Hertz to the nearest sixteenth for the current connection. Frequency offset is also reported in the 1200 bps and 2400 bps modes.

S78 Slow Mode Line Quality

The S78 register reports the modem's estimate of the quality of the current connection. This register is valid only when in 212A, V.22 or V.22 bis mode. The quality is represented in a scale from 0 to 100. The higher the number the better the quality of the line. Errors are less likely to occur on a higher quality line.

A line quality greater than 50 can be considered acceptable for good communications. You may want to redial to establish another connection if the line quality is less than 30, as the line error rate may increase transmission cost and reduce reliability.

S90 V.22 Mode Enable

Range: 0 or 1

Default: 0

The S90 register enables or disables V.22 mode when operating in 1200 bps transmission mode. Possible contents for this register are:

- 0 Bell 212A Mode
- 1 V.22 Mode (V.25 answer sequence)

The selected mode is important only on the answer side of a communications link. The originate modem operates the same for either 212A or V.22 mode. At the beginning of a call, the answer modem will send either a 2225 Hz answer tone in 212A mode or a 2100 Hz answer tone in V.22 mode. Refer to the descriptions of registers S50 and S91 for additional information.

5C

S91 Guard Tone Selection

Range: 0 - 2

Default: 0

In V.22 or V.22 bis mode, the answer modem checks this register to determine if a guard tone is required, and what type of guard tone to transmit with the data. Possible contents of this register are:

- 0 No guard tone (typical U.S. operation)
- 1 1800 Hz guard tone
- 2 550 Hz guard tone

Refer to the description of the S50 and S90 registers for more information.

S92 Answering Sequence Selection

Range: 0 - 2

Default: 0

The S92 register is used to change the sequence of answering tones issued by the modem when answering a call in automatic speed determination mode (S50=0). This is required to accommodate slower speed modems which are adversely affected by PEP answer tones.

5C

The following possible contents of the S92 register are only valid when the modem is answering a call in automatic speed determination mode:

- 0 Use the normal search sequence specified in the S50 register description.
- 1 Issue the PEP answer tones at the end of the search sequence rather than at the beginning to accommodate connecting with slower speed (non-PEP) modems.

In order to establish a connection in PEP mode when the answering modem's S92 register is set to 1, the calling (originating) modem must be using firmware release R2.3 or greater, and have its S50 register set to 255. In addition, the calling modem's S7 register should be set to 60 seconds or greater to allow enough time to detect a valid PEP answer sequence. The answering modem takes about one half of the time specified in its S7 register to send the PEP answer tones, and should not be set to less than its default of 40 seconds.

- 2 Use the normal search sequence specified in the S50 register description but preceded by a three second V.25 answer tone.

S94 Transmission Speed Negotiation

Range: 0 - 1

Default: 1

The S94 register determines whether the modem will connect at any speed up to the maximum specified by the S50 register, or only at the speed specified by the S50 register. This register is ignored when the S50 register is set to 0 or 255.

- 0 The speed of the connection must be as specified by the S50 register. If S50 is set to 254, the connection speed must match the speed of the last AT command.
- 1 Allows a connection at any transmission speed supported by both modems up to the maximum specified by the S50 register. The modems arrive at the correct speed by selecting the highest speed which is supported by both modems.

If the selected transmission speed is 1200 bps, the modem will reference the present setting of the S90 register to select either the Bell 212A or CCITT V.22 communication standard.

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S95 MNP Operating Mode

Range: 0 - 2

Default: 0 - Enhanced, 2 - Conventional

This register determines how the modem establishes an MNP connection while operating in Slow (Non-PEP) mode. MNP is a nearly-transparent, packetizing protocol which provides an error-free link to a remote asynchronous modem. There are several classes of MNP which provide various levels of performance. This modem supports Classes 1 through 5. When an MNP connection is established, the modem will automatically operate at the highest MNP level supported by both modems. The negotiated setting of this register can be displayed by issuing an I4 command.

