Telebit T1600

Reference Manual

90156-01 Rev. A

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When connectivity counts.

Telebit T1600

Reference Manual

90156-01 Rev. A

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This equipment generates and uses radio frequency energy, and if not installed and used in strict accordance with the instructions in this manual, may cause interference to radio and television reception. It has been tested and found to comply with the limits for a Class A computing device under Part 15 of the FCC Rules, which are designed to provide reasonable protection against such interference in a commercial installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the modem on and off, you are 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 ER95WS-17716-MD-E.

    *   Ringer equivalence number 0.3B.

    *   Modular jack number USOC RJ-11C.

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. 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 *Troubleshooting* chapter of this manual, you 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 Chapter 8, *Warranty and Repair Procedures* 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.

PREFACE

The T1600 Modem

Telebit's T1600 standalone modem supports full asynchronous and synchronous compatibility with dial up V.32 modems. The modem features error control, data compression, modem security, remote management, and diagnostics. The modem operates over both dial-up and two-wire leased line circuits, and is compatible with CCITT and Bell standard lower-speed modems.

The T1600 modem provides reliable, and error-free connectivity at speeds from 300 to 38,400 bps. The modem is shipped with prestored configurations, which allow operation with a wide variety of industry standard modems worldwide.

About This Manual

This manual is a comprehensive guide for setting up and using the Telebit T1600 modem. This manual is designed for both new and experienced modem users.

To help you install and configure the modem, refer to the *T1600 Fast Start Guide*, a separate booklet provided with your modem. If you have special requirements or experience any problems while using the *T1600 Fast Start Guide*, refer to this manual for additional information.

This manual is divided into eight chapters.

Note: Whether you are a first-time or experienced user, install your T1600 modem using the instructions in Chapter Two, Installation.

- Chapter One, *Introduction*, describes the main features of the T1600 modem.

- Chapter Two, *Installation*, provides instructions on how to install the modem and connect the AC power cord, RS-232D cable and telephone line cable.

- Chapter Three, *The Basics,* explains how to use the modem, including manipulating the front panel controls and indicators, and establishing and terminating a connection.

- Chapter Four, *Beyond the Basics*, describes command mode operations, flow control, RS-232 control signal interpretations, error control, data compression, protocol support, and synchronous support.

- Chapter Five, *AT Command Descriptions,* provides descriptions of the commands, including explanations of the possible parameters, the range of parameters and the default settings.

- Chapter Six, *AT Register Descriptions,* describes the registers used to operate the T1600 modem, including explanations of the possible parameters, the range of parameters and the default settings.

- Chapter Seven, *Troubleshooting,* describes the diagnostic tests performed by the modem after it is powered up. This chapter also provides user assurance test procedures with troubleshooting guidelines to assist you if you are encountering problems installing and using your modem.

- Chapter Eight, *Warranty and Repair Procedures*, discusses Telebit's policies, regarding warranty and repair procedures.

A glossary and index are included at the end of this manual. The glossary defines terms used throughout the manual, and the index provides a reference to information contained in this manual.

CONTENTS

Chapter 6 AT Register Descriptions...........................6-1

List of Figures

Tables

ONE

INTRODUCTION

1
INTRODUCTION

This chapter gives you a quick overview of the features and benefits of the T1600 modem. Some of the major features offered by the modem are discussed below:

CCITT V.32 Support

The modem can operate in either asynchronous or synchronous V.32 mode. When operating in V.32 mode with Trellis Coded Modulation, the modem utilizes a speed of 9600 bits per second (bps) with a selectable fallback of 4800 bps.

Compatibility with Other Modems

For use with other modems, the T1600 is compatible with the 9600 bps V.32, 2400 bps V.22 bis, 1200 bps V.22 and Bell 212A, 300 bps Bell 103J and V.21 standards.

Interface Speeds

The T1600 modem supports interface speeds of 300, 1200, 2400, 4800, 7200, 9600, 12,000, 14,400, 19,2000, and 38,400 bps in fixed speed or autobaud operation.

CCITT V.42 Error Control

The T1600 modem supports the V.42 error control protocol standard that provides error-free transmission over a standard full-duplex, V.32, V.22 bis, V.22, or Bell 212A connection.

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

CCITT V.42 bis Data Compression

The T1600 modem supports the V.42 bis standard. V.42 bis is a high-performance data compression algorithm that increases the data throughput by a ratio of up to 4:1. V.42 bis data compression is possible only for connections established in LAP-M and if both connected modems are configured for data compression.

MNP Support

The modem can be configured to support MNP up to class 4 for error correction, and class 5 for data compression while operating in V.32 and 300 through 2400 bps modes. MNP 5 increases the data throughput by a ratio of up to 2:1. When a connection is established, the modems at each end negotiate the highest MNP class supported by both modems.

Prestored Configurations

The T1600 modem maintains prestored configurations in program memory for various applications. The configurations are selectable by using the AT&F command or through the front panel.

Command Set

The T1600 modem supports the Telebit Extended AT command set, which is also compatible with the industry standard AT command set.

Modem Security

The T1600 modem supports both callback and password security to protect the Data Terminal Equipment (DTE) from unauthorized access.

To utilize the security features, the answering modem's number directory is loaded with up to 10 callback numbers and corresponding passwords.

In call back security, if the password entered by the user corresponds to the password listed in the number directory, the answering modem hangs up the phone, waits 10 seconds, and calls back the user at the appropriate number indexed in the directory.

Password security also requires the caller to enter their password before gaining access, but does not call back the user.

Remote Management and Diagnostics

Remote access allows the central site technician to configure, test, and diagnose the T1600 modems in the field.

To ensure reliable network performance, each time you turn on the modem, a series of internal logic tests, memory tests, and internal loopback checks are performed.

In addition, the modem provides data transmission statistics, such as line-quality analysis, data-flow analysis, and packet-error rates.

Hardware and Software Flow Control

The T1600 modem lets you specify the method of data flow control when transmitting information. You can select a software protocol such as XON/XOFF and/or hardware flow control using the RS-232 RTS/CTS control signals.

Stored Telephone Numbers

The T1600 modem number directory stores up to 10 telephone numbers and descriptors in nonvolatile memory for easy dialing.

Synchronous Capabilities

The modem supports transparent or direct synchronous operation at speeds of 1200, 2400, 4800, 9600 bps using either dial-up or two-wire leased lines.

File Transfer Protocol Support

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

TWO

INSTALLATION

2
INSTALLATION

The instructions presented in this chapter describe procedures for connecting the T1600 modem between your equipment and the telephone line. The modem is designed to be used with a computer, terminal or other serial device via an RS-232D serial interface port.

If you have already installed the modem by following the instructions in your *T1600 Fast Start Guide*, you do not need to read this chapter.

Equipment Checklist

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

❑ An AC power cord and transformer provided with your modem.

❑ A seven-foot telephone cable supplied with your modem.

❑ A shielded RS-232D 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-232D connectors are provided in Appendix B, *Interface Description.*

❑ 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.

1. Before installing the modem in its final position, you may need to first connect it to a terminal (or personal computer with a terminal emulation program), and configure it for your system. Refer to Chapter 3, *The Basics*.

2. Verify that the modem's power switch is turned off, then connect the AC power cord. Refer to page 2-3.

3. Connect a shielded RS-232D cable between the modem and your equipment. Refer to page 2-4.

4. Connect the telephone line from the wall jack to the LINE connector on your modem. Refer to page 2-5.

5. If desired, connect your telephone to the PHONE connector on the modem. Refer to page 2-5.

6. Power up and initialize the modem.

After you have completed the preceding check list, the modem should be ready for use. Refer to Chapter 3, *The Basics*, for information on configuring and using the modem.

Connecting the AC Power Cord

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

> **Warning**
>
> *To avoid damaging the modem, use only the AC power cord and transformer provided with your T1600 modem.*
>
> *Pour utilizer avec BASLER ELECTRIC Model BE117125BBB010 source d'alimentation.*

Refer to Figure 2-1 while connecting the AC power cord to your modem as described below:

1. Verify that the power switch (1/0) on the rear of the modem is turned off (0).

2. Attach the power cord to the connector labeled POWER on the rear panel of the modem. The beveled edge of the plug should be facing up so that it mates with the retainer clip on the connector.

3. Plug the other end of the power cord into a grounded AC wall outlet.
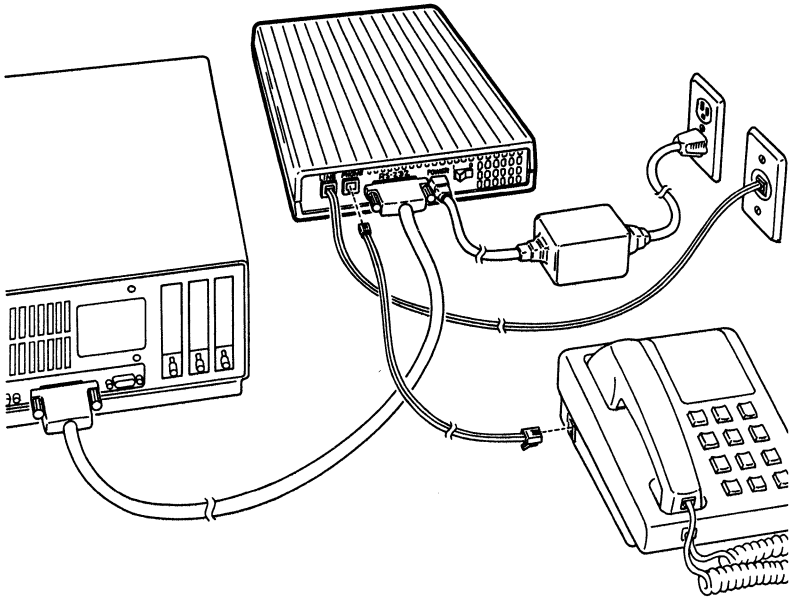
Figure 2-1. T1600 Cable Connection

Connecting the RS-232D Cable

A 25-pin RS-232D 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-232D cable. Pin assignments for the connectors are listed in Appendix B, *Interface Description.*

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

1. Attach the male connector of the RS-232D cable to the female connector on the rear panel of the modem labeled RS-232D, and tighten the connector screws until snug.

2.   Attach the other end of the RS-232D
     cable to the correct RS-232D connector
     on your DTE equipment. Consult your
     equipment manual for the location of
     this connector.

Connecting the Telephone Line

A 7 foot telephone cable is provided with your
modem. You should use this cable to connect
the modem to the telephone line as shown in
Figure 2-1.

Attach one end of the provided RJ-11 tele-
phone cable to the connector labeled TO LINE
on the rear panel of the modem. Attach the
other end to your telephone wall jack.

> *Note: The modem is equipped with a special
> phone cable that is designed to fit tightly into
> the rear panel RJ-11 jack. If you substitute
> your own cable, be certain that it fits securely
> into the modem's TO LINE jack before
> attempting to use the modem. Loose connec-
> tions may affect the modem's performance.*

Connecting a Telephone

Your telephone can be connected 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 TO PHONE
on the rear panel of the modem.

After Completing the Installation

Before powering up your T1600 modem, refer to Chapter 3, *The Basics*, to determine how to configure the modem to ensure compatibility with your computer's data communications software.

THREE

THE BASICS

3

THE BASICS

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

Proceed with this chapter after the modem has been installed by following the instructions in the *T1600 Fast Start Guide* or Chapter 2 of this manual.

Front Panel Controls and Indicators

The modem's front panel contains two switches and ten LED indicators that determine the current operating status of the modem (refer to Figure 3-1). The status indicators are described in Table 3-1.
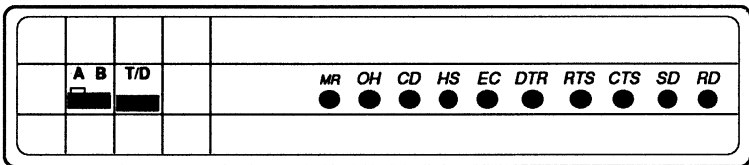
Figure 3-1. Front Panel Display

The front panel console switches are described below:

- **A/B Configuration Select**

  This switch is used to select one of two possible sets of operating configurations.

  When the modem is powered up or reset, Configuration A or B operating parameters are loaded from the nonvolatile memory depending on the position of the A/B switch. If the switch is in the A position, Configuration A is loaded, whereas if the switch is in the B position, Configuration B is loaded.

  Changing the position of the A/B switch resets the modem and loads the new configuration from nonvolatile memory. Note that the A/B switch should not be pressed while a communications session is in progress, as this will prematurely disconnect the call.

- **T/D Talk Data Switch**

  This switch controls the modem's connection to the telephone line much like the hook switch on your telephone.

  If the T/D switch is pressed while the modem is on-hook (OH indicator is OFF), the modem will go off-hook and attempt to connect. This allows you to manually place a call using the telephone set then switch to Data Mode when the call is established.

  If the T/D switch is pressed while the modem is off-hook (OH indicator is ON), the modem will go on-hook allowing you to either disconnect the call, or to switch to voice communications provided the telephone handset has been lifted off-hook before the switch is pressed.

  If the T/D switch is pressed while switching on the power, you enter the Configuration Selection Mode.

Table 3-1. Front Panel Status Indicators

MR	**Modem Ready** - Indicates that the modem is operational.
OH	**Off-Hook** - Indicates the modem is using the telephone line.
CD	**Carrier Detect** - Indicates that the modem has established a connection with another modem.
HS	**High Speed** - Is ON when the T1600 is connected at a modulation rate of 9600 bps and OFF when the T1600 is connected at a rate below 9600 bps.
EC	**Error Control** - Indicates when an error controlled (MNP or V.42) connection has been established.
DTR	**Data Terminal Ready** - This RS-232 signal indicates whether or not the terminal or computer connected to the serial port is ready to transmit or receive data.
RTS	**Request to Send** - This RS-232 signal indicates whether the terminal is able to receive data from the modem (DCE).
CTS	**Clear to Send** - This RS-232 signal indicates whether or not the modem is ready to accept data from the terminal or computer. When the indicator is lit, the modem will accept data from the DTE for transmission.
SD	**Send Data** - This RS-232 signal indicates that the terminal or computer is sending data to the modem.
RD	**Receive Data** - This RS-232 signal indicates that the terminal or computer connected to the modem is receiving data from the modem.

> *Note: Each of the following LED'S: MR, OH, CD, HS, and EC, are also used in the factory prestored configuration matrix when the T1600 is powered up with the Talk/Data switch depressed.*

Power Switch

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

Modem Configuration Requirements

If the modem is connected directly to a terminal, input the commands from the keyboard. When the modem is connected to a computer, 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 that 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 nonvolatile memory.

Prestored Configurations

The T1600 modem contains prestored con-
figurations. These configurations were
designed to address a wide range of applica-
tions. Before choosing your application,
decide which configuration meets the require-
ments of your system.

The prestored configurations are selectable by
the front panel or the &F command described
in Table 3-2.

Configuration Selection

The prestored configurations may be selected
via the AT&F command or the front panel.

To select a pre-stored configuration via the
front panel, use the Talk/Data and A/B
switches. The LED's provide a visual display
of the modes selected.

> *Note: Not all configurations are accessible*
> *from the front panel.*

To load a pre-stored configuration into the
T1600 modem, follow the steps below. Table
3-2 shows the various LED displays encoun-
tered while selecting a default set.

1. Determine the EEPROM Configuration
   (configuration A or B) in which the
   selected operating mode is to be
   stored. If the operating mode is to be
   stored in Configuration A, set the A/B
   switch to position A. If the operating
   mode is to be stored in Configuration B,
   set the A/B switch to position B.

2.   Enter the configuration select mode by holding down the Talk/Data switch while turning the power on. Release the Talk/Data switch when the MR, OH, CD, HS, and EC LED's are flashing.

3.   View the prestored configuration choices by pressing the Talk/Data switch for less than two seconds. The LED's step to the next choice each time the switch is pressed (refer to Table 3-2).

4.   When the LED's indicate the desired operating mode, make your selection by pressing the Talk/Data switch for more than two seconds. When your choice is accepted, the LED's corresponding to the selected operating mode will flash. Release the Talk/Data switch when the LED's flash.

5.   After you select a prestored configuration, the LED's are turned off, the selected operating mode is written to the configuration selected in Step 1 and the modem is configured for the selected ·operating mode. When the modem is ready, the MR LED will light up.

Use Tables 3-2 and 3-3 as a guide to select the configuration that meets the requirements of your system.

Table 3-2. Prestored Configurations

Prestored Configuration	Front Panel LED					AT&F Command
	MR	OH	CD	HS	EC	
TTY (factory default)	●	●	●	●	●	AT&F or AT&F0
Unattended Answer Mode	●					AT&F1
Intelligent Answer Mode		●				AT&F2
System V (HDB) (UUCP)	●	●				AT&F3
Ver 2 (BSD) (UUCP) 4.2-4.3 and SCO Xenix			●			AT&F4
Transparent Sync	●		●			AT&F5
IBM PC/MAC/with SW flow control (XON/XOFF)				●		AT&F8
IBM PC/MAC/with HW flow control (RTS/CTS)	●			●		AT&F9
Leased Line Async Originate Mode		●		●		AT&F10
Leased Line Async Answer Mode	●	●		●		AT&F11
Leased Line Sync Originate Mode			●	●		AT&F12
Leased Line Sync Answer Mode	●		●	●		AT&F13

● = LED ON

Table 3-3. Prestored Configurations
Accessed only by the &F Command

Prestored Configuration	AT&F Command
Async/Sync Hayes &M1	AT&F32
HP 3000 (host)	AT&F33
HP 3000 (terminal)	AT&F34

Note: For additional information on the configurations refer to the &F command description in Chapter 5, AT Command Descriptions and Appendix D, Prestored Configurations.

If you are a personal computer user, the communication software package may not provide the initialization sequence required to operate the T1600 modem in your PC system environment. If there are no available options in the software package that meet your system's needs, choose either of the prestored configurations with hardware or software flow control.

Configuration Memory Organization

The active configuration stored in RAM defines the current operating characteristics of the modem. The factory default configurations are the operating parameters most commonly used for data communications that are permanently stored in ROM. The default parameters are restored to the active configuration by issuing an AT&F command from the terminal or by initializing the modem through the front panel switches.

The current operating parameters can be modified and saved in nonvolatile memory as Configuration A or Configuration B via the AT&W command. When a new configuration is retrieved, its settings replace the current operating parameters. Refer to Chapter 5, *AT Command Descriptions,* for additional information on these commands.

The S255 register determines which configuration is used when the modem is powered up or reset. When S255 is set to 255 (by typing ATS255=255), pressing the A/B switch resets the modem and loads the new configuration indicated by the switch into the active configuration (refer to Figure 3-2).

Active
Configuration
RAM

A/B Switch
(active when S255=255)

Nonvolatile Memory
EEPROM

Configuration
A

Current
Operating
Parameters   Power-up
Reset *

A
○   AT&W(n)

B

Configuration
B

Defaults
ROM

Configuration
Selectors
S254 and S255

AT&F(n) or
front panel switch

Prestored
Configuration

Telephone
Number
Directory
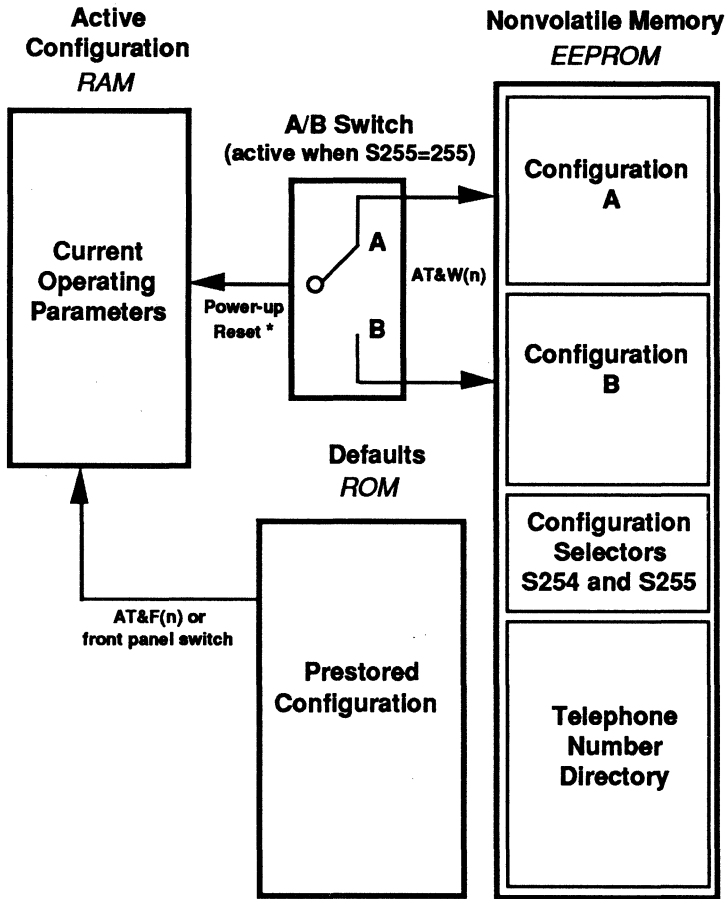
* Source of configuration loaded is
determined by the setting of the S255 register.

Figure 3-2. T1600 Memory Configuration

Commands and Registers

The T1600 modem is equipped with commands and registers that can be set to meet the specific requirements of your data communications system. The T1600 modem currently supports the Telebit Extended AT command set.

You may enter a command line of up to 80 characters in uppercase or lowercase 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. The option should immediately follow the command.

The notation (x) represents an assigned value. If a command is typed without a value when one is expected, the modem assumes a value of 0.

The parentheses should not be typed.

The = command enables the setting of S registers to desired values.

The ? command allows you to inspect the contents of a given S register. An example follows using the S51 register:

ATS51?<CR>

The &V command allows you to view the current configuration.

How to Enter a Command

To enter a command, type the prefix AT
before the command. For example:

ATQ0<CR>

sets the Q command (Quiet Mode Select) to
the numeric option (0), which indicates how
the modem will report result codes.

Refer to Chapter 5, *AT Command Descrip-
tions*, for additional information on the Telebit
Extended Command set.

How to Set a Register

The following is an example of how to set a
specific register:

ATS0=5<CR>

sets the S0 register to a value of 5.

Refer to Chapter 6, *AT Register Descriptions*,
for complete descriptions of the registers.

Establishing a Connection

This section describes the procedures used to establish a connection.

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 the period of time defined by the S7 command, 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

Using the T/D Switch

If you set the S104 register to 3, pressing the T/D switch automatically dials the first or second number in the Number Directory depending on the current setting of the A/B switch. When the A/B switch is in the A position, the first number (~N0) is dialed, whereas if the switch is in the B position, the second number (~N1) is dialed.

Using the Auto Answer Feature

The modem automatically answers an incoming call after a specified number of rings, and usually sends a carrier signal to the remote modem. If no originate signal is detected within a specified period of time, or if any character is sent from your equipment before the modems have established a communication link, the modem returns a NO CARRIER result code.

If a carrier is detected, the modem sends a CONNECT result code indicating the successful connection, and, depending on the X command, the speed of the connection or serial interface.

Connecting During a Phone Conversation

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

1. Have the other party enter **AT D** on their system without entering a phone number.

2. Enter **AT A** on your system within a few seconds.

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

Terminating a Connection

To terminate a connection, you should disconnect through your communications software. If you are not using communications software, you can disconnect a call by pressing the T/D switch on the front panel of the modem.

FOUR

BEYOND THE BASICS

4
BEYOND THE BASICS

The T1600 modem is designed to interface with a wide variety of computer and data communications equipment, and can be used in many applications. Since each device has its own specific requirements, the modem is equipped with a wealth of commands and registers which can be set to meet the specific requirements of your system.

Command Mode Operation

The T1600 modem supports the Telebit Extended AT command set (refer to Chapter 5, *AT Command Descriptions* and Chapter 6, *AT Register Descriptions*).

The modem supports two basic modes of operation: command mode and data transfer mode.

In command mode, the modem processes data received through the serial interface port as instructions to perform various functions.

The modem is placed in command mode when any of the following conditions occur:

- The power is turned on, and the modem has completed the power up diagnostic tests.

- A data call is disconnected, and the modem is placed on-hook.

- The modem cannot successfully complete a call, or the remote modem's data carrier is dropped.

- The modem receives a defined escape sequence or break signal.

- A semicolon (;) is entered at the end of a dialing string.

You may enter a command line of up to 80 characters in uppercase or lowercase with the first command preceded by an AT and the last command followed by a carriage return.

Blanks and tabs 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.

Commands are processed from left to right. If an error occurs during the execution of a command line, processing stops and everything following the erroneous command is ignored.

To ensure that the modem recognizes the AT prefix, one of the following data formats must 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

There are many commands and registers referred to in the following sections of this chapter. For additional detailed descriptions of the Telebit Extended AT command set, refer to Chapter 5, *AT Command Descriptions*. Chapter 6, *AT Register Descriptions* provides complete descriptions of the registers.

How to Use the Number Directory

Set Number Directory

The ~N command allows you to save any character string in the number directory in nonvolatile memory. The string of digits and dialing control characters 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 70 alphanumeric characters. For example:

AT~N3=1234567\TEST\<CR>

List Number Directory

The ~L command lists all entries stored in the number directory, from 0 through 9. Each entry is displayed on its own line. If there is no number in a particular entry, the directory entry number is displayed alone. For example:

AT~L<CR>

```
0: 12345-6789
1: 1 (415)555-6789
2:
3: 1-800-555-1212
4:
5:
6: (415)555-4739
7: 123S=8\lines may have up to 70 characters\
8:
9: 222-3333 \HOME\
```

Dialing

To dial a number in the number directory, use the S= modifier after the D command. For example, to dial entry number 4 in the number directory, enter the following command.

AT D S=4

Automatic Dialing

The S104 register is used to enable automatic dialing via the DTR signal from the local DTE or from the front panel T/D switch. Possible contents for this register are as follows:

0	Disable automatic dialing.
1	Enable automatic dialing via an OFF to ON transition on the DTR control signal line. When DTR goes ON, the modem goes off-hook and dials the first or second number in the Number Directory (the actual number is determined by the position of the A/B switch).
2	Reserved. An ERROR response code is sent if this register setting is attempted.
3	Enable automatic dialing from the front panel T/D switch. When the modem is idle (OH indicator is off), pressing the T/D switch causes the modem to go off-hook and automatically dial the first or second number in the Number Directory (the actual number is determined by the position of the A/B switch).

| 4 | When the DTR signal is ON, the modem assumes the originate mode if the setting of register S1 is equal to 0. If the setting of register S1 is greater than 0, the modem assumes the answer mode. |

For values 0 through 4, the S100 register will apply unless it is overridden by an R dial modifier.

Break Signal Handling

The modem's default action upon receiving a break signal is to enter command mode. The modem can be configured to pass the break signal through the modem on to the remote end by changing the setting of the S61 register. The S63 register determines the modem's response when a break signal is to be transmitted by the local DTE.

The S61 register determines how the modem handles a break signal as follows:

| S61=0 | Break is processed as defined in register S63. |
| S61=1 | The modem switches to command mode when a break signal is received. |

The S63 register determines the modem's behavior if the break signal is to be transmitted, as follows:

S63=0	Break signal and data are sent in sequence.
S63=1	Send break to remote DTE immediately.
S63=2	Discard buffered data and send break to the remote side.
S63=3	Discard the break signal.

Escape Sequence
(return from data mode to command mode)

The escape sequence, during a data connection, provides you with a way to enter command mode without disconnecting the communications link. An escape sequence consists of the guard time (specified by the S12 register), followed by three consecutive escape characters (defined by the S2 register), followed by the guard time again. The time between each of the escape characters must be less than the guard time.

The modem switches to command mode only after an escape sequence with the proper guard time is entered. The data connection is maintained while the modem is in command mode.

> *Note: Any data received from the remote modem will be discarded if a link protocol is not active.*

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. Register S51 governs the serial interface speed of the modem.

When a connection is established in non-reliable (no error control) mode, the modem may change its interface speed to match the speed of the connection depending on the current setting of the S181 register. Refer to the V.42 and MNP Error Control Protocol Support section later in this chapter.

The interface speed of the modem can be set either manually or automatically. An example of how to set the DCE speed to 300 bps, using the S51 register is as follows:

ATS51=0

To manually set the modem's interface speed, the S51 register should be set to one of the values listed below:

S51=0	300 bps
S51=1	1200 bps
S51=2	2400 bps
S51=3	4800 bps
S51=35	7200 bps
S51=4	9600 bps
S51=43	12000 bps
S51=46	14400 bps
S51=5	19200 bps
S51=6	38400 bps

The T1600 modem can also automatically sense the DTE's speed by monitoring the AT prefix of every command line. The modem uses the A in the prefix to determine the serial interface speed and the T to determine the parity. This is commonly called autobaud.

To select autobaud, S51 can be set to one of the following three values:

S51=252   Autobaud selection with type ahead not permitted.

S51=253   Autobaud selection with type ahead permitted and a default speed of 38,400 bps.

S51=254   Autobaud selection with type ahead permitted and a default speed of 19,200 bps.

S51=255   Autobaud selection with type ahead permitted and a default speed of 9600 bps.

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 is the speed used to send RING and CONNECT messages when an incoming call is received.

When S51 is set to 253, 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 connection is dropped, and the modem is placed on-hook.

- A break is received in command mode.

- A NO CARRIER result code is generated due to the carrier being lost, a dial command being aborted, or the time allowed to connect as specified by the S7 register has expired.

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 uses 38,400 bps (S51=253), 19,200 bps (S51=254) or 9600 bps (S51= 255) to send RING and CONNECT messages when an incoming call is received.

Modem Flow Control

Flow control is used between the modem (DCE) and the terminal (DTE) to avoid loss of data. Whenever there is a speed mismatch between the DTE and DCE, or when a protocol is used, modem flow control must be enabled. There are two types of flow control: software (XON/XOFF) and hardware (RTS/CTS).

In software flow control (XON/XOFF), the modem sends a signal from one system to the other. The receiving system responds by either suspending the data transmission or resuming the flow of data. The XON signal turns the data flow ON. The XOFF signal turns the data flow OFF.

In hardware flow control (RTS/CTS), the modem uses an electrical signal from one system to the other. When the Clear to Send (CTS) signal is turned ON, the modem is notifying the terminal to start sending data. When the CTS signal is turned OFF, the modem is notifying the terminal to stop sending data.

The electrical signal from the terminal is Ready to Send (RTS). When RTS is ON, the DTE is notifying the DCE to start sending data. When RTS is OFF, the DTE is notifying the DCE to stop sending data.

The primary reason for selecting RTS/CTS flow control is to allow non-ASCII text data to be transferred without unintentionally sending and detecting an XON or XOFF.

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	Use RTS/CTS flow control in half duplex mode.
S58=2	Use RTS/CTS flow control in full duplex mode.
S58=3	Use XON/XOFF flow control.
S58=4	Use both RTS/CTS and XON/XOFF flow control.

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

S68=0	No flow control is used.
S68=2	Use RTS/CTS flow control in full duplex mode.
S68=3	Use XON/XOFF flow control.
S68=4	Use both RTS/CTS and XON/XOFF flow control.
S68=255	Use the same flow control specified by S58.

When XON/XOFF flow control is used,
recognition of the XON and XOFF characters
is controlled by the S56, S57, and S48 regis-
ters. 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 examines only
the lower seven data bits to detect an XON or
XOFF character. This means that if the DTE
is using an 8-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
8-bit characters.

RS-232 Control Signal Interpretations

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

DTR Signal Interpretation

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

&D0   The modem assumes that DTR is always true.

&D1   The modem enters command mode when the DTR signal is switched from ON to OFF.

&D2   The modem disconnects a call in progress, enters command mode, and disables auto-answer when the DTR signal is switched from ON to OFF. Auto-answer is enabled when the DTR signal is turned to ON.

&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 current user profile parameters from nonvolatile memory.

When &D is set to 0 through 2, the modem does not recognize DTR signal level changes with a duration less than the time specified by the S25 register.

The S104 register defines the automatic calling options possible via the DTR signal as follows:

S104=1   OFF to ON DTR transition dials a prestored number. The first location in the number directory is used if the A/B switch is in the A position. The second location is used if the switch is in the B position.

S104=4   OFF to ON DTR transition initiates
                call attempt. No dialing is
                performed. Register S1 is
                referenced to determine whether
                the modem will attempt to connect
                in answer or originate mode.

DSR Signal Handling

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

&S0   The DSR signal is always ON.

&S1   The DSR signal is turned ON
             when the answer tone is detected,
             and stays on for the duration of
             the connection.

&S2   The DSR signal is always ON
             except when it is pulsed OFF for a
             period of time, specified by the
             S47 register, while disconnecting
             a call.

&S3   The DSR signal is turned ON
             when DTR is turned ON, or when
             a carrier is detected with DTR
             present. DSR is turned OFF
             when DTR is dropped, or the
             carrier is lost.

DCD Signal Handling

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

&C0   The DCD signal is always ON.

&C1   When a carrier is detected from
             the remote modem, the DCD
             signal is turned ON after the
             CONNECT result code is sent to
             the DTE. DCD is turned OFF
             when the carrier is dropped.

&C2   The DCD signal is always ON
except when it is pulsed OFF for a
period of time, specified by the
S47 register, while disconnecting
a call.

&C3   The DCD signal is the inverse of
the CTS signal.

CTS Signal Handling

When the modem is using RTS/CTS flow
control, the CTS signal is turned ON/OFF to
control the flow of data from the DTE as
described in the S58 and S68 register descrip-
tions.

When the modem is not using RTS/CTS flow
control, the &R command determines how the
modem uses the CTS control signal as fol-
lows:

&R0   When a connection is established,
the CTS signal follows the RTS
signal delayed by the period of
time specified by the S25 register.
When the modem is off-line, the
CTS signal stays ON. Hardware
flow control is overridden.

&R1   When a connection is established,
the CTS signal is turned ON after
the modem sends the CONNECT
result code, and stays ON for the
duration of the connection.
Hardware flow control is
overridden.

&R2   When a connection is established,
the CTS signal follows the RTS
signal with a fixed 200 ms delay,
and hardware flow control is
honored if enabled. When the
modem is off-line, the CTS signal
is turned OFF.

&R3   CTS is always ON if hardware
           flow control is not enabled.

&R4   When a connection is established,
           the CTS signal follows the RTS
           signal delayed by the period of
           time specified by the S25 register.
           When the modem is off-line, the
           CTS signal follows DTR.
           Hardware flow control is
           overridden.

Modulation Speed Considerations

The modem's modulation speed is determined by the current setting of the S50 and S94 registers when S50 is not set to 0.

The S50 register can be set to any of the following values:

S50=0   Automatic speed determination

S50=1   300 bps operation (Bell 103 or
           V.21)

S50=2   1200 bps operation (Bell 212A or
           V.22)

S50=3   2400 bps operation (V.22 bis)

S50=6   9600 bps (V.32)

S50=254   Match speed of last AT command

The S94 register can be set to any of the following values:

S94=0   Negotiation disabled – The speed
           of the connection must match the
           speed specified by the S50
           register.

S94=1   Full negotiation enabled –
           Connect at any speed specified by
           the remote modem up to the
           maximum speed designated by
           the S50 register.

S94=2	Partial negotiation enabled – Connect only at the speed specified the S50 register or at the corresponding modulation mode's fallback speed.
S94=3	Only fallback enabled – Connect only at the fallback speed of the modulation mode specified by the S50 register. If the selected modulation mode does not have an associated fallback speed, connect at the primary speed.

V.22 bis uses a fallback speed of 1200 bps; V.32 falls back to 4800 bps.

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.

The B command determines if the modem issues Bell standards (212A and 103) or CCITT standards (V.22 and V.21) for 1200 bps and 300 bps operation as follows:

B0	Use CCITT V.22 and V.21 standards.
B1	Use Bell 212A and 103 standards.

If you plan to use the modem in V.22 or V.22 bis mode, be aware that some 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

V.42 and MNP Error Control Protocol Support

The modem supports the CCITT V.42 error control protocol. V.42 provides error-free transmission over a V.32, V.22 bis, V.22, or Bell 212A connection.

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

As shown below, the V.42 error control mode and fallback is controlled by two registers: S180 and S181.

The S180 register determines if and which type of error control should be attempted while connecting with a remote modem:

S180=0	Disable error control.
S180=1	V.42 error control without detection phase.
S180=2	V.42 error control with detection phase.
S180=3	MNP error control.

If an error controlled connection cannot be established, or if error control mode is disabled, the S181 register is used to select the fallback alternatives.

S181=0　　If no error control is negotiated, connect in non-buffered direct mode. The DTE interface speed is set to match the modulation speed of the connection, and flow control is disabled.

S181=1　　If no error control is negotiated, connect in buffered mode.

S181=2　　If no error control is negotiated, the connection is dropped.

Data Compression

While connecting in MNP or LAP-M mode, data compression is negotiated between the two connecting modems. Data compression can be enabled in either the transmit or receive direction in the T1600 modem by setting the S190 register, as shown in Table 4-1.

Data compression can be required in either direction. However, data compression must be required and negotiated by the same modem, or the physical link will be dropped.

Table 4-1 displays how the S190 register values are set for data compression negotiation.

Table 4-1. S190 Data Compression Values

T		RECEIVE		
R		Allowed	Required	None
A				
N	A	1	2	5
S				
M	R	3	4	6
I				
T	N	7	8	0

For example, if data compression is required in both the transmit and receive directions, set S190 equal to 4. The remote modem must either require or allow compression in both the transmit and receive directions. If the remote modem is a T1600, its S190 register should be set to 1 through 4.