Possible contents for this register are:

- 0 Normal Mode - MNP is disabled. The modem does not attempt to establish an MNP connection.
- 1 Reliable Mode - When a carrier is established, the modem attempts to establish an MNP connection. If a connection cannot be made within 18 seconds of establishing carrier, the connection is dropped and NO CARRIER is reported. If an MNP connection is established, a CONNECT XXXX/REL message is reported.
- 2 Auto-Reliable Mode - When a carrier is established, the modem attempts to establish an MNP connection. If a connection cannot be made within 4 seconds of establishing carrier, the modem falls back to a normal, non-reliable connection and a CONNECT XXXX message is reported. If an MNP connection is established a CONNECT XXXX/REL message is reported.

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.

Note that Microcom modems use the "\N" command to set MNP capabilities. The corresponding Microcom and Telebit settings are:

Normal	\N0	S95=0 S66=1
Direct	\N1	S95=0 S66=0
Reliable	\N2	S95=1 S66=1 or 2
Auto-Reliable	\N3	S95=2 S66=1 or 2

If the S95 register is set to 1 or 2, set the S66 register to 1 or 2 to enable flow control.

S96 MNP Data Compression Enable

Range: 0 or 1

Default: 1

This register determines if the modem will use data compression while operating in MNP Mode. Possible contents for this register are:

- 0 Data compression is disabled.
- 1 Data compression is enabled provided the connection is made in MNP Mode and the modem at the remote end also has data compression enabled (S96 equals 1).

Data compression is negotiated between the two connecting modems during the MNP negotiation. If either modem does not support data compression, then it will not be used during the communications session. Changing this register after a connection is established will not change the data compression setting for the session in progress. The data compression negotiated by the two connecting modems can be displayed by issuing an I4 command.

Note that Microcom modems use the "%C" command to set MNP Class 5 data compression. The corresponding Microcom and Telebit settings are:

Disable MNP Data Compression	%C0	S96=0
Enable MNP Data Compression	%C1	S96=1

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Enhanced Command Mode

S100 Answer in Originate Mode

Range: 0 or 1

Default: 0

The S100 register controls whether the modem will answer an incoming call as if it had originated the call or in normal answer mode. Possible contents for the register are:

- 0 The modem will answer a call in normal answer mode.
- 1 The modem will answer the ringing signal and attempt to connect as if it had originated the call.

When S100 is set to 1, the calling modem must be placed in answer mode to establish the connection.

S101 Continuous Answer/Originate

Range: 0 - 4

Default: 0

This register can be set to have the modem continuously attempt to establish a connection in either answer or originate mode. Values 1 - 4 are intended for leased lines. Possible contents for the register are:

- 0 Connect normally. That is, as if the modem was called on the Public Switched Telephone Network (PSTN) with S0 not equal to 0, or in response to a "D" or "A" command.
- 1 Attempt to connect as an answer modem every 20 seconds whenever a carrier is not present.
- 2 Attempt to connect as an originate modem every 20 seconds whenever a carrier is not present.
- 3 Immediately attempt to connect as an answer modem whenever a carrier is not present. The modem pauses for 20 seconds after carrier is lost before attempting a new connection.
- 4 Immediately attempt to connect as an originate modem whenever a carrier is not present. The modem pauses for 20 seconds after carrier is lost before attempting a new connection.

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S104 Automatic Dialing Options

Range: 0 - 1

Default: 0

The S104 register is used to enable automatic dialing via the DTR signal from the local DTE.

Possible contents for this register are:

- 0 Disable automatic dialing.
- 1 Enable automatic dialing via an off to on transition on the DTR control signal line. When DTR is asserted, the modem will go off-hook and dial the first or second number in the Number Directory. The modem will attempt to connect in either originate or answer mode depending on the setting of the S100 register.

S111 File Transfer Protocol Support

Range: 0, 10 - 14, 20, 30, 255

Default: 255

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 S111 register determines which file transfer protocol, if any, should be supported during a communications session. The content of this register is only valid when a connection is made in PEP mode.

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Possible contents for the S111 register are:

- 0 No protocol is supported.
- 10 Kermit protocol with no parity supported.
- 11 Kermit protocol with odd parity supported.
- 12 Kermit protocol with even parity supported.
- 13 Kermit protocol with mark parity supported.
- 14 Kermit protocol with space parity supported.
- 20 Xmodem/Ymodem protocol supported.
- 30 UUCP "g" protocol supported.
- 255 Use protocol specified by remote modem.