File Transfer Protocol Support

When file transfer protocol support is enabled, the modem interacts with the protocol to eliminate delays in the file transfer that 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:

- **Kermit**
- **X/Ymodem**
- **UUCP**
- **ENQ/ACK**

Beyond The Basics **4-19**

The typical protocol support 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 S111 set to 255, no protocol is supported. If neither modem has its S111 register set to 255, then both modems must agree on the setting of the S111 register to allow protocol support. Refer to Chapter 6, *AT Register Descriptions* for additional information.

Asynchronous/Synchronous Mode Selection

The modem's asynchronous or synchronous interface mode is determined by the &Q command.

&Q0   An asynchronous interface is used for the command and data modes.

&Q1   Synchronous Mode 1 - The modem operates in asynchronous mode until a connection is established, at which time the modem switches to synchronous mode. This transition is signaled by the OFF to ON transition of DCD (if enabled), or by the CONNECT message. All result codes and messages are sent asynchronously.

After DCD is true, the modem waits the number of seconds specified in S25 and checks DTR status. If DTR is ON, data connection is completed.

If DTR is OFF, the modem hangs up and reverts to asynchronous mode. Changing the state of the DTR signal later, during the call, causes the action specified in the S52 register to occur. This may include going to asynchronous command state or terminating the call.

Synchronous Mode 1 is suited for applications that use the asynchronous mode to establish a connection, which is then used in the synchronous mode. To establish a call, issue the D or A command using the asynchronous mode. To drop a connection, press the Talk/Data switch, disconnect the phone line, or drop DTR (if the S52 register is set appropriately). Once the modem hangs-up, it reverts to asynchronous mode.

&Q2   Synchronous Mode 2 - This mode is the same as &Q1, except for its stored number dialing function-ality. In this mode S104 is ignored. OFF to ON transitions of DTR, causes the modem to dial a stored number location and attempt to establish a con-nection. The first location is dialed if the A/B switch is in the A position and the second location is dialed if the switch is in the B position.

In synchronous mode 2, the modem supports a synchronous-only terminal, or a computer with a synchronous adapter card. Once synchronous mode 2 has been selected, the modem goes off-hook and dials the stored number as soon as the modem is connected to the terminal.

&Q3   Synchronous Mode 3 - This mode
       is the same as QM1, except DTR
       initiation of a call attempt is
       added. S104 is ignored in this
       mode. OFF to ON transitions of
       DTR causes the modem to
       attempt to establish a connection
       based on the S1 value.

       S1=0 The modem attempts to
            originate a call.

       S1>0 The modem attempts to
            answer a call.

       In synchronous mode 3, the DTR
       interchange circuit performs as a
       data/talk switch. A synchronous-
       only data terminal or computer
       with a synchronous adapter card
       is supported in this mode. A
       telephone must be attached to the
       jack labeled TO PHONE on the
       rear of the modem when in this
       mode.

&Q6   Transparent Synchronous - The
       command mode is disabled and a
       synchronous interface is utilized at
       all times. All RS-232 signals are
       interpreted according to the
       various parameters stored in the
       modem with the following
       exception:

       If &D1 is set, loss of DTR is
       ignored and the connection is not
       dropped.

Modem Security

Callback security protects the Data Terminal
Equipment (DTE) from unauthorized access.
Register S46 determines the type of call
security to be carried out when an incoming
call is answered.

To change the setting of this register, you are required to enter a password. **The default system password is PEP, which must be entered in uppercase.** This password can be changed by entering the ~U command

Possible contents of the S46 register are as follows:

S46=0   Callback security disabled.

S46=1   Callback security enabled.

S46=2   Callback security enabled with password reverification.

S46=3   Password security enabled, no callback is required.

Callback phone numbers and associated passwords are stored in the ~N number directory. When the S46 register is set to 1, the modem prompts the caller for a password; this is not the system password.

If the password entered by the caller **corresponds to a password listed in the number directory,** the answering modem hangs up the phone, waits 10 seconds, and calls back the appropriate number indexed in the number directory, eventually connecting the caller to the local DTE.

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

If S46 is set to 3, the modem prompts the caller for a password. If a valid password is entered, the caller is immediately connected to the local DTE. No callback is required.

Update System Password Command

The ~U command (Update System Password) allows you to change the system callback security password which must be given when attempting to change the value of the S46 register.

This password is also required when attempting to change an entry in the telephone number directory when callback security is enabled (the S46 register is not equal to zero).

When the ~U command is entered, you are prompted for the old password (**PEP is the factory default, which must be entered in uppercase**), the new password (which can be entered in any combination of uppercase and lowercase), and a confirmation of the new password.

After changing the password, you are asked for a new prompt string (up to 20 characters), which is to be displayed at the caller's terminal. The default value of this prompt string is Enter Password:. This prompt string can be retained by entering a carriage return.

Remote Access

Remote Access in the T1600 modem allows you to send commands to the remote modem. To negotiate and use remote access, an MNP error control connection must be established.

The S45 register enables or disables access to the control functions of the modem from a remote modem as follows:

| 0 | Disables remote access. |
| 255 | Enables/negotiates remote access. |

To allow remote command access, the following conditions must be met:

1. Both modems must have remote access capability, and must have an MNP connection.

2. Register S45 must be set to 255 prior to establishing an MNP call.

Remote access will not be enabled for the session unless all of the above conditions are met.

Remote Modem Access Command

The % command allows you, at a local DTE, to send a command to a remote modem as if the commands had been entered by the remote DTE.

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

AT%&V

displays the remote modem's active configuration.

Responses from the remote modem are preceded by a % character and are controlled by the setting of the remote modem's X command.

Local and remote commands can be entered on the same line. For example, to get the local modem's number of accepted packets and line quality, followed by the same information from the remote modem, enter:

ATS75?S78?%S75?S78?

> **Note:** 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.

> **Note:** When the T1600 modem is configured via the front panel switches for the "TTY" configuration, S45 is set to 255 (enable remote access) in the active configuration (RAM) and 0 (disable remote access) in nonvolatile memory (EEPROM). This allows Technical Support remote access to the modem through an MNP connection, if necessary, as long as the modem is not reset.

FIVE

AT COMMAND DESCRIPTIONS

5

AT COMMAND DESCRIPTIONS

This chapter describes the Telebit Extended AT commands used when the T1600 modem is operating in command mode. Chapter 6, *AT Register Descriptions,* contains complete descriptions of the registers.

- 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.

Command Syntax

- If a command is typed without a value when one is expected, the modem defaults to a value of 0.

- A comma (,) used between commands causes the system 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.

- Blanks and tabs may be added to enhance readability.

- The notation (n) in the command descriptions represents a decimal numeric option. The option should immediately follow the command.

  For example, to turn off the result codes, type:

  ATQ1

  Do not type:

  ATQ=1

- The notation (x) represents an assigned value.

- The parentheses should not be typed.

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 **ATD** on their system without entering a phone number.

2. Enter **ATA** on your system within a few seconds. Both parties can hang-up the phone. The modem sends a CONNECT result code when the connection is made.

If no carrier signal is detected within the time-out period defined by the S7 register, the modem hangs up, sends a NO CARRIER result code, and returns to command state.

This command can be aborted by typing any key. If the command is aborted, an OK result code is returned.

B(n)   Bell/CCITT Mode Selection
Range: 0 or 1
Default: 1

The B command is used to select either Bell standards (212 and 103J) or CCITT standards (V.22 and V.21) while operating at 300 or 1200 bps transmission modes. The parameters are as follows:

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

D(n)   Dial
See also: T, P, S7

The D command is used to place a call by sending a dialing string to the modem. A valid dialing string is composed of a D followed by the digits 0 through 9 and dialing options that specify the number to dial. The characters A, B, C, D, #, and * may also be used when tone dialing (T) is selected. These characters are ignored while pulse dialing (P). Parentheses, slashes, hyphens, periods, and spaces may be used in the dialing string 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 uses the last mode selected. Also, the modem defaults to pulse dialing when powered on, unless the parameter in the nonvolatile memory has been set to tone dialing.

The following characters are commands that are valid within a dialing string:

P	Use pulse dialing.
R	Switch to answer mode when finished dialing. The R command may occur at any location during the dial string, but is only valid during the dial string in which it occurs.
T	Use tone dialing.
W	Wait up to the number of seconds in the S7 register for a valid dial tone.
S=(n)	Designates a number directory entry to be used in the current dial string. The designated number directory entry is substituted into the dial string in place of S=(n) and execution progresses as if this string had been entered directly. The stored number is displayed when the S=(n) modifier is executed, but before dialing begins. The range of values for n are 0 through 9.
,	Pause for the amount of time specified by the S8 register before continuing with the dial string.
@	Wait for five seconds of silence after a remote ring 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 exclamation point (!) dial modifier causes the modem to go on-hook for 0.5 seconds, then go off-hook, and wait two seconds before executing the next modifier. The telephone handset must be on-hook for this to work.
;	Remain in command mode after dialing without waiting for a connection. The semicolon (;) terminates the dial string, causing the modem to remain in command mode. The modem does not attempt to train.
$	Causes the modem to wait for a calling card billing prompt tone. If the prompt tone is not detected within the amount of time specified by the S7 register, the NO PROMPTTONE result code is generated. If busy is detected while waiting for the prompt tone, the BUSY result code is generated.
\	Indicates to the modem that a number defined by a name in the number directory is to be dialed. When the modem encounters text containing the backslash (\), the number directory is searched for an entry that has identical text between the backslash symbols. The number directory element is stripped of the identifier text and inserted into the dial string and processed. For example:

If the following command was previously executed,

AT~N3=(415)555-1212\HELP

then the following three command lines are equivalent.

ATDT (415)555-1212

ATDT\HELP

ATDTS=3

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 spaces and hyphens in the dialing string.

E(n)   **Command Echo ON/OFF**
        Range: 0 or 1
        Default: 1

The E command instructs the modem, while in command mode, to echo characters back to the local DTE. The parameters are as follows:

E	Same as E0.
E0	OFF.
E1	ON.

H(n)   Hook Control
Range: 0 or 1

The H command allows the modem to control
the telephone switch hook. The parameters are
as follows:

H	Same as H0.
H0	Go on-hook.
H1	Go off-hook.

I(n)   Information Request
Range: 0 - 5

The I command requests the modem's product
identification number, internal diagnostic
status, current transmission mode, or current
revision level, as follows:

I	Same as I0.
I0	Returns the product identification character string, 965, which defines the model number.
I1	Returns any error code status generated by summing the numbers associated with failed tests. If it is not 000, call Telebit Technical Support. See Chapter 8, *Warranty and Repair Procedures*.
I2	Reports CONNECT status. See Appendix C, *Result Codes*.
I3	Responds with T1600 -Version LAx.xx, where x.xx is the firmware revision level.
I4	Reserved.
I5	Last number dialed.

L(n)   Speaker Volume
Range: 0 - 3
Default: 2

The L command determines the speaker volume as follows:

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

M(n)   Speaker Mode
Range: 0 - 3
Default: 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.

O(n)   Return to Data State
Range: 0 - 1

The O command places the modem in a data
state during a connection. When the modem
has been forced to enter command mode via
the break signal or the escape sequence, the O
command resumes data communication. If
the modem is off-hook but not connected, it
attempts to connect in the same mode (orig-
inate or answer) as the most recent connec-
tion. An error result code is sent to the DTE
if this command is issued while the modem
is on-hook. The parameters are as follows:

O	Same as O0.
O0	The modem switches to data state.
O1	Retrain equalizer before returning to data state.

P   Pulse Dialing

The P command causes the modem to use
pulse dialing for all subsequent dialing opera-
tions.

Q(n) Quiet Mode Select
Range: 0 - 2
Default: 0

The Q command controls the reporting of result codes to the local modem. The parameters are as follows:

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

T Tone Dialing

The T command causes the modem to use tone dialing for all subsequent dialing operations.

V(n) Verbose Select
Range: 0 or 1
Default: 1

The V command determines the format of the result codes. See Appendix C, *Result Codes*, for more details on result code reporting. The parameters are as follows:

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

X(n)   Result Code Select
Range: 0 - 2, 11, 12
Default: 1
See also: V(n)

The X(n) command selects a set of result codes. The parameters are as follows:

X	Same as X0.
X0	Supports the following result codes:

NUMERIC	VERBOSE
0	OK
1	CONNECT
2	RING
3	NO CARRIER
4	ERROR

X1	Adds modulation speed to the CONNECT message:

NUMERIC	VERBOSE
0	OK
1	CONNECT 300
2	RING
3	NO CARRIER
4	ERROR
5	CONNECT 1200
10	CONNECT 2400
11	CONNECT 4800
12	CONNECT 9600

X2	Supports the X1 result codes and adds the following:

NUMERIC	VERBOSE
6	NO DIALTONE
7	BUSY
52	RRING
53	DIALING

X11	Similar to X1, except that the number after the CONNECT message reflects the DTE interface speed rather than the modulation speed. The result codes are as follows:

NUMERIC VERBOSE

0	OK
1	CONNECT 300
2	RING
3	NO CARRIER
4	ERROR
5	CONNECT 1200
10	CONNECT 2400
11	CONNECT 4800
48	CONNECT 7200
12	CONNECT 9600
49	CONNECT 12000
13	CONNECT 14400
14	CONNECT 19200
15	CONNECT 38400

X12	Supports the X11 result codes and adds the following:

NUMERIC VERBOSE

6	NO DIALTONE
7	BUSY
52	RRING
53	DIALING

When dialing using X0, X1 or X11, the BUSY signal will not be recognized since the BUSY result code has not been enabled, and the T1600 modem will perform a blind wait before dialing.

When dialing using X2 or X12, the functionality associated with the enabled result codes will also be enabled. In particular, the BUSY signal will be detected, and the modem will require dial tone before dialing, even if the W modifier is not entered.

Y(n)   Long Space Disconnect
Range: 0 or 1
Default: 0

The Y command determines if the modem
responds to a long space disconnect signal.
The valid parameters are as follows:

Y	Same as Y0
Y0	Modem does not respond to a long space disconnect signal.
Y1	If the modem receives a continuous break signal from the remote modem for a period greater than or equal to 1.6 seconds, it disconnects. When commanded to hang up, the modem transmits a four second break signal, then disconnects (goes on-hook).

Z(n)   **Reset**
        Range: 0 or 1
        See also: S255

The Z command disconnects the phone line
and resets the active configuration from the
user configuration values stored in non-
volatile memory. If the modem is off-hook
and/or in data mode, the modem goes on-
hook, drops the connection, and loads a
configuration specified by the command line
parameter as follows:

Z   Same as Z0.

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

        S255 = 0 use configuration A,
        A/B switch is disabled.

        S255 = 1 use configuration B,
        A/B switch is disabled.

        S255 = 255 use A/B switch to
        determine which configuration to
        load.

Z1   Modem resets and recalls User
        Configuration B.

Note: Any commands on the command line
following the Z(n) command are ignored.

&C(n)   Data Carrier Detect (DCD) Control
Range: 0 - 3
Default: 0
See also: S 47

The &C command controls the DCD signal interpretation to the local DTE. The parameters are as follows:

&C	Same as &C0.
&C0	The DCD signal is always ON.
&C1	When a carrier is detected from the remote modem, the DCD signal is turned ON after the CONNECT result code is sent to the DTE. The DCD signal is turned OFF when the carrier is dropped.
&C2	The DCD signal is always ON, except when it is pulsed OFF for a period of time, specified by the S47 register, while disconnecting a call.
&C3	DCD is the inverse of the Clear To Send (CTS) signal.

&D(n)   Data Terminal Ready (DTR) Interpretation
Range: 0 - 3
Default: 0
See also: &M(n), S25

The &D command defines the DTR signal interpretation from the DTE. The &Q command can override the behavior dictated by this command, which does not change the current value of the &D command.

The modem responds to changes in the DTR signal as follows:

&D   Same as &D0.

&D0   The modem assumes that DTR is always true.

&D1   Modem enters command mode when a filtered (filter time is defined by the S25 register) ON-to-OFF transition of DTR is detected. Auto answer ignores DTR.

&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 current user configuration parameters from nonvolatile memory.

&Fn   Load Factory Defaults
Range: 0 - 5, 8 - 13, 32 - 34
See also: S254, S255

This command loads the ROM-based factory defaults into the active configuration except for registers S254 and S255. The parameters are the following:

&F   Same as &F0.

&F0   TTY (factory default) - Load configuration according to the S254 register.

	Used with most asynchronous terminals or PC's emulating asynchronous terminal operation.
&F1	Unattended Answer Mode.
	Used with most asynchronous Front End Processor (FEP) host ports operating at a fixed interface speed of 9600 bps.
&F2	Intelligent Answer Mode
	Used with most computers running intelligent software, which interprets the modem result codes and adjusts the interface speed accordingly. Modem result codes are sent to the computer. The modem interface speed follows the connect speed.
&F3	System V (HDB) UUCP.
	Used with most HoneyDanBer UUCP UNIX systems. (You must have: /usr/lib/uucp/ Systems, Devices, and Dialers files).

For additional information when configuring the modem for UUCP protocol support, use your hardware and software configuration guides for your UNIX operating system or refer to the Nutshell handbook entitled *Managing UUCP and Usenet* published by O' Reilly and Associates, Inc.

For specific configuration guides, call your Technical Support representative, 408-734-5200.

&F4   Ver 2 (BSD) UUCP 4.2-4-3 and SCO Xenix.

Used with most Version 2 UUCP systems (You must have /usr/lib/uucp/L.sys and L-devices files).

For additional information when configuring the modem for UUCP protocol support, use your hardware and software configuration guides for your UNIX operating system or refer to the Nutshell handbook entitled *Managing UUCP and Usenet* published by O' Reilly and Associates, Inc.

For specific configuration guides, call your Technical Support representative, 408-734-5200.

&F5   Transparent Synchronous.

Used with most 9600 bps synchronous terminals or devices. Operates in V.32 transparent synchronous full-duplex mode at 9600 bps utilizing the DCE's clock.

&F8   IBM PC/Mac with SW flow control (XON/XOFF).

Used with most PC software packages, which support software (XON/XOFF) flow control.

&F9   IBM PC/Mac with HW flow control (RTS/CTS.)

Used with most software packages, which support hardware (RTS/CTS) flow control.

Note: In order to use RTS/CTS control on a Macintosh, the communications software must support the feature and a special cable must be used as recommended in the software documentation.

&F10   Leased Line - Asynchronous Originate Mode.

Used in any asynchronous point-to-point, 2-wire leased line V.32 application. The modem connects automatically on a leased line to another T1600 modem, configured with the AT&F11 command, in asynchronous V.32 mode at 9600 bps.

&F11   Leased Line - Asynchronous Answer Mode.

Used in any asynchronous point-to-point, 2-wire leased line V.32 application. The modem connects automatically on a leased line to another T1600 modem, configured with the AT&F10 command, in asynchronous V.32 mode at 9600 bps.

&F12   Leased Line - Synchronous Originate Mode.

Used in any synchronous point-to-point, 2-wire leased line V.32 application. The modem connects automatically on a leased line to another T1600 modem, configured with the AT&F13, command in synchronous V.32 mode at 9600 bps.

&F13 Leased Line - Synchronous
   Answer Mode.

   Used in any synchronous point-
   to-point, 2-wire leased line V.32
   application. The modem
   connects automatically on a
   leased line to another T1600
   modem, configured with the
   AT&F12 command, in
   synchronous V.32 mode at 9600
   bps.

&F32 Asynchronous/Synchronous
   &Q1.

   When the modem is not on-line,
   the primary data and clock line
   operate in asynchronous mode.
   But the modem switches to
   synchronous mode when a
   connection to another modem is
   established.

&F33 HP 3000 (host).

   Used with an HP 3000 host
   system utilizing ENQ/ACK flow
   control.

&F34 HP 3000 (terminal).

   Used with an HP terminal
   utilizing ENQ/ACK flow control,
   which calls an HP 3000 host
   system utilizing the same flow
   control.

Note: Refer to Appendix D, Prestored Con-
figurations, for additional information.

&G(n) Guard Tone Selection
Range: 0 - 2
Default: 0

This command selects the type of guard tones the answering modem should send in V.22 or V.22 bis mode, as follows:

&G	Same as &G0.
&G0	No guard tones.
&G1	550 Hz guard tone.
&G2	1800 Hz guard tone.

&J(n) Jack Type Selection
Range: 0 - 2
Default: 0

The &J command designates how the modem utilizes available telco leads, as follows:

&J	Same as &J0.
&J0	Auxiliary telco leads disabled.
&J1	A/A1 control selected.
&J2	MI/MIC control selected.

> *Note: The hardware jumpers must be con-figured correctly for proper operation. Refer to Appendix B, Interface Description.*

&L(n) **Leased Line**
Range: 0 or 1
Default: 0
See also: &Q, A, D, S100, S104

The &L command is used to place the modem into a mode of operation for usage on leased lines, as follows:

&L	Same as &L0.
&L0	The modem functions as a dial-up modem.
&L1	The modem functions as a leased line modem.

When a connection is initiated, the modem continously attempts to connect. The connection may be initiated through an A or D command, through DTR dialing (see S104 and &Q), or the T/D switch.

If a loss of carrier is detected the modem attempts to re-establish the connection continously.

If the call is disconnected by the user (T/D switch, H, Z, DTR drop), the modem does not attempt to re-establish the connection.

Note: Any modem function that references S1, references S0 instead, if &L1 is set.

&M(n) Async/Synch Mode Select
        Range: 0 - 3, 6
        Default: 0
        See also: &Q

The modem can be configured for asynchro-
nous, synchronous, or error control mode, as
follows:

&M	Same as &M0.
&M0	Asynchronous Mode. This command is equivalent to &Q0.
&M1	This command is equivalent to &Q1.
&M2	This command is equivalent to &Q2.
&M3	This command is equivalent to &Q3.

> *Note: The &M command is a subset of the*
> *&Q command, and since the functions are*
> *identical for each of the parameters of &M,*
> *only &Q is displayed in the &V display.*

&Q(n) Async/Synch Mode Select

Range: 0-3, 6
Default: 0
See also: S1, S25, S104

The &Q command determines the operating mode of the modem, either asynchronous or synchronous interface, as follows:

&Q   Same as &Q0.

&Q0   Asynchronous mode.
            Asynchronous interface used for command and data modes.

&Q1   Synchronous Mode 1. The modem operates in asynchronous mode until a connection is established, at which time the modem switches to synchronous mode. This transition is signalled by the OFF to ON transition of DCD if enabled), or by the CONNECT message.

            All result codes and messages are sent asynchronously. After DCD is true, the modem waits the number of seconds specified in S25 and checks DTR status. If DTR is ON, data connection is completed. If DTR is OFF, the modem hangs up and reverts to asynchronous mode.

            DTR must be ON within the time specified by the S25 register.

&Q2   Synchronous Mode 2. Similar to
            &Q1, but adds stored number
            dialing to the functionality. In
            this mode, S104 is ignored.

            OFF to ON transitions of DTR,
            causes the modem to dial a
            stored number location and
            attempts to establish a
            connection. If the A/B switch is
            in the A position, the first
            location is dialed and if the
            switch is in the B position, the
            second location is dialed. All
            other operation is identical to
            &M1.

&Q3   Synchronous Mode 3. Similar to
            &Q1, but adds initiation of a call
            attempt. In this mode, S104 is
            ignored. OFF to ON transitions
            of DTR causes the modem to
            attempt to establish a
            connection based on the S1
            value. If S1 = 0, the modem
            attempts to originate a call. If
            S1>0, the modem attempts to
            answer a call. All other
            operation is identical to &Q1.

&Q6   Transparent Synchronous Mode
            The command mode is disabled
            and a synchronous interface is
            always used. RS-232 signals
            are interpreted according to the
            various parameters stored in the
            modem, with one exception:

            If &D is set to 1, loss of DTR is
            ignored and the connection is
            not dropped.

&R(n)   Clear To Send (CTS) Control
Range: 0 - 4
Default: 3
See also: S26

The &R command determines how the modem uses the CTS control signal as follows:

&R	Same as R0.
&R0	When a connection is established, the CTS signal follows the RTS signal delayed by the period of time defined by the S26 register. CTS is ON when the modem is not connected to another modem.
&R1	When a connection is established, the CTS signal is turned ON after the modem sends the CONNECT result code, and stays ON for the duration of the connection.
&R2	When a connection is established, the CTS signal follows the RTS signal with a fixed (200 milliseconds) delay, and hardware flow control is honored if enabled. When the modem is not connected to another modem, the CTS signal is turned OFF.
&R3	CTS is always ON if hardware flow control is not enabled.
&R4	When a connection is established, the CTS signal follows the RTS signal delayed by the period of time defined by the S26 register. CTS follows DTR when the modem is not connected to another modem.

For &R0, &R1 and &R4, hardware flow control is overridden.

&S(n) **Data Set Ready (DSR) Control**
Range: **0 - 3**
Default: **0**
See also: **S47**

The &S command controls the Data Set Ready (DSR) signal. The parameters are as follows:

&S   Same as &S0.

&S0   DSR is always ON.

&S1   DSR is ON after the answer tone is detected and stays ON throughout the connection.

&S2   DSR is ON, except when it pulses OFF for a period of time, defined by S47, when disconnecting a call.

&S3   DSR is ON if DTR goes ON, or carrier is detected and DTR is present. DSR drops if DTR drops or carrier is lost.

&T(n) **Test Modes**
Range: **0, 1, 3 - 9**
Default: **4**
See also: S18, H, Z

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 connection between the two sites. When the modem is performing a test function, its Modem Ready (MR) indicator blinks at a rate of approximately once per second.

The parameters are as follows:

&T   Same as &T0.

&T0   Terminate the test in progress. To terminate a test, you can always use the H (hang-up) or Z (reset) command. Also, you can set the S18 register 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 wait for the CONNECT message before typing, then type a few sentences. If the modem echoes your keyboard input as you type, the local DTE and modem are operating correctly. Terminate the test by issuing an escape sequence and &T0 command.

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

&T4   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 modem 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 goes back on-line. Type a few sentences. They are 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 modem 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.
&T9	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 configuration of nonvolatile memory.

If the EEPROM checksum is incorrect, the factory default settings are used.

&Vn View Active Configuration
Range: 0
See also: S254, S255

The &V command displays the modem's active operational parameters, as follows:

&V	Same as &V0.
&V0	Display Active RAM configuration including S254 and S255 registers.

&W(n) Write Current Configuration
Range: 0 or 1
See also: S254, S255

This command writes the active configuration
in RAM to EEPROM. The value of registers
S254 and S255 are not stored by this com-
mand. The EEPROM configuration that is
written is determined by the parameter used.

The modem accepts any of the following &W
commands:

&W   Same as &W0.

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

           If S255 = 0, save configuration
           in A; A/B switch is disabled.

           If S255 = 1, save configuration
           in B; A/B switch is disabled.

           If S255 = 255 use A/B switch to
           determine in which configuration
           to save.

&W1   Writes current settings to
           Configuration B.

&X(n) Select Clock Source
Range: 0 - 2
Default: 0

The &X command selects the clock to be used for the modem transmitter when in a synchronous mode. The valid parameters are as follows:

&X   Same as &X0.

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

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

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

~H(n)   Help
       Range: 0 - 9

This command displays brief descriptions of all commands and registers used in the T1600 modem, which have been divided iinto pages for display purposes. A parameter of 1-9 displays the selected page. A parameter of 0 displays the first page, then places the modem into the interactive help mode. In interactive help mode,

       type P to go the previous page, or
       type Q to quit interactive mode.

Any other character will go to the next page.

~H	Same as ~H0
~H0	Puts you in interactive help mode. This mode is not available from remote access.
~Hn	Display page n of help text.

Note: Any commands on the command line following the ~H0 command are ignored.

~L   List Number Directory

The ~L command lists all entries stored in the number directory, entries from 0 through 9. Each entry is displayed on its own line. If there is no number currently set in a particular directory, the directory entry number is displayed alone.

~M(n) Modify Stored Configuration
Range: 0 or 1

This command modifies parameters in the specified configuration without affecting the current operating parameters. Commands following the ~M command in the command line will be addressed directly to the stored configuration. Commands that do not normally change any configuration elements are ignored in this mode.

The parameters are the following:

~M	Same as ~M0.
~M0	Modify configuration A.
~M1	Modify configuration B.

~N(n)=x Set Number Directory

The ~N command allows you to save any character string in the number directory. The string of digits and dialing control character, 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 70 characters. For example:

AT~N3=1234567\TEST\<CR>

Any string, including errors, may be saved in the number directory.

~U   Update Security Password
See also: S46

The U command allows you to change the system callback security password, which must be given when attempting to change the value of the S46 register. This password is also required when attempting to change an entry in the telephone number directory when callback security is enabled (S46 not equal to zero).

When the U command is entered, you are prompted for the old password (PEP is the factory default, which must be entered in upper case), the new password (which can be entered in any combination of uppercase and lowercase), and a confirmation of the new password.

After changing the password, you are asked for a new prompt string (up to 20 characters), which is to be displayed at the caller's terminal. The default value of this prompt string is Enter Password:. This prompt string can be retained by entering a carriage return.

> *Note: Any commands on the command line following the ~U command are ignored.*

~V(n)   View Nonvolatile Configurations
Range: 0 or 1

This command displays the nonvolatile modem configurations. A header displayed by this command designates which configuration is displayed (A or B).

~V	Same as ~V0.
~V0	Display EEPROM configuration A.
~V1	Display EEPROM configuration B.

%   Remote Modem Access
See also: S45

This command allows you to send commands to a remote modem as if the commands had been entered by the remote DTE.

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

AT%&V

reads the remote modem's active configuration.

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.

Local and remote commands can be entered on the same line. For example, to get the number of packets accepted and the line quality of the local modem, followed by the same information for the remote modem, enter:

ATS75?S78?%S75?S78?

> *Note: 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.

> *Note: When the T1600 modem is reset to the "TTY" configuration (&F0) via the front panel switches, S45 is set to 255 (enable remote access); this allows remote command access to the modem through an MNP connection.*

SIX

AT REGISTER DESCRIPTIONS

6
AT REGISTER DESCRIPTIONS

This chapter describes the registers used in the Telebit
Extended AT command set, which are used to store
and/or configure various options, in the T1600 modem.

- You may enter a command line of up to
  80 characters in uppercase or lowercase
  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.

Command Syntax

- If a command is typed without a value
  when one is expected, the modem
  defaults to a value of 0.

- A comma (,) used between commands
  causes the system 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.

- Blanks and tabs may be added to en-
  hance readability.

- The notation (n) in the command descriptions represents a decimal numeric option. The option should immediately follow the command.

- The notation (x) represents an assigned value.

- The parentheses should not be typed.

How to Modify a Register

The T1600 modem supports a number of definable registers. The modem remembers the last register queried or modified. For example, to set register S11 to 70, type:

ATS11=70   This sets S11 to a value of 70.

If you then type:

AT=95

This sets S11 to a value of 95 since the modem remembered that the last register modified was S11.

If an S command is used, with no number, the register number defaults to zero and the modem changes the value of S0. For example, the following are equivalent:

ATS0=3   This sets S0 to a value of 3.

ATS=3   This sets S0 to a value of 3.

Register Inquiry

Typing the ATS(n)? command allows you to read the contents of a given S register.

As in modifying a register, the modem also remembers the location of the last inquiry. For example, the following sequence of commands displays the contents of the S11 register twice:

ATS11?   This displays the value of S11.

AT?   This displays the value of S11.

When S is used with no number, the register number defaults to zero and the modem responds with the value of S0. For example:

ATS?   This displays the value of S0.

Register Concatenation

Register modifications and inquiries can be linked together on the same command line. For example:

ATS11?=60 This displays the value of S11 and then sets it to a value of 60.

Another example follows:

ATS11=60? This first sets S11 to the value of 60 and then display its contents.

Register Initialization

The modem is reset to the values stored in the nonvolatile memory if the power is turned OFF then ON, or the modem is reset by a Z or &T command.

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

S0   **Automatic Answer**
          Range: 0 - 255
          Default: 0

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 when the count is greater than
or equal to the value contained in this register.
S0=0 disables auto answer.

S1   **Ring Count**
          Range: 0 - 255

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

S2   **Escape Character**
          Range: ASCII Code 0 - 255
          Default: ASCII Code 43 (+)
          See also: S12, S48

The S2 register contains the code used as the
escape character. If S48=0, setting this register
to a value greater than 127 disables the recog-
nition of the escape character by the modem.

S3   Command Line Terminator
Range: ASCII Code 0 -127
Default: ASCII Code 13

The S3 register contains the code used as the carriage return character when in command mode. Attempting to set S3 to a value greater than 127 generates an ERROR response.

S4   Line Feed Character
Range: ASCII Code 0 - 127
Default: ASCII Code 10

The S4 register contains the code output as the line feed character when in command mode. Attempting to set S4 to a value greater than 127 generates an ERROR response.

S5   Backspace Character
Range: ASCII Code 0 - 127
Default: ASCII Code 8

The S5 register sets the backspace character. When this character is sent to the modem, it causes the modem to remove the last command line character.

The last character is also removed from the command buffer. This character does not back up over the AT prefix.

The allowable values for this register are ASCII codes 0 through 127. Values greater than 127 generate an ERROR response.

S6   **Pause Before Dialing**
         Range: 2 - 255
         Default: 2 (seconds)

The S6 register contains the length of time in seconds that the modem waits after going off-hook before dialing when a D command is encountered. This allows the telephone central office time to detect the off-hook condition and apply a dial tone.

S7   **Wait for Connection/Dial Tone Time**
         Range: 1 - 255
         Default: 40 (seconds)

The S7 register controls the time in seconds that the modem waits 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.

S8   **Comma Pause Time**
         Range: 0 - 255
         Default: 2 (seconds)

The S8 register contains the time in seconds that the modem waits when it encounters a comma in the command line, inside or outside of a dial string.

S9   Carrier Redetect Time
Range: 1 - 255
Default: 6 (600 milliseconds)

The S9 register contains the length of time that the modem waits before reconnecting to the phone line when a carrier has been detected after it has been lost. Each count represents 100 milliseconds.

S10   Carrier Loss Disconnect Time
Range: 1 - 255
Default: 14 (1.4 seconds)

The S10 register contains the amount of time the modem waits after the carrier has been lost before disconnecting the line. Each count represents 100 milliseconds. Setting register S10 to 255 causes the modem to wait until explicitly told to disconnect.

S11   Touch Tone Timing
Range: 50 - 255
Default: 70 (milliseconds)

The S11 register defines the time in milliseconds of the duration and spacing of the 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 Duration Timer**
          Range: 0 - 255
          Default: 0

This register determines the length of time in seconds a diagnostic test runs before being automatically terminated. If the register is left at its factory default setting of 0, the timer does not expire.

S25   **DTR Delay Timing**
          Range: 0 - 255
          Default: 5

The S25 register specifies the minimum time that the DTR signal needs to be OFF in order to be recognized, and specifies the number of seconds after a connection has been established before the modem checks for the presence of DTR.

The modem ignores DTR level changes with a duration of less than the value specified by the S25 register. Each unit represents 10 milliseconds.

When the modem is in Asynchronous/Synchronous Mode, S25 determines the number of seconds after a data connection has been synchronized before the modem looks at the DTR line. If DTR is ON at that time, the data connection is not disconnected.

S26   RTS to CTS Delay Interval
Range: 0 - 255
Default: 1 (100 milliseconds)
See also: &R

When &R0 is in effect and the modem detects an OFF-to-ON transition of the RTS signal, the modem delays the period of time specified by this register before turning the CTS signal ON. The units for this register are 100 milliseconds.

S38   Delay Before Disconnect
Range: 0, 1-254, 255
Default: 0

When the modem receives a command to hang up, it waits up to the number of seconds specified by this register before disconnecting. This is required in any 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.

Possible contents for this register are the following:

0	Discard buffered data and disconnect.
1-254	Attempt to transmit buffered data until completed. If the remote modem hangs up, or the S38 timer expires, the untransmitted data is discarded and the modems are disconnected.
255	Attempt to transmit buffered data until completed. If the remote modem hangs up, untransmitted data is discarded.

Note: If S38=255 the modem never times-out and it will disconnect only when all of the buffered data has been sent.

S41   Inactivity Time-Out
Range: 0 - 255
Default: 0

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

S45 Remote Access Enable
Range: 0 or 255
Default: 0
See also: S180, S181

The S45 register enables or disables access to the control functions of the modem from a remote modem.

To allow remote command access, an MNP connection must be established (S180=3), and this register on both modems must be set to 255 before establishing the connection.

Remote access is not enabled for a session unless these condition are met. Possible contents of this register are the following:

0	Disables remote access.
255	Enables/negotiates remote access.

S46 Modem Security
Range: 0 - 3
Default: 0
See also: ~U

Register S46 determines the type of call security to be carried out when an incoming call is answered.

To change the setting of this register, you are required to enter a password. The default system password is PEP, which must be entered in uppercase. This password can be changed by entering the ~U command.

Possible contents of the register are the following:

S46=0	Callback security disabled.
S46=1	Callback security enabled.
S46=2	Callback security enabled with password reverification.
S46=3	Pass through security enabled; no call back required.

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

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

If S46 is set to 3, the modem prompts the caller for a password. If a valid password is entered, the caller is immediately connected to the local DTE. No call back is required.

Note: These passwords are not the system password.