Protocol support is negotiated between the two connecting modems during the PEP initialization sequence. Both modems must agree on the protocol supported; otherwise no protocol is supported. If one modem has its S111 set to 255, it will support the protocol specified by the other modem. If both modems have the S111 register set to 255, no protocol is supported.

Changing this register after a connection is established will not change the protocol supported for the session in progress unless an &R1 command is issued to the modem. The protocol support negotiated by the two connecting modems can be displayed by issuing an I4 command.



Note to UUCP Users:

For additional information when configuring the modem for UUCP protocol support send an electronic mail request to: *{ames, sun, uunet}!telebit!modems* or call your Technical Support representative. Also refer to the Nutshell handbook entitled *Managing UUCP and Usenet* published by O'Reilly and Associates, Inc.

Notes to Kermit Users:

Kermits that use sliding windows or large blocks may be used with protocol support. However, the modem modifies the "S" packet exchange forcing regular Kermit (no window, 94 byte maximum packet size) to be negotiated between both computers.

The CTRL-X and CTRL-Z options for interrupting file transfer operations are not supported when used to interrupt the reception of a file. However these two options can be used to interrupt the transmission of a file.

S112 Kermit Mark Character

Range: ASCII Code 0 - 255

Default: ASCII Code 1 (SOH)

The S112 register specifies the code used by Kermit as a mark character to begin a packet. The default of 1 (ASCII SOH) is the standard mark character used by Kermit. This register is only used while operating in Kermit protocol support mode.

S121 Echo Suppressor Compensation

Range: 0 or 1

Default: 0

The S121 register is used to compensate for the effects of echo suppressors which may be interfering with data transmissions between modems. This compensation reduces throughput by approximately five percent, and should only be used when data transmission problems occur over a connection involving echo suppressors.

The possible contents of this register are:

- 0 Do not compensate for echo suppression.
- 1 Enable echo suppressor compensation.

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Note that both modems must be using firmware version R2.3 or greater for this register to be effective. Otherwise, the register is ignored. If either modem has S121 set to 1, echo suppressor compensation is enabled. This is negotiated during the PEP initialization sequence.

Changing this register setting after the connection is established will not change the echo suppressor compensation for that session unless an &R1 command is issued to the modem. The negotiated setting of this register can be displayed by issuing an I4 command.

S130 Data Set Ready Interpretation

Range: 0 - 5

Default: 2

The S130 register defines the Data Set Ready (DSR) signal interpretation. Possible contents for this register are:

- 0 DSR is always ON.
- 1 DSR is turned ON when an 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.
- 2 DSR is ON when the modem is ready to accept commands or data.
- 3 DSR is ON when the modem is ready to accept commands or data. When carrier is lost, DSR is turned off for the amount of time specified by the S47 register, then is restored.
- 4 DSR is ON when the modem is off-hook.
- 5 DSR is ON only when a carrier is detected from the remote modem.

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S131 Data Carrier Detected Interpretation

Range: 0 - 3

Default: 2

The S131 register defines the Data Carrier Detected (DCD) signal interpretation. Possible contents for this register are:

- 0 DCD is always ON.
- 1 DCD is ON only when a carrier is detected from the remote modem.
- 2 DCD is ON when the modem is ready to accept commands or data.
- 3 DCD is ON when the modem is ready to accept commands or data. When carrier is lost, DCD is turned off for the amount of time specified by the S47 register, then is restored.

S222 Enhanced Command Mode**Access Character**

Range: ASCII Code 0 - 255

Default: ASCII Code 126 (~)

This register contains the ASCII code for the character which is interpreted as the Enhanced Command Mode access character used in Conventional Command Mode. The default character is "~". If your keyboard does not have a "~" character, the modem should be reinitialized and the S222 register changed to the ASCII code of the character to be used as the access character. Setting this register to a value greater than 127 disables recognition of the access character.

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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S255 Default User Profile Selection

Range: 0 - 2

The S255 register designates which user profile to recall when the modem is powered up or reset. The possible contents of this register are:

- 0 Recall User Profile A after power up or reset.
- 1 Recall User Profile A after power up or reset.
- 2 Recall User Profile B after power up or reset.

This register also determines the profile used when none is specified for any of the following commands: Reset (Z), Recall EEPROM Operating Parameters (&E), Display EEPROM Operating Parameters (&N), or Write Configuration Parameters (&W).

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

C