S47   DSR/DCD Delay Time
Range: 0 - 255
Default: 4 (200 milliseconds)
See also: &S, &C

The S47 register specifies the amount of time
that DSR and/or DCD is pulsed when carrier
is lost and &S2 or &C2 is in effect. Each
count represents 50 milliseconds.

S48   Control Character Mask
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 charac-
ter. Possible contents for this register are the
following:

0	The most significant bit of the 8-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 8-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 be used only when the local DTE is using 8 data bits with or without parity.

S50 Modulation Speed
Range: 0 - 3, 6, 254
Default: 0
See also: S94

The S50 register determines the modulation speed between modems. Possible contents for this register are the following:

0	Automatic speed determination.
1	300 bps operation (Bell 103 or V.21 Mode).
2	1200 bps operation (Bell 212A or V.22 Mode).
3	2400 bps operation (V.22 bis Mode)
6	9600 bps operation (V.32 Mode).
254	Attempt to connect at speed of last AT command.

If S94 is set to 0, the modem connects only at the speed specified by the S50 register, whereas if the S94 register is set to 1, it attempts 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.

If the S50 register is set to 0, the modem automatically determines the appropriate data transmission method.

If the S50 register is set to 1 or 2, the B command is used to select between the Bell and CCITT standards.

If the S50 register is set to 3, the modem operates in V.22 bis mode, and starts any search sequence at 2400 bps.

If the S50 register is set to 6, the modem operates in V.32 mode, and starts any search sequence at 9600 bps.

When the S50 register is set to either 2 or 3, the modem checks the &G command to determine what type of guard tone (if any) 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.

If the S50 register is set to 254, the modem automatically searches 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 V.32 connection would only be attempted if the last AT command was issued at 9600 bps or greater.

S51   DTE Interface Speed
Range: 0 - 6, 35, 43, 46, 252 - 255
Default: 255

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

When the connection is made and direct mode is enabled, 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, 253, 254 or 255 (autobaud).

Possible contents for this register are the following:

0	300 bps
1	1200 bps
2	2400 bps
3	4800 bps
35	7200 bps
4	9600 bps
43	12000 bps
46	14400 bps
5	19200 bps
6	38400 bps
252	Autobaud; type-ahead not permitted.
253	Autobaud; type-ahead permitted. Default to 38400 bps.
254	Autobaud; type-ahead permitted. Default to 19200 bps.
255	Autobaud; type-ahead permitted. Default to 9600 bps.

Note: When using autobaud, one of the following data formats must be used:
8-bit data, no parity
7-bit data, even/odd parity
7-bit data, mark/space parity

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 configuration was saved is the speed used to send RING and CONNECT messages when an incoming call is received.

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 253, 254 or 255 while in command mode.
- A data call is disconnected and the modem is placed on-hook.
- A break is received.
- A NO CARRIER condition is generated due to connect time has expired, (S7 register) dial command is aborted, or the carrier is lost.

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. This may be useful for communications software scripting.

If no command lines have been entered after powering on, the modem uses 38400 bps (S51=253), 19,200 bps (S51=254), or 9,600 bps (S51=255) to send RING and CONNECT messages when a call is received.

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 or 4.

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 or 4.

S58   DTE Flow Control
Range: 0 - 4
Default: 3
See also: S48, S56, S57, S68, S181,
S182

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 a buffered or error-control connection is
established. Possible contents of this register
are the following:

0	No flow control is used.
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 receives data from the local DTE. When the local DTE turns OFF RTS, the modem turns OFF CTS and sends buffered data to the local DTE.

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 sends data to the local DTE.
3	Use XON/XOFF flow control. If an XOFF is received by the modem, it stops 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 an 8-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 stops sending data to the local DTE. Sending is resumed when RTS is turned ON or an XON is received.

S59   CONNECT Suffixes
Range: 0 -15
Default: 0
See also: V

In Verbose mode (V1), each of the CON-NECT messages can have suffixes, which are separated by the slash (/) character, and are controlled by the S59 register. The numeric code associated with the root CONNECT message is the numeric result code, regardless of the value of S59. Refer to Appendix C for a description of the Result Codes.

S60 Data Format
Range: 0 - 4
Default: 0

The S60 register defines the format of the data sent over the serial interface between the local modem and the local DTE. Possible contents for this register are the following:

0	8 data bits, no parity (10-bit word size).
1	8 data bits, odd parity.
2	8 data bits, even parity.
3	8 data bits, mark parity.
4	8 data bits, space parity.

Note: For links that use 7 data bits and parity, leave S60 at the default of 0 to allow end to end parity checking.

S61 Local Action on Break
Range: 0 or 1
Default: 1

The S61 register determines how the modem reacts to the detection of a break signal on the serial interface. Possible contents for this register are the following:

0	Break is processed as defined in register S63.
1	Go into command mode.

S62   Break Length
Range: 0 - 255
Default: 15 (150 milliseconds)

The content of the S62 register determines the length of time a break signal places on the Receive Data (RD) line when a break is received from the remote modem during an Error Controlled connection. Each count represents 10 milliseconds.

S63   Link Layer Action on Break
Range: 0 - 3
Default: 0

The S63 register determines the modem's response when a break signal is transmitted by the local DTE during an error controlled connection. Possible contents for this register are the following:

0	Break is in sequence with the data.
1	Send break immediately.
2	Discard buffered data and send break.
3	Discard break.

S64   Dial/Answer Sequence Abort
Range: 0 or 1
Default: 0

The S64 register controls whether or not the modem aborts a dialing or answering sequence if characters are transmitted by the local DTE before a connection is established. Possible contents for this register are the following:

0	Abort the dialing or answering sequence if characters are 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.

S68   DCE Flow Control
Range: 0, 2, 3, 4, or 255
Default: 255
See also: S48, S56, S57, S58

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.

If S58 is set to 1, the contents 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.

Possible contents of the S68 register are the following:

0	No flow control is used.
2	Use full-duplex hardware 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 accepts 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. The format of the XON and XOFF characters is defined by the S48 register.
4	Use both XON/XOFF and RTS/CTS hardware flow control.
255	Use the flow control specified by S58.

S69   XON/XOFF Signal Handling
Range: 0 - 2
Default: 0

The S69 register determines how the XON/XOFF character is handled when XON/XOFF flow control is used by the local DTE. Possible contents for this register are the following:

0	XON/XOFF character is processed and discarded by the modem, and is not passed to the remote modem.
1	Reserved.
2	If the modem has previously received an XOFF/XON character, the XON/XOFF character is processed by the modem and is not passed on to the remote modem. If the modem has not received an XOFF/XON character, the XON /XOFF character is not processed, but is passed on to the remote modem.

> *Note: Registers S70, S72, S74, S75, and S78 provide statistical information, are read-only registers, and cannot be set by the user.*

S70   Transmit Modulation Rate

The S70 register indicates the modulation rate at which data is being transmitted to the remote modem in bits per second. S70 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 reinitializes this register.

S72   Receive Modulation Rate

The S72 register indicates the modulation rate at which data is being received from the remote modem in bits per second. 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 reinitializes this register.

S74   Packets Retransmitted

The S74 register contains a count of the number of received MNP or LAP-M packets requiring retransmission since the current connection was made. When the connection is broken, the register retains 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 MNP or LAP-M packets received since the current connection was made. When the connection is broken, the register retains the count until the next connection is attempted. S75 is a read-only register.

S78   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, V.22 bis, or V.32 modes. The quality is indicated on 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. This is a read-only register.

S90   DSRS Behavior
(Data Signal Rate Select)
Range: 0 or 1
Default: 0

The S90 register enables or disables the DSRS pin on the RS-232 interface. Possible contents of this register are the following:

0	Disables DTE/DSRS input.
1	Enables DTE/DSRS input on the RS-232 interface. If there is a conflict between the S94 register and the DTE/DSRS line, the DTE/DSRS line takes precedence if it specifies a fallback speed.

S93 V.32 AC Transmit Time
Range: 3 - 255
Default: 8 (800 milliseconds)
See also: S50

This register sets the amount of time the modem waits for a V.32 originate sequence before abandoning this mode, when the modem is in answer mode, and register S50 is set to 0 or 6. The default of 800 milliseconds works well with most V.32 modems. If you have some trouble connecting with some V.22 bis modems, try a shorter duration. For manual or "late answer" V.32 modems, a longer duration may be necessary. The units for this register are 100 milliseconds.

S94 Modulation Speed Negotiation
Range: 0 - 3
Default: 1
See also: S50, S90

The S94 register determines whether the modem connects at any speed up to the maximum specified by the S50 and S90 registers. This register is ignored when the S50 register is set to 0. The possible contents of the S94 register are the following:

0   Negotiation disabled. 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 that is supported by both modems. Fallback can occur within a given modulation scheme, or, if necessary, can go to another scheme.
2	Fallback within a specified modulation scheme only. The modem cannot use another scheme if the connection fails. Connect only at the speed specified by the S50 register, or the associated fallback speed.
3	Use appropriate fallback exclusively. Connect only in the modulation scheme specified by the S50 register.

Note: If forced fallback is specified, and the specified modulation has no fallback, the primary speed will be used.

S100   Reverse Answer/Originate Mode
Range: 0 or 1
Default: 0

The S100 register controls whether the
modem reverses the answer/originate protocol
used to establish a connection. Possible
contents for this register are the following:

0	Normal Mode. After dialing, the modem uses the originate protocol. If the R dial modifier is present, or after answering a ring signal, the modem uses the answer protocol.
1	After dialing, the modem uses the answer protocol. After answering a ring signal, the modem uses the originate protocol. The R dial modifier still causes the modem to use the answer protocol after dialing.

S102   Pulse Dial Make/Break Ratio
Range: 0 or 1
Default: 0

The S102 register is used to select the make/
break ratio used when pulse dialing. Possible
contents for this register are the following:

0	39% make/61% break ratio (US).
1	33% make/67% break ratio (UK).

S104   Automatic Dialing
Range: 0, 1, 3, 4
Default: 0
See also: S100, S105

The S104 register is used to enable automatic dialing via the DTR signal from the local DTE or from the front panel T/D switch.

Possible contents for this register are the following:

0	Disable automatic dialing.
1	Enable automatic dialing via an OFF to ON transition on the DTR control signal line. When DTR is ON, the modem goes off-hook and dials the first or second number in the Number Directory (the actual number is determined by the position of the A/B switch).
3	Enable automatic dialing from the front panel T/D switch. When the modem is idle (OH indicator is off), pressing the T/D switch causes the modem to go off-hook and automatically dial the first or second number in the Number Directory (the actual number is determined by the position of the A/B switch).
4	When the DTR signal goes from OFF to ON, the modem assumes the originate mode if the setting of register S1 is equal to 0. If the setting of register S1 is greater than 0, the modem assumes the answer mode.

For values 0 through 4, the S100 register applies unless it is overridden by an R dial modifier.

S105   T/D Switch Enable
Range: 0 -2
Default: 1

The S105 register enables or disables the T/D switch on the front panel. Possible contents for this register are the following:

0	Disable the T/D switch.
1	Enable the T/D switch.
2	Enable the T/D switch only when the modem is on-hook (OH indicator is off).

This register does not prohibit the use of the T/D switch when initializing the modem to its factory default settings.

S111   File Transfer Protocol Support
Range: 0, 10 - 14, 20, 30, 40, 41-43, 255
Default: 255

The S111 register determines which file transfer protocol, if any, should be supported during a communications session.

When protocol support is enabled, the modem interacts with the protocol to eliminate delays in the file transfer that normally occur with other high-speed modems. This significantly increases the data throughput rate without altering the protocol functionality. Possible contents for this register are the following:

0	No protocol is supported.
10	Kermit protocol with no parity supported.
11	Kermit protocol with odd parity

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.
40	ENQ/ACK protocol - Host.
41	ENQ/ACK protocol - Terminal.
42	ENQ/ACK protocol - Host not negotiated.
43	ENQ/ACK protocol - Terminal not negotiated.
255	Use protocol specified by remote modem.

Both modems must agree on the protocol supported; otherwise, no protocol is supported. If one modem has its S111 set to 255, it supports the protocol specified by the other modem. If both modems have the S111 register set to 255, no protocol is supported.

Note to UUCP Users:

For additional information when configuring the modem for UUCP protocol support, use your hardware and software configuration guides for your UNIX operating system or refer to the Nutshell handbook entitled *Managing UUCP and Usenet* published by O' Reilly and Associates, Inc.

For specific configuration guides, call your Technical Support representative.

Notes to Kermit Users:

The modem modifies the S packet exchange to force the use of Kermit without sliding windows.

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 (CTRL-A)

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

S180   Error Control Request
Range: 0 - 3
Default: 2
See also: S181, S182

The S180 register determines whether or not an error control connection should be attempted and also determines the type. Refer to Table 6-1. Possible contents for this register are the following:

0	Error control disabled.
1	V.42 without detection phase.
2	V.42 with detection.
3	MNP.

S181 Error Control Fallback
Range: 0 - 2
Default: 1

The S181 register determines the alternatives for the modem if an error controlled connection could not be negotiated or is turned off. Refer to Table 6-1. Possible contents for this register are the following:

0   If no error control, non-buffered mode.
     DTE = DCE speed.

1   If no error control, buffered mode.

2   If no error control is negotiated, the connection is dropped.

Table 6-1 displays how registers S180 and S181 values are set for error control mode and fallback.

Table 6-1. Error Control

Error Control Mode and Fallback			S180	S181
		Direct	0	0
LAP-M —>		Direct	1	0
LAP-M —>	MNP —>	Direct	2	0
	MNP —>	Direct	3	0
		Buffered	0	1
LAP-M —>		Buffered	1	1
LAP-M —>	MNP —>	Buffered	2	1
	MNP —>	Buffered	3	1
LAP-M —>	MNP		2	2
LAP-M only			1	2
	MNP only		3	2
No connection			0	2

S183   Error Control Detection Timer
Range: 8 - 255
Default: 28 (2.8 seconds)

This register determines the amount of time the modem waits for the LAP-M mode or MNP mode start pattern. The units for this register are 100 milliseconds.

S190   Data Compression Enable
Range: 0 - 8
Default: 1

The S190 register controls the negotiation of data compression in both transmit and receive directions. Possible contents of the register are as follows:

0	Disabled in both directions.
1	Enabled in both directions. Allows single on or both off.
2	Enabled in both directions. Allows receive only, disconnect if transmit only or both off.
3	Enabled in both directions. Allows transmit only, disconnect if receive only or both off.
4	Enabled in both directions; disconnect if not.
5	Enabled in transmit only; continue if not.
6	Enabled in transmit only; disconnect if not.
7	Enabled in receive only; continue if not.
8	Enabled in receive only; disconnect if not.

> **Note:** *In the case of MNP compression negotiation, the value of 0 disables MNP 5. If any non-zero value compression is enabled, MNP 5 is attempted.*

Table 6-2 displays how the S190 register values are set for data compression negotiation.

Table 6-2. S190 Data Compression Values

T R A N S M I T		RECEIVE		
		Allowed	Required	None
	A	1	2	5
	R	3	4	6
	N	7	8	0

S253 Command Set Selection
Range: 0 or 10,
Default: 10
See also: Z

The S253 register specifies the command set used by the modem. Once the register is set, the appropriate command set becomes active, along with that command set's operational properties, the next time a power-up or Z reset is executed. Possible contents for this register are the following:

0	No command set (modem does not respond to any commands).
10	AT asynchronous command set.

S254   &F0 Configuration Select
Range: 0, 1, 255
Default: 255
See also: &F

When the &F0 command is executed, the
S254 register defines the configuration that is
recalled. Possible contents for this register are
as follows:

0	Load configuration A.
1	Load configuration B.
255	Load factory defaults.

> *Note: An &F command does not change the setting of this register.*

S255   Configuration Select
Range: 0 , 1, 255
Default: 255

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

0	Recall User Configuration A after power up or reset. Disable A/B switch.
1	Recall User Configuration B after power up or reset. Disable A/B switch.
255	Recall user configuration specified by A/B switch after power up or reset. If A/B is set to A, then load A configuration on power-up; otherwise, load the B configuration on power-up.

This register also determines the configuration used when 0 is specified for any of the following commands:

Reset (Z).

Write Configuration Parameters (&W).

Note: An &F command does not change the setting of this register.

SEVEN

TROUBLESHOOTING

7
TROUBLESHOOTING

This chapter describes the diagnostic tests performed by the modem when it is powered up and provides user assurance test procedures along with troubleshooting guidelines if you encounter a problem while setting up or using the modem.

Diagnostic Tests

When power is turned on, the modem automatically runs a series of self-diagnostic tests. The results of these tests can be obtained by using the I1 command. This command returns a decimal number that represents the sum of the failure codes triggered during testing. If no errors are detected during the diagnostic tests, 000 (zero) is returned.

You can run the diagnostic tests at any time by using the &T9 command. However, you should not run the diagnostic tests during a current communications session as this disconnects the line and resets the modem. The &T9 command displays the results of the tests as a short message on the screen. If no errors are detected, the &T9 command returns a Diagnostics Complete message.

The diagnostic tests performed by the modem upon power up or when the &T9 command is issued are as follows:

ROM Test

RAM Addressing Test

RAM Read/Write Test

EEPROM Test

Loopback Test

Signal Processor Test

Successful completion of the first three tests means that the modem's firmware is intact and that the memory is functioning correctly.

During the EEPROM test, a checksum is read, which tests the integrity of the nonvolatile memory. If the checksum is correct, Profile A or B register settings stored in the EEPROM are loaded into memory. If the checksum is incorrect, the factory default settings are loaded. The configuration loaded is dependent on the current setting of the S255 register.

The final two tests check the loopback capability of the Digital/Analog Interface chip and verify that the Signal Processor chip is operating correctly.

User Assurance Tests

The following tests are intended to check those components not tested at power-up. You should be familiar with the contents of this manual and understand how to operate the modem. It is assumed that you can communicate with the modem through the RS-232D serial interface port using a terminal or personal computer.

Nonvolatile Memory Test

To verify that the modem's nonvolatile memory is working correctly, perform the following:

1. Enter one or two telephone numbers in the Number Directory.

2. Turn the modem off then back on, and verify that the new numbers are still present.

Telephone Dialer Test

To check the integrity of the analog/digital circuitry and telephone line interface, perfom the following:

1. Enter the following tone dialing command:

   AT DT 12345

2. Turn on the speaker and listen to the tones from the speaker to verify that the modem is tone dialing.

3. Press the RETURN key to hang up the line.

4. Enter the following pulse dialing command:

   AT DP 12345

5. Listen for the relay clicking sounds to verify that the modem is pulse dialing.

Ring Detect Test

The easiest way to check the modem's ring detection circuit is to disable the auto-answer feature by setting the S0 register to 0, and call the number to which the modem is connected. When the modem detects a ring signal, the word RING is displayed on the screen. The word should appear every four to six seconds to indicate the end of each ring signal.

If a telephone is connected to the TO PHONE connector on the rear of the modem, the telephone should also ring.

Remember to set the S0 register back to 1 if you plan on using the auto-answer feature.

Common Problems

If you encounter problems while setting up and using your modem, you can simplify the troubleshooting process by progressing in stages. This approach makes it easier to isolate and resolve any problems that you might encounter as you progress through the various stages.

This section covers the following three stages of establishing a communications link as follows:

* **Pre-Call Initialization** - focuses on ensuring that the modem and your equipment are properly configured for communications over the DTE-DCE interface.

  To confirm that the modem can in fact communicate with your equipment.

• **Call Establishment** - deals with
problems that may occur while
attempting to place or answer a call up
to the point at which data can be
exchanged across the communications
link.

If you have problems placing or
answering a cal.

• **Call In Progress** - addresses problems
that may occur while actually
transmitting information between two
locations.

Some of the problems that can occur
while a call is in progress are: lost or
garbled data, the modems unexpectedly
stop communicating, or the connection
is prematurely dropped. If you
experience problems in any of these
areas.

Modem Preconfiguration

Is the modem configured to operate in Asynchronous Mode and connected to an asynchronous DTE?

The modem and DTE must be operating in Asynchronous Mode while preconfiguring the modem.

Is the MR (Modem Ready) indicator on the front panel lit?

The MR light indicates that the modem is operational. If the indicator is off, try issuing an ATI1 command to obtain the results of the diagnostic tests. If you get no response or the test result code returned is not 000, try running the self diagnostics test again by turning the modem's power off and back on. If the MR indicator still does not light, contact your technical support representative for further assistance.

Issue an AT ~V? command to display the modem's current register settings.
Are double characters appearing on the screen?

Both the DTE and the modem are echoing characters to the screen. Disable local echo on your DTE. If this is not possible, then disable echo from the modem by issuing an ATE0 command to the modem.

Are you getting garbled data or no response from the modem?

Verify that the modem is connected to a functioning RS-232D port on your DTE, and that the RS-232D cable is configured correctly. Refer to Appendix B, *Interface Description.*

Make sure that the modem and DTE are both operating in Asynchronous Mode and are using the same interface speed and data format.

Configure the modem to meet the specific requirements of your system and save the configuration parameters in nonvolatile memory.

Refer to Chapter 3, *The Basics*, for configuration guide lines.

Placing a Call

Is the telephone line connected to the TO LINE connector on the modem's backpanel?

A common mistake is to connect the telephone line to the TO PHONE connector, which is used for connecting a telephone to the modem for voice communications. Connect the telephone line to the TO LINE connector on the modem's backpanel. Optionally, connect a telephone set to the TO PHONE connector.

Is the modem ready to accept commands or data from the DTE? The MR (Modem Ready), DTR (Data Terminal Ready) and CTS (Clear to Send) indicators should be lit.

The modem must be operational and able to communicate with the DTE before placing a call.

Send a dialing command sequence to the modem from your terminal or computer.

Be sure to include any required access codes and wait for dial tone characters (W) in the dialing sequence. If your call requires operator assistance, you can place a call manually using your telephone set, then press the T/D switch to cause the modem to go off-hook and listen for the called modem's answer tones.

Placing a Call (continued)

**Did the modem go off-hook and begin the dialing
sequence? You should hear a brief dial tone followed
by dialing sounds as the modem places the call. The
(Off-Hook) OH indicator should be lit.**

If the OH indicator did not light, the modem probably did not
recognize the dial command. Try entering the command
again. Be sure to precede the command with an AT prefix
and follow the command with a carriage return. Verify that
the modem is properly configured to communicate with your
equipment.

If you did not hear a dial tone before the modem started
dialing, connect a telephone to the telephone line and listen
for a dial tone. If you do not hear the dial tone, the tele-
phone line is dead. Contact your telephone company
service representative for assistance.

**Did the telephone ring at the remote site? You should
hear a ringing signal over the speaker.**

Depending on how quickly the remote site answers the call,
you may not hear a ringing signal. If you hear the answer-
ing modem's answer tones, you can assume that the remote
site answered the call.

Make certain that you entered the correct dialing sequence.
If you are going through a Private Branch Exchange (PBX),
you may need to enter 9W to access an outside line and wait
for a second dial tone. The S7 register determines
how long the modem waits for a dial tone when a W is
entered in a dialing sequence.

If your call is routed through key systems, security devices,
or similar equipment, additional access digits might be
required, and it may take longer to set up the call. One or
more commas can be used in the dialing sequence to
cause the modem to pause when necessary. The length
of the pause is determined by the S8 register.

You may need to extend the time that the modem waits for a
carrier by increasing the value of the S7 register.

Placing a Call (continued)

It is possible that the touch tone speed is too fast for the phone switching equipment, which occasionally happens with older phone equipment. Try lengthening the touch tone timing specified by the S11 register.

Did the remote modem answer the call? You should hear answer tones from the remote site over the speaker.

If the phone continues to ring with no answer, verify that you are dialing the correct number. Ask the operator at the remote site to confirm that their equipment will answer the phone.

If the ringing signal stops, but you do not hear the answer tones from the answering modem, ask the operator at the remote site to check their equipment and connections.

Did the modems at both ends synchronize?

Verify that the modems at both ends agree on the transmission mode used. The S50 register determines the transmission mode used by the modem. If this register is not set for Automatic Speed Determination (S50=0), it must match the transmission speed of the remote modem.

If the modem goes on-hook (the OH indicator turns off) during synchronization, you may need to extend the time that it waits for a carrier by increasing the value of the S7 register.

If you are calling a V.22 or V.22 bis-type modem, you should also check the setting of the B command and the &G command. The B command is used to select either 212A (B1) or V.22 (B0) emulation when operating at 1200 bps. Some V.22 or V.22 bis modems use guard tones during synchronization. Try changing the setting of the &G register to use either a 1800 Hz guard tone (&G2) or a 550 Hz guard tone (&G1), if you have problems synchronizing in V.22 or V.22 bis.

Placing a Call (continued)

If expected, did you receive a valid (ungarbled) sign-on message from the remote site?

Sign-on procedures vary from one system to another. You may need to press the space bar or take some other action to get the sign-on message. Refer to the system's operating instructions for the appropriate procedure.

If after taking the appropriate action you still do not receive a sign-on message, or the message is garbled, there may be some problem with the interface speed between the DTE and modem at either end, or a mismatch in the data format (usually parity) used between the DTEs at each site.

Answering a Call

Is the MR (Modem Ready) indicator on the modem's front panel lit?

The MR light indicates that the modem is operational. If the indicator is off, the modem failed the power up diagnostic test. Contact your technical support representative for further assistance.

Did the modem answer an incoming call by going off-hook when a ringing signal was received? The OH (Off-Hook) indicator should be lit.

If register S0 is set to 0, the modem does not automatically answer an incoming call. To enable auto-answer mode, set this register to the ring number on which the modem should answer a call.

For certain &D values, the modem does not answer an incoming call while Data Terminal Ready (DTR) is OFF. Your equipment should provide this signal when it is ready to transmit or receive data, or in response to a ringing signal on the Ring Indicator (RI) signal line of the RS-232D interface.

If the DTR indicator on the front panel is not lit, verify that the RS-232D cable is configured correctly. If your equipment asserts DTR in response to a ringing signal, verify that it is receiving a signal on the RI line, and turning ON DTR at the appropriate time.

Try placing the same call with a telephone set on each end
of the connection. If the call cannot be placed with tele-
phone sets, it will not work with modems.

**Did the modem answer the call and then hang-up
before a connection was established? This can occur
very rapidly so that the Off-Hook (OH) indicator is
barely noticeable. The caller may hear a pair of clicks
after the last ring.**

Make certain that your equipment is not sending a sign-on
message before Data Carrier Detected (DCD) is turned on.
This could cause the modem to hang-up. Note that setting
S64 to 1 causes the modem to ignore any characters sent
by the local DTE while dialing or answering a call.

If the modem is configured to show status messages, your
equipment may be echoing the status message back to the
modem causing it to hang-up. To solve this problem, turn
off echo and place the modem in quiet mode by issuing the
E0 and Q1 commands.

For certain &D values, the modem disconnects a call if DTR
is dropped. Make certain that your equipment is not turning
OFF DTR during a call. Your equipment may be periodically
switching DTR ON and OFF while searching for an active
device (looking for an active DSR or DCD signal from a
modem). Try setting &C and &S to 0 to enable both of these
signals. If you cannot configure your equipment to provide
DTR, set &D to 0 so that the modem does not hang up when
DTR is not present.

Did the modems at both ends synchronize?

Verify that the modems at both ends agree on the transmis-
sion mode used. The S50 register determines the transmis-
sion mode used by the modem. If this register is not set for
Automatic Speed Determination (S50=0), it must match the
transmission speed of the calling modem.

Answering a Call (continued)

When the modem answers a call in Automatic Speed Determination mode, it steps through several different answer tones to allow the calling modem to synchronize on the appropriate tone. The calling modem may need to extend the time that it waits for a carrier before disconnecting to allow time for the modem to arrive at the correct answer tone.

If the calling modem is a V.22 or V.22 bis-ttype modem, you should also check the setting of the B command and the &G command. The B command register is used to select either 212A (B1) or V.22 (B0) emulation when operating at 1200 bps. Some V.22 or V.22 bis modems use guard tones during synchronization. Try changing the setting of the &G command to use either a 1800 Hz guard tone (&G2) or a 550 Hz guard tone (&G1) if you have problems synchronizing in V.22 or V.22 bis.

If expected, did the calling modem receive a valid (ungarbled) sign-on message from the remote site?

Sign-on procedures vary from one system to another. The caller may need to press the space bar or take some other action to get the sign-on message. Ask the operator at the calling site to confirm that they are following the correct sign-on procedure.

If after taking the appropriate action, the caller still does not receive a sign-on message, or the message is garbled, there may be some problem with the interface speed between the DTE and modem at either end, or a mismatch in the data format (usually parity) used between the DTEs at each site.

At this point, the modem should be capable of communicating with the calling modem.

Call in Progress

Is data (or the sign-on message) being garbled during transmission?

If a connection has been made (CD indicator is lit), the line quality of the connection may be inadequate for error-free transmission. Hang up and try placing the call again. The probability of getting the same connection is unlikely.

There may be some problem with the interface speed between the DTE and modem at either end, or a mismatch in the data format (usually parity) used between the DTEs at each site.

Ask the operator at the remote site to confirm that they do not have an interface speed mismatch at their end.

Check the setting of the S60 register. Except for a few rare cases, this register should be set to 0, which permits end-to-end parity checking between DTEs as well as providing a transparent data path for binary file transmissions.

Verify that the data format (data length, parity, and stop bits) used by your DTE matches the data format used by the DTE at the remote site. Refer to your equipment's manual for instructions on setting the data format.

Is data being lost during transmission?

Most problems with loss of data during transmission result from a mismatch in the flow control method used between the modem and the DTE at either end. Data in the DTE or modem's buffer is being overwritten.

The modem uses two registers to control the flow of data between the DTE and the modem. The S58 register controls data flow over the Received Data (RD) line to the DTE. A similar register, S68, controls data flow over the Transmitted Data (TD) line to the modem. The two most common flow control methods supported by the modem are XON/XOFF or RTS/CTS.

Call In Progress (continued)

Check your equipment's manual to determine which type of flow control method it supports, and set the S58 and S68 registers to match that flow control method.

The DTE may not be responding to the flow control signal soon enough to avoid a buffer overflow condition.

Did either modem unexpectedly stop transmitting or receiving data?

The calling modem, answering modem, or both modems may have been inadvertently placed in Command Mode by a break signal or escape sequence. Registers S61 and S63 determine how the modem responds to a break signal. The escape sequence, during a data connection, provides you with a way to enter command mode. An escape sequence contains three consecutive escape characters defined by the S2 register and bordered by the proper guard time specified by the S12 register. You may need to change the setting of these registers to prevent the modem from entering Command Mode at an inappropriate time.

> *Note: If the modem is installed in an unattended answer environment, these registers should usually be set to not enter Command Mode under any condition.*

If the answering site's modem is configured to ignore the DTR signal (&D0), it maintains the connection even if its DTE drops DTR due to inactivity or some other condition. If this happens, the calling site must terminate the connection, and if desired reinitiate the call.

Was the connection dropped prematurely?

If a connection has been made (CD indicator is lit), the carrier signal may have been dropped due to a degradation in the line quality of the connection. Try placing the call again. The probability of getting the same connection is unlikely.

If the modem's &D command is set to 2 or 3, and its associated DTE drops DTR due to inactivity or some other condition, the modem disconnects the call.

Troubleshooting   *7-15*

EIGHT

WARRANTY AND
REPAIR PROCEDURES

8
WARRANTY AND
REPAIR PROCEDURES

Telebit Corporation has made every effort to ensure that the product you have purchased is of excellent quality in all respects. Telebit products are rigorously tested and subjected to strict quality control procedures. However, if you experience difficulty in the use of this product, or it does not appear to operate correctly, we suggest doing the following:

- Read this manual. It has been provided to help you configure and use your modem.

- Contact your dealer. Telebit authorized dealers are familiar with Telebit's products and should be able to help you resolve any problems that you may encounter while setting up and using the modem.

- Finally, call Telebit's Technical Support at 408-734-5200. Before calling, please have all the following information about your unit available:

  Product Name

  Serial Number

  Date of Purchase

  Place of Purchase

Install the modem on a system close to your telephone, before calling Telebit Technical support. The Technical Support representative will want to test the modem with you.

If your product should require service, we will repair or replace it under the terms of our One-Year Limited Warranty. Please read the warranty statement included in this chapter, and return the Warranty Registration Card at the back of this manual.

When the One-Year Limited Warranty period expires, Telebit will continue to service your product for the current applicable service fee. If you wish, you may extend your warranty protection for an additional two years by purchasing the Two-Year Limited Warranty Extension anytime before the first year warranty expires. The limited warranty will then be for a total of three years from the purchase date.

However, there is a cost savings if you purchase this option within 10 days of the original equipment purchase date.

Return for Repair Procedure

The following procedure describes how to return the unit to Telebit for repair. This procedure is applicable to both in and out of warranty repairs.

1. Call Telebit's Technical Support Department at 408-734-5200 and describe the problem. Be prepared to test the unit with the service representative. Tell the technical support representative if your unit is, or is not, covered by warranty. They will issue you an RMA number.

    If the unit is covered by a warranty, but not registered, you must submit proof of purchase.

*If you do not have proof of purchase, or your unit is not covered by the warranty, you must send the **current repair fee** with your unit.*

The technical support representative will provide you with that information and any further instructions if necessary.

2. Pack the unit in its original container or in a sturdy corrugated box using *non-static* material, such as newspaper, as a cushion. *Do not* use highly static-prone material such plastic wrap or Styrofoam packing material (beads or peanuts) as they may further damage the unit in transit.

3. Ship the unit only. Do not ship manuals, power supply or phone cord unless your technical support representative instructs you to do so.

4. Include the following information with your unit:

    Name

    Address

    City, State, Zip Code

    Telephone Number

    RMA Number

    Description of the problem

    Current Repair Fee (if applicable)

5. Ship the unit (for repair) freight prepaid to:

    Telebit Corporation

    1315 Chesapeake Terrace

    Sunnyvale, CA 94089

    Attention: Technical Support RMA #

    We recommend that you insure the unit when shipped. *Telebit will not accept units shipped C.O.D.*

6. Telebit will ship the repaired or replacement product at no cost to you to any destination in the U.S.A. Telebit will choose the carrier and method of shipment. If you desire some other specific form of conveyance, or you are located outside the U.S.A., you must bear the cost of return shipment and other incidental costs.

One-Year Limited Warranty

Telebit Corporation (Telebit) warrants the hardware products and all components thereof against defects in materials and/or workmanship for one year from the date of your original retail purchase.

If you discover a malfunction or defect in materials or workmanship, Telebit, at its option, will repair or replace the product or component at no charge to you, provided you return it, as set forth above, during the warranty period.

Telebit will furnish repair parts and replacement products on an exchange basis; all returned parts and products become Telebit's property. Repairs and replacements may be either reconditioned or new. Telebit will make the final determination as to the existence and cause of any alleged defect. If a returned product shows "no trouble found," Telebit may assess a repair charge.

Telebit does not warrant that any product will operate uninterrupted or without error. The warranty is contingent upon proper use of the product in the application for which it is intended.

The warranty will be void on products that have been subjected to abuse, misuse, accident, alteration, neglect, unauthorized repair or installation; modified without Telebit's approval; subjected to unusual physical or electrical stress; or used with a power supply other than the one provided with the product. Expendable items (such as lamps and fuses) are not warranted. This limited warranty is extended only to the original purchaser and is not assignable.

THE WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHERS, ORAL OR WRITTEN, EXPRESS OR IMPLIED. TELEBIT MAKES NO EXPRESS OR IMPLIED WARRANTIES INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, EXCEPT AS EXPRESSLY SET FORTH IN THIS LIMITED WARRANTY.

SOFTWARE AND DOCUMENTATION
IS PROVIDED ON AN AS IS BASIS. IN
NO EVENT SHALL TELEBIT BE LI-
ABLE FOR ANY INCIDENTAL OR
CONSEQUENTIAL DAMAGES, COSTS
OR EXPENSES ARISING OUT OF OR IN
CONNECTION WITH THE USE OR
PERFORMANCE OF ANY PRODUCT
DELIVERED HEREUNDER.

> *Note: Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages for consumer products, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.*

Please see *Return for Repair Procedure* in this chapter for specific instructions on returning products for service.

You may extend the limited warranty period for an additional two years by purchasing the Two-Year Limited Warranty Extension. The limited warranty will then be for a total of three years from the purchase date.

Two-Year Limited Warranty Extension

You can extend your one year limited warranty for an additional two years by paying a reasonable one-time fee. This fee guarantees repair or replacement of a faulty unit as often as required while it is under warranty subject to the same terms and conditions as the Telebit One-Year Limited Warranty. The warranty period will then be for a total of three years from the date of purchase. You may purchase this warranty extension at any time before the One-Year Limited Warranty expires.

If you purchase this warranty extension within 10 days of the date you purchase the modem, the price of the extended warranty is reduced. Contact your sales representative or Telebit's Technical Support Department for the current pricing options for your product. Be prepared to provide them with the product name, serial number, and date and place of purchase.

You may also purchase this warranty extension by completing Part 2 of the Warranty Registration Card and returning it to Telebit.

APPENDICES

A
ASCII CODE CHART

Code	Mnem	Dec	Hex	Code	Dec	Hex	Code	Dec	Hex	Code	Dec	Hex
	NUL	00	00	SP	32	20	@	64	40	`	96	60
CTRL A	SOH	01	01	!	33	21	A	65	41	a	97	61
CTRL B	STX	02	02	"	34	22	B	66	42	b	98	62
CTRL C	ETX	03	03	#	35	23	C	67	43	c	99	63
CTRL D	EOT	04	04	$	36	24	D	68	44	d	100	64
CTRL E	ENQ	05	05	%	37	25	E	69	45	e	101	65
CTRL F	ACK	06	06	&	38	26	F	70	46	f	102	66
CTRL G	BEL	07	07	'	39	27	G	71	47	g	103	67
CTRL H	BS	08	08	(	40	28	H	72	48	h	104	68
CTRL I	HT	09	09	)	41	29	I	73	49	i	105	69
CTRL J	LF	10	0A	*	42	2A	J	74	4A	j	106	6A
CTRL K	VT	11	0B	+	43	2B	K	75	4B	k	107	6B
CTRL L	FF	12	0C	,	44	2C	L	76	4C	l	108	6C
CTRL M	CR	13	0D	-	45	2D	M	77	4D	m	109	6D
CTRL N	S0	14	0E	.	46	2E	N	78	4E	n	110	6E
CTRL O	SI	15	0F	/	47	2F	O	79	4F	o	111	6F
CTRL P	DLE	16	10	0	48	30	P	80	50	p	112	70
CTRL Q	DC1	17	11	1	49	31	Q	81	51	q	113	71
CTRL R	DC2	18	12	2	50	32	R	82	52	r	114	72
CTRL S	DC3	19	13	3	51	33	S	83	53	s	115	73
CTRL T	DC4	20	14	4	52	34	T	84	54	t	116	74
CTRL U	NAK	21	15	5	53	35	U	85	55	u	117	75
CTRL V	SYN	22	16	6	54	36	V	86	56	v	118	76
CTRL W	ETB	23	17	7	55	37	W	87	57	w	119	77
CTRL X	CAN	24	18	8	56	38	X	88	58	x	120	78
CTRL Y	EM	25	19	9	57	39	Y	89	59	y	121	79
CTRL Z	SUB	26	1A	:	58	3A	Z	90	5A	z	122	7A
	ESC	27	1B	;	59	3B	[	91	5B	{	123	7B
	FS	28	1C	<	60	3C	\	92	5C	|	124	7C
	GS	29	1D	=	61	3D	]	93	5D	}	125	7D
	RS	30	1E	>	62	3E	^	94	5E	~	126	7E
	US	31	1F	?	63	3F	_	95	5F	DEL	127	7F

B

INTERFACE DESCRIPTION

Telephone Network Interface

The modem is connected to the telephone network through an RJ-11 modular connector. Table B-1 presents a definition of the pins in the line connector.

Table B-1. Phone Line Connector Pin Definitions

PIN	LINE	PHONE
1	Not Used	Not Used
2	A or MI	A1 or MIC
3	Ring	Tip
4	Tip	Ring
5	A1 or MIC	A or MI
6	Not Used	Not Used

Before the A/A1 or MI/MIC function can be implemented, the hardware jumpers on the modem board need to be properly positioned. Figure B-1 on the following page shows the location of the jumpers on the board and the position of the jumpers for the MI/MIC function. To use the A/A1 function, move the jumper to the opposite position.

Set the &J command to enable the selected function.
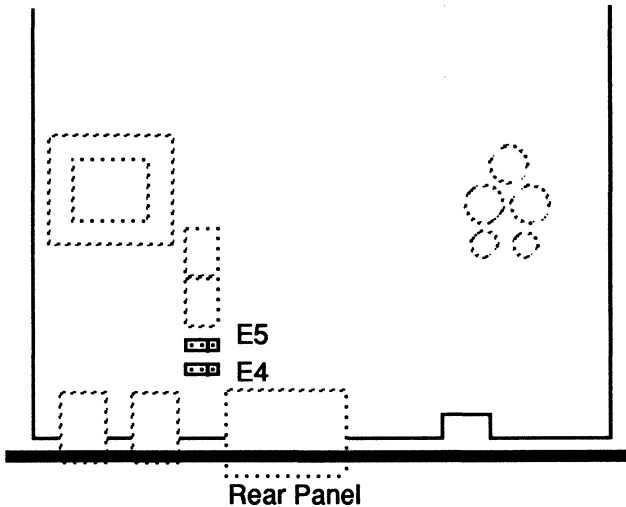
Figure B-1. Jumper Placement

RS-232D Interface

Communication between the modem and the local DTE is accomplished through a 25-pin RS-232D connector.

The RS-232D standard is a set of specifications developed by the Electronic Industries Association (EIA) that applies to the transfer of data between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE). It is the most common DTE-DCE interface in use in the United States, and is compatible with the International Telegraph and Telephone Consultative Committee Recommendation V.24 and V.28.

The RS-232D standard covers three specific areas:

1. The electrical and mechanical character-istics of the interface.

2. The function of each interchange circuit.

3. Standard subsets of interchange circuits for specific communication system applications.

A specific connector is not defined. However, the DB-25 connector is almost universally associated with the RS-232D interface. Table B-2 lists the RS-232D interchange signals and their associated pins.

Table B-2. RS-232D Connector Pin Assignments

Pin	EIA Circuit	CCITT Circuit	Signal Description	From DCE	To DCE
1	AA	101	Protective Ground	X	X
2	BA	103	Transmitted Data (TD)		X
3	BB	104	Received Data (RD)	X	
4	CA	105	Request to Send (RTS)		X
5	CB	106	Clear to Send (CTS)	X	
6	CC	107	Data Set Ready (DSR)	X	
7	AB	102	Signal Ground	X	X
8	CF	109	Data Carrier Detected (DCD)	X	
9	-	-	Reserved for Test		
10	-	-	Reserved for Test		
11	-	-	Unassigned		
12	CI	122	DCE Signal Rate Select	X	
13	SCB	121	Secondary Clear to Send	X	
14	SBA	118	Secondary Transmitted Data		X
15	DB	114	DCE Transmitter Signal Element Timing	X	
16	SBB	119	Secondary Received Data	X	
17	DD	115	Receiver Signal Element Timing	X	
18	LL	141	Local Analog Loopback		X
19	SCA	120	Secondary Request to Send		X
20	CD	108.2	Data Terminal Ready (DTR)		X
21	RL/CG	140	Remote Digital Loopback		X
22	CE	125	Ring Indicator (RI)	X	
23	CH	111	DTE Signal Rate Selector		X
24	DA	113	DTE Transmitter Signal Element Timing		X
25	TM	142	Test Mode	X	

Test Signals

Remote Digital Loopback

Pin 21 (Remote Digital Loopback) is used by the
local DTE to place the modem into remote digital
loopback. The modem must have a connection
established with a remote modem, and must be in the
data mode. When Pin 21 is turned ON, the modem
loopbacks all data received from the remote modem.
When Pin 21 is turned OFF, the modem returns to the
data mode.

Local Digital Loopback

Pin 18 (Local Digital Loopback) is used by the local
DTE to put the modem into local digital loopback.
The modem should be off-line and in the command
mode. When Pin 18 is turned ON, the modem enters
local digital loopback. All data received on the
primary transmit data pin (Pin 2) is looped back on
the primary receive data pin (Pin 3). When Pin 18 is
turned OFF the modem returns to the off-line
condition.

Test Mode

Pin 25 (Test Mode) is a signal from the modem to the
local DTE signifying that the modem is in a test
mode. The test mode may be initiated either through
the &T commands, or the Remote Digital or Local
Digital Loopback RS-232 pins.

Rate Select Signals

DTE Signal Rate Select

Pin 23 (DTE Signal Rate Select) is used by the local DTE to select between a primary signalling rate and the fallback rate. The only modulation modes where Pin 23 may be used are V.32 (9600 bps with 4800 bps fallback) and V.22 bis (2400 bps with 1200 bps fallback). Use of Pin 23 is enabled by setting S90=1 (for V.22 bis, B0 must also be set). If Pin 23 is ON prior to the completion of a connection, the T1600 attempts to connect only at the primary rate.

If Pin 23 is OFF, then only the fallback rate is attempted. If this pin is not driven by the local DTE, it assumes the ON condition.

DCE Signal Rate Select

Pin 12 (DCE Signal Rate Select) is generated by the modem to inform the local DTE of the current connection rate. The only modulation modes where Pin 12 is valid are V.32 (9600 bps with 4800 bps fallback) and V.22 bis (2400 bps with 1200 bps fallback). When Pin 12 is ON, the connection was made at the primary rate. When Pin 12 is OFF, the connection was made at the fallback rate.

RS-232D Primary Interchange Signals

The modem hardware supports all data, control and timing signals defined by the RS-232D standard. However, when operating in Asynchronous Mode, the modem uses only the primary interchange circuits defined in Figure B-2. This figure shows the cable configuration for connecting the modem to a standard DTE device.

DTE   **Modem**

DTE	Signal	Modem
1	Protective Ground	1
7	Signal Ground	7
2	Transmitted Data (TD) →	2
3	← Received Data (RD)	3
4	Request to Send (RTS) →	4
5	← Clear to Send (CTS)	5
20	Data Terminal Ready (DTR) →	20
6	← Data Set Ready (DSR)	6
8	← Data Carrier Detected (DCD)	8
22	← Ring Indicator (RI)	22
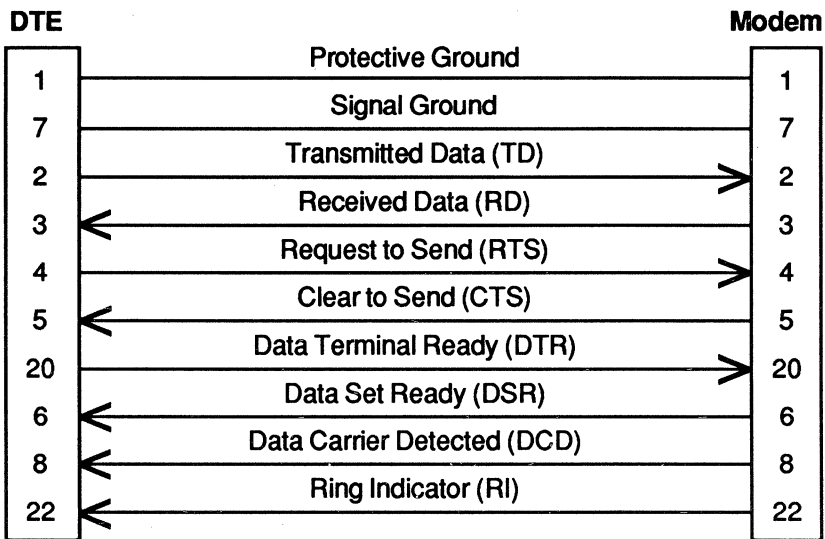
Figure B-2. Asynchronous RS-232D Cable Diagram
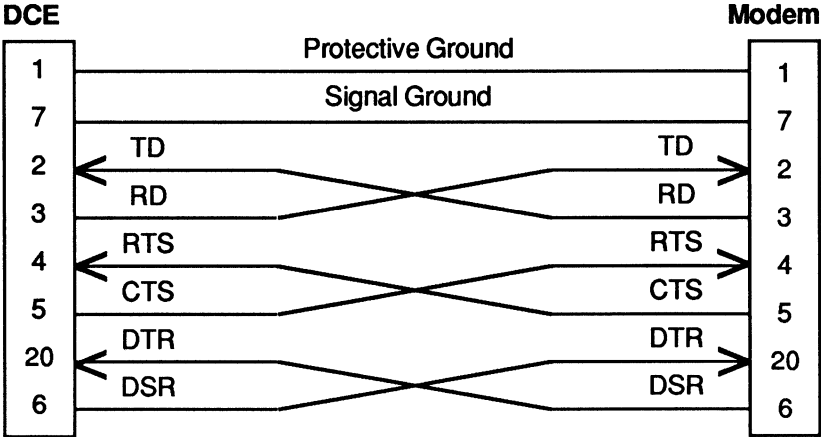
Figure B-3. Special Asynchronous RS-232D Cable Diagram

For systems that require the modem to act as a DTE connected to a DCE device, a specially modified RS-232D cable must be used. Figure B-3 shows a recommended cable arrangement for this case. Your system may require a different cable configuration. Consult your equipment manual for specific cabling requirements.

The primary interchange signals used by the modem in Asynchronous Mode are described in the following sections.

Protective and Signal Ground

Pin 1 (Protective Ground) should be electrically connected to the frame or chassis of the equipment. The equipment may be further connected to an external earth ground as required by local electrical codes. Pin 7 (Signal Ground) is the common reference signal ground for all of the other pins. This line should be connected at both ends to complete the signal circuits.

Transmitted Data (TD) and Received Data (RD)

These two signal lines are used for transferring data between the DTE (computer or terminal) and the DCE (modem). All signal names are as viewed from the DTE. Therefore, the DTE transmits data on the Transmitted Data line (pin 2), and receives data on the Received Data line (pin 3). On the other hand, the DCE receives data from the DTE on the Transmitted Data line (pin 2), and sends data to the DTE on the Received Data line (pin 3).

Request to Send (RTS) and Clear to Send (CTS)

According to the RS-232D standard, the DTE asserts Request to Send (RTS) on pin 4 when it has data to transmit. It then waits for the DCE to respond by asserting Clear to Send (CTS) on pin 5 before sending data to the DCE via the Transmitted Data (TD) line.

Depending on its register settings while operating in Asynchronous Mode, the modem uses RTS and CTS to implement hardware flow control between the DTE and the modem.

Data Terminal Ready (DTR) and Data Set Ready (DSR)

Pin 20 (Data Terminal Ready) is used by the DTE to indicate its readiness to transmit or receive data. In automatic answer mode, DTR is activated in response to the ring indicator to tell the modem to answer the call. The DTR signal may be turned ON whenever the DTE is ready to transfer data over the interface, or simply used to indicate that the DTE has been turned on.

The modem can be configured to interpret the DTR signal in a couple of different ways thus allowing it to interface with a variety of DTE devices that may use DTR differently.

Pin 6 (Data Set Ready) is used by the modem to indicate its readiness to transmit or receive data. Data Set is another term for the modem typically used by the Bell Operating Companies.

Like the DTR signal, the modem can be configured to use the DSR signal in a variety of ways to meet the expectations of the DTE device.

Data Carrier Detected (DCD)

Although this signal line is actually named *Received Line Signal Detector* in the RS-232D standard, the term Data Carrier Detected is more commonly used. An active level on pin 8 (Data Carrier Detected) indicates to the DTE that the modem has received a signal over the telephone network, which meets its criteria for an acceptable carrier signal.

Depending on the requirements of the DTE device, the modem can be configured to hold DCD active whether or not a carrier is detected, or to activate DCD only when an acceptable carrier signal is detected.

Ring Indicator (RI)

Pin 22 (Ring Indicator) is used by the modem to inform the DTE that the telephone is ringing. The Ring Indicator (RI) signal is asserted in cadence with the ringing signal on the telephone line. When the ringing voltage is present, RI is active. Between rings, RI is OFF.

The modem can be configured to automatically answer an incoming call, or to answer the call only when the DTE indicates that it is ready to accept the call by asserting the DTR signal.
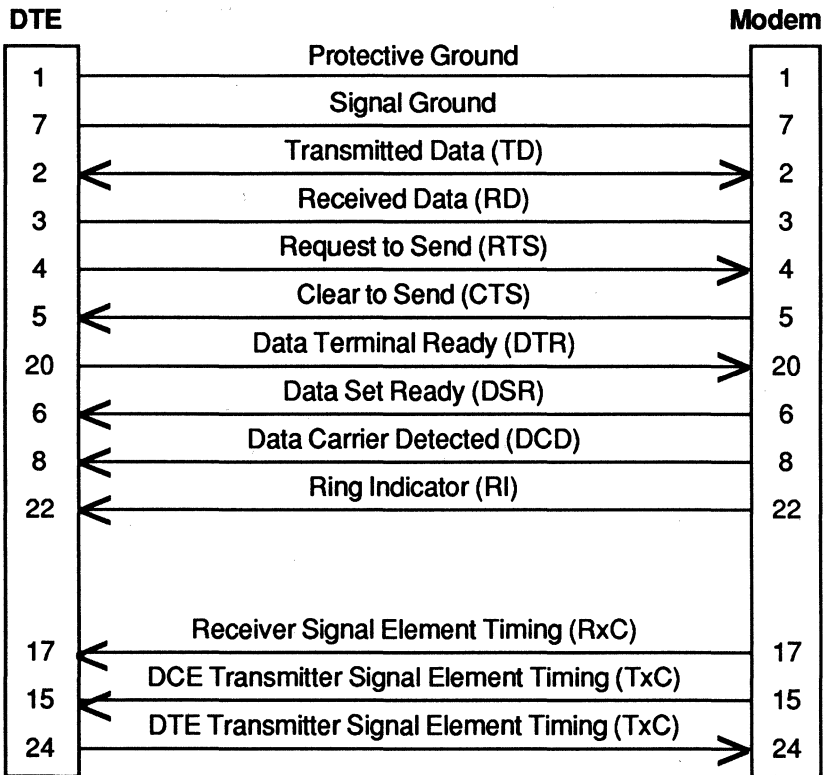
Figure B-4. Transparent Synchronous RS-232D Cable Diagram

RS-232D Timing Interchange Signals

When operating in one of the synchronous modes, the modem uses the RS-232D timing signals in addition to the primary interchange signals described above. Figure B-4 shows the recommended cable configuration for connecting the modem to a synchronous device.

The timing interchange signals used by the modem in the synchronous modes are described in the following sections.

Receiver Signal Element Timing (RxC)

Pin 17 (Receiver Signal Element Timing) is used by the modem to provide the local DTE with received signal element timing information. The transition from an ON to OFF condition indicates the center of each signal element on the Received Data (RD) signal line.

Transmitter Signal Element Timing (TxC)

The modem can be configured to either provide the Transmitter Signal Element Timing signal to the DTE via pin 15, or accept the Transmitter Signal Element Timing signal from the DTE via pin 24. The &X command determines which Transmit Clock is used. The default setting for this command is to use the DCE Transmit Clock (pin 15) to control the timing of the DTE's transmissions.

An ON to OFF transition on pin 15 (DCE Transmitter Signal Element Timing) indicates that a transition between signal elements on the Transmitted Data (TD) signal line should occur.

An ON to OFF transition on pin 24 (DTE Transmitter Signal Element Timing) indicates the center of each signal element that is sent over the Transmitted Data (TD) signal line.

C
RESULT CODES

The modem provides you with the current status of a call by issuing result codes. Depending on the current setting of the V(n) command, the modem's responses are displayed in either numeric (V0) or text (V1) mode.

The current setting of the X(n) command determines which set of result codes are used as described:

X0	Only use the first five basic result codes, (0-4) listed in Table C-1. No speed is reported in the CONNECT message. BUSY, NO ANSWER, and NO DIAL TONE are mapped to NO CARRIER. The RRING message is not reported.
X1	Includes the modulation speed in the CONNECT message. Adds result codes 5 and 10-12 to the first five basic result codes (0-4) listed in Table C-1.
X2	Supports all of the X1 result codes and adds result codes 6, 7, 52 and 53 to the result codes of X1.
X11	Includes the DTE interface speed in the CONNECT message. Adds result codes 5, 10-15, 48 and 49 to the first five basic result codes (0-4) listed in Table C-1.
X12	Supports all of the X11 result codes and adds results codes 6, 7, 52 and 53 to the result codes of X11.

Table C-1. Result Codes

Number	Message and Description
0	OK – The command was successfully completed.
1	CONNECT
1	CONNECT 300
2	RING – An incoming ring has been detected.
3	NO CARRIER – Time to connect has expired, dial command aborted or carrier lost.
4	ERROR – A command error has been encountered.
5	CONNECT 1200 – Connected at 1200 bps (Bell 212A or V.22 Compatible).
6	NO DIAL TONE – No dial tone was detected.
7	BUSY – Remote connection is busy.
8	NO ANSWER – Five seconds of silence was not detected within 30 seconds when an @ modifier was encountered in the dial string.
10	CONNECT 2400
11	CONNECT 4800
12	CONNECT 9600
13	CONNECT 14400
14	CONNECT 19200
15	CONNECT 38400
48	CONNECT 7200
49	CONNECT 12000
50	CONNECT FAST
52	RRING – Remote connection is ringing.
53	DIALING
54	NO PROMPT TONE

Certain modifiers of the D command generate result codes that override the X0, X1, and X11 settings. The dial modifiers are the following:

- W - always returns a NO DIALTONE result code if a dial tone is not present when the W is executed.

- @ - always returns aNO ANSWER result code if five seconds of silence is not detected within 30 seconds after a remote ring.

- $ - always returns a NO PROMPTTONE result code if the calling card prompt tone is not detected within 30 seconds after the $ starts execution.

When dialing using X0, X1 or X11, the BUSY signal is not recognized since the BUSY result code has not been enabled, and the T1600 modem performs a blind wait before dialing.

When dialing using X2 or X12, the functionality associated with the enabled result codes is also enabled. In particular, the BUSY signal is correctly detected, and the T1600 modem performs dial tone detection before it commences dialing, whether or not you entered the W dial modifier.

Each of the CONNECT messages can have suffixes, separated by the slash (/) character, which are controlled by the S59 register. The format of the extended CONNECT message is:

CONNECT (X cmd speed)/(link)/(compression)/(other speed)

When a suffix is not generated, the slash (/) delimiter for that suffix is also suppressed, that is, double slashes are not generated.

The following presents the possible CONNECT
message suffixes for link protocol, compression, and
other speed for the format specified.

Possible link protocol suffixes

nothing
REL
LAPM

Possible compression suffixes

nothing
COMP

Possible other speed suffixes (depending on the
value of X).

X1 or X2	X11 or X12
nothing	nothing
300	300
1200	1200
2400	2400
4800	4800
7200	
9600	9600
12000	
14400	
19200	
38400	

The value of the S59 register does not affect the
numeric result code associated with the root CON-
NECT message. For example:

CONNECT 9600/REL/COMP/19200

has the same numeric result code as

CONNECT 9600

which is 12.

D

PRESTORED CONFIGURATIONS

The T1600 modem provides you with prestored configurations. The configurations are selected by using the AT&F command or by powering up the modem with the T/D switch held in. Refer to Chapter 3, *The Basics,* for procedures on using the modem's front panel to select a prestored configuration.

After the configuration is selected, you can use the AT&V command to display the configuration on the screen.

The following sections give the suggested uses for each configuration, the appropriate &F command, and a screen display for that configuration.

Configuration: TTY
Command: AT&F0

> The AT&F0 configuration is used with most asynchronous terminals or PC's emulating asynchronous terminal operation.

> *Note: The TTY settings are the factory defaults.*

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1   E1   L1   M1   P    Q0   V1   X1   Y0
&C0  &D0  &G0  &J0  &L0  &Q0  &R3  &S0  &T4
S000=0    S001=0    S002=43   S003=13   S004=10   S005=8    S006=2    S007=40
S008=2    S009=6    S010=14   S011=70   S012=50   S018=0    S025=5    S026=1
S038=20   S039=0    S041=0    S045=0    S046=0    S047=4    S048=0    S050=0
S051=255  S056=17   S057=19   S058=3    S059=0    S060=0    S061=1    S062=15
S063=0    S064=0    S068=255  S069=0    S090=0    S093=8    S094=1    S100=0
S102=0    S104=0    S105=1    S111=255  S112=1    S180=2    S181=0    S183=25
S190=1    S253=10   S254=255  S255=255
```

When selected from the front panel, the following registers differ from that stored in nonvolatile memory.

                S000=1 S045=255

Configuration: Unattended Answer Mode
Command: AT&F1

The AT&F1 configuration is used with most asynchronous Front End Processor (FEP) host ports operating at a fixed interface speed of 9600 bps.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E0  L1  M1  P   Q2  V1  X1  Y0
&C1 &D2 &G0 &J0 &L0 &Q0 &R2 &S1 &T4 &X0
S000:1   S001=0    S002:255 S003=13  S004=10  S005=8   S006=2   S007=4
S008=2   S009=6    S010=14  S011=70  S012=50  S018=0   S025=5   S026=1
S038=20  S039=0    S041=0   S045=0   S046=0   S047=4   S048=0   S050=0
S051=255 S056=17   S057=19  S058=3   S059=0   S060=0   S061:0   S062=15
S063=0   S064:1    S068=255 S069=0   S090=0   S093=8   S094=1   S100=0
S102=0   S104=0    S105=1   S111=255 S112=1   S180=2   S181:1   S183=25
S190=1   S253=10   S254=255 S255=255
```


Configuration: Intelligent Answer Mode
Command: AT&F2

The AT&F2 configuration is used with most computers running intelligent software which interprets the modem result codes, and adjusts the interface speed accordingly. Notable characteristics are:
  • Modem result codes are sent to the computer.
  • The modem serial interface speed follows the connect speed.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E1  L1  M1  P   Q0  V1  X1  Y0
&C1 &D2 &G0 &J0 &L0 &Q0 &R2 &S1 &T4 &X0
S000:1   S001=0    S002=43  S003=13  S004=10  S005=8   S006=2   S007=4
S008=2   S009=6    S010=14  S011=70  S012=50  S018=0   S025=5   S026=1
S038=20  S039=0    S041=0   S045=0   S046=0   S047=4   S048=0   S050=0
S051=255 S056=17   S057=19  S058=3   S059=0   S060=0   S061=1   S062=1
S063=0   S064=0    S068=255 S069=0   S090=0   S093=8   S094=1   S100=0
S102=0   S104=0    S105=1   S111=255 S112=1   S180=2   S181:0   S183=25
S190=1   S253=10   S254=255 S255=255
```

Configuration: System V (HDB-UUCP)
Command: AT&F3

The AT&F3 configuration is used with most HoneyDanBer UUCP UNIX systems. (you must have: "/usr/lib/uucp/Systems, Devices, and Dialers" files in your operating file system).

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E0  L1  M1  P   Q2  V1  X0  Y0
&C2 &D3 &G0 &J0 &L0 &Q0 &R3 &S0 &T4
S000:1    S001=0    S002=43   S003=13   S004=10   S005=8    S006=2    S007=40
S008=2    S009=6    S010=14   S011=70   S012=50   S018=0    S025=5    S026=1
S038=20   S039=0    S041=0    S045=0    S046=0    S047=4    S048=0    S050=0
S051:254  S056=17   S057=19   S058:0    S059=0    S060=0    S061:0    S062=15
S063=0    S064:1    S068:3    S069=0    S090=0    S093=8    S094=1    S100=0
S102=0    S104=0    S105=1    S111:30  S112=1    S180=2    S181:1    S183=25
S190=1    S253=10   S254=255 S255=255
```

Configuration: Ver. 4.2-4.3 (BSD-UUCP) and SCO Xenix
Command: AT&F4

The AT&F4 configuration is used with most Version 2 UUCP systems (you must have: "/usr/lib/uucp/L.sys and L-devices" files in your operating system).

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E0  L1  M1  P   Q2  V1  X0  Y0
&C1 &D3 &G0 &J0 &L0 &Q0 &R3 &S1 &T4
S000:1    S001=0   S002=43 S003=13 S004=10 S005=8   S006=2   S007=40
S008=2    S009=6   S010=14 S011=70 S012=50 S018=0   S025=5   S026=1
S038=20   S039=0   S041=0  S045=0  S046=0  S047=4   S048=0   S050=0
S051:5    S056=17  S057=19 S058:0  S059=0  S060=0   S061:0   S062=15
S063=0    S064:1   S068:3  S069=0  S090=0  S093=8   S094=1   S100=0
S102=0    S104=0   S105=1  S111:30 S112=1  S180=2   S181:1   S183=25
S190=1    S253=10  S254=255 S255=255
```

Configuration: Transparent Sync
Command: AT&F5

TheAT&F5 configuration is used with most 9600 bps synchronous terminals or devices. Notable characteristics are:

- The modem operates in V.32 transparent synchronous full duplex mode at 9600 bps.
- Fallback to slower modulations is allowed.
- The DCE's clock is used.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E1  L1  M1  P   Q0  V1  X1  Y0
&C3 &D2 &G0 &J0 &L0 &Q6 &R0 &S1 &T4 &X1
S000:1    S001=0   S002=43 S003=13 S004=10 S005=8   S006=2   S007=40
S008=2    S009=6   S010=14 S011=70 S012=50 S018=0   S025=5   S026=1
S038=20   S039=0   S041=0  S045=0  S046=0  S047=4   S048=0   S050:6
S051=255  S056=17  S057=19 S058=3  S059=0  S060=0   S061=1   S062=15
S063=0    S064=0   S068=255S069=0  S090=0  S093=8   S094=1   S100=0
S102=0    S104=0   S105=1  S111:30 S112=1  S180:0   S181:1   S183=25
S190=1    S253=10  S254=255S255=255
```

Configuration: IBM PC/Mac
with SW Flow control (XON/XOFF)
Command: AT&F8

The AT&F8 configuration is used with most personal computer software packages that support software (XON/XOFF) flow control.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E1  L1  M1  P   Q2  V1  X1  Y0
&C1 &D2 &G0 &J0 &L0 &Q0 &R3 &S0 &T4 &X0
S000=0   S001=0   S002=43  S003=13  S004=10  S005=8   S006=2   S007=40
S008=2   S009=6   S010=14  S011=70  S012=50  S018=0   S025=5   S026=1
S038=20  S039=0   S041=0   S045=0   S046=0   S047=4   S048=0   S050=0
S051=255 S056=17  S057=19  S058=3   S059=0   S060=0   S061=1   S062=15
S063=0   S064=0   S068=255 S069=0   S090=0   S093=8   S094=1   S100=0
S102=0   S104=0   S105=1   S111=255 S112=1   S180=2   S181:1   S183=25
S190=1   S253=10  S254=255 S255=255
```

Configuration: IBM PC
with HW Flow control (RTS/CTS)
Command: AT&F9

The AT&F9 configuration is used with most software packages, which support hardware (RTS/CTS) flow control.

Note: In order to use RTS/CTS flow control on a Macintosh, the communications software must support the feature and a special cable must be used as recommended in the software documentation. You must set the modem to ignore DTR (400).

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E1  L1  M1  P   Q0  V1  X1  Y0
&C1 &D2 &G0 &J0 &L0 &Q0 &R3 &S0 &T4 &X0
S000=0   S001=0   S002=43  S003=13  S004=10  S005=8   S006=2   S007=40
S008=2   S009=6   S010=14  S011=70  S012=50  S018=0   S025=5   S026=1
S038=20  S039=0   S041=0   S045=0   S046=0   S047=4   S048=0   S050=0
S051=255 S056=17  S057=19  S058:2   S059=0   S060=0   S061=1   S062=15
S063=0   S064=0   S068=255 S069=0   S090=0   S093=8   S094=1   S100=0
S102=0   S104=0   S105=1   S111=255 S112=1   S180=2   S181:1   S183=25
S190=1   S253=10  S254=255 S255=255
```

Configuration: Leased Line Async Originate Mode
Command: AT&F10

The AT&F10 configuration is used in any asynchronous point-to-point, 2-wire leased line, V.32 application. The modem will connect automatically on a leased line to another T1600 modem, configured with the "AT&F11" command, in asynchronous V.32 mode at 9600 bps.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E1  L1  M1  P   Q0  V1  X1  Y0
&C1 &D0 &G0 &J0 &L1 &Q0 &R3 &S1 &T4 &X0
S000=0   S001=0   S002=43  S003=13  S004=10  S005=8   S006=2   S007:25
S008=2   S009=6   S010=14  S011=70  S012=50  S018=0   S025=5   S026=1
S038=20  S039=0   S041=0   S045=0   S046=0   S047=4   S048=0   S050:6
S051=255 S056=17  S057=19  S058=3   S059=0   S060=0   S061=1   S062=15
S063=0   S064=0   S068=255 S069=0   S090=0   S093=8   S094:1   S100=0
S102=0   S104=0   S105=1   S111=255 S112=1   S180=2   S181:1   S183=25
S190=1   S253=10  S254=255 S255=255
```

Configuration: Leased Line Async Answer Mode
Command: AT&F11

The AT&F11 configuration is used in any asynchronous point-to-point, 2-wire leased line, V.32 application. The modem will connect automatically on a leased line to another T1600 modem, configured with the "AT&F10" command, in asynchronous V.32 mode at 9600 bps.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E1  L1  M1  P   Q0  V1  X1  Y0
&C1 &D0 &G0 &J0 &L1 &Q0 &R3 &S1 &T4 &X0
S000=0   S001=0   S002=43  S003=13  S004=10  S005=8   S006=2   S007:25
S008=2   S009=6   S010=14  S011=70  S012=50  S018=0   S025=5   S026=1
S038=20  S039=0   S041=0   S045=0   S046=0   S047=4   S048=0   S050:6
S051=255 S056=17  S057=19  S058:2   S059=0   S060=0   S061=1   S062=15
S063=0   S064=0   S068=255 S069=0   S090=0   S093=8   S094:1   S100=0
S102=0   S104=0   S105=1   S111=255 S112=1   S180=2   S181=1   S183=25
S190=1   S253=10  S254=255 S255=255
```

Configuration: Leased Line Sync Originate Mode
Command: AT&F12

The AT&F12 configuration is used in any synchro-
nous point-to-point, 2-wire leased line, V.32 applica-
tion. The modem will connect automatically on a
leased line to another T1600 modem, configured with
the "AT&F13" command, in synchronous V.32 mode
at 9600 bps.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E1  L1  M1  P   Q0  V1  X1  Y0
&C3 &D0 &G0 &J0 &L1 &Q0 &R0 &S1 &T4 &X0
S000=0  S001=0   S002=43 S003=13 S004=10 S005=8   S006=2
S007:255
S008=2  S009=6   S010=14 S011=70 S012=50 S018=0   S025=5  S026=1
S038=20 S039=0   S041=0  S045=0  S046=0  S047=4   S048=0  S050:6
S051=255S056=17  S057=19 S058=3  S059=0  S060=0   S061=1  S062=15
S063=0  S064=0   S068=255S069=0  S090=0  S093=8   S094:0  S100=0
S102=0  S104=0   S105=1  S111=255S112=1  S180:0   S181=0  S183=25
S190=1  S253=10  S254=255S255=255
```

Configuration: Leased Line Sync Answer Mode
Command: AT&F13

The AT&F13 configuration is used in any synchro-
nous point-to-point, 2-wire leased line, V.32 applica-
tion. The modem will connect automatically on a
leased line to another T1600 modem, configured with
the "AT&F12" command, in synchronous V.32 mode
at 9600 bps.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E1  L1  M1  P   Q0  V1  X1  Y0
&C3 &D0 &G0 &J0 &L1 &Q0 &R0 &S1 &T4 &X0
S000:1  S001=0   S002=43 S003=13 S004=10 S005=8   S006=2  S007:255
S008=2  S009=6   S010=14 S011=70 S012=50 S018=0   S025=5  S026=1
S038=20 S039=0   S041=0  S045=0  S046=0  S047=4   S048=0  S050:6
S051=255 S056=17 S057=19 S058=3  S059=0  S060=0   S061=1  S062=15
S063=0  S064=0   S068=255 S069=0 S090=0  S093=8   S094:0  S100=0
S102=0  S104=0   S105=1   S111=255S112=1  S180:0   S181=0  S183=25
S190=1  S253=10  S254=255 S255=255
```

Configuration: Async /Sync Hayes &Q1
Command: AT&F32

The AT&F32 configuration is used when an asynchronous device instructs the modem to establish a connection, which is then used by a synchronous device. It is the user's responsibility to switch the serial interface between the asynchronous calling unit and the synchronous data unit.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1   E1   L1   M1   P    Q0   V1   X1   Y0
&C3 &D2 &G0 &J0 &L0 &Q1 &R0 &S1 &T4 &X1
S000=0    S001=0    S002=43   S003=13   S004=10   S005=8    S006=2    S007=40
S008=2    S009=6    S010=14   S011=70   S012=50   S018=0    S025=5    S026=1
S038=20   S039=0    S041=0    S045=0    S046=0    S047=4    S048=0    S050=0
S051=255  S056=17   S057=19   S058=3    S059=0    S060=0    S061=1    S062=15
S063=0    S064=0    S068=255  S069=0    S090=0    S093=8    S094=1    S100=0
S102=0    S104=0    S105=1    S111=255  S112=1    S180:0    S181=0    S183=25
S190=1    S253=10   S254=255  S255=255
```

Configuration: HP 3000 (host)
Command: AT&F33

The AT&F33 configuration is used with an HP 3000 host system utilizing ENQ/ACK flow control.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1   E1   L1   M1   P    Q0   V1   X1   Y0
&C1 &D2 &G0 &J0 &L1 &Q6 &R2 &S1 &T4 &X1
S000:1    S001=0    S002:255  S003=13   S004=10   S005=8    S006=2    S007=40
S008=2    S009=6    S010=14   S011=70   S012=50   S018=0    S025=5    S026=1
S038=20   S039=0    S041=0    S045=0    S046=0    S047=4    S048=0    S050=0
S051=255  S056=17   S057=19   S058=3    S059=0    S060=0    S061=1    S062=15
S063=0    S064=0    S068:1    S069=0    S090=0    S093=8    S094=1    S100=0
S102=0    S104=0    S105=1    S111:40   S112=1    S180=2    S181=1    S183=25
S190=1    S253=10   S254=255  S255=255
```

Configuration: HP 3000 (terminal)
Command: AT&F34

The AT&F34 configuration is used with an HP terminal utilizing ENQ/ACK flow control, when calling an HP 3000 host system utilizing the same flow control.

Screen display:

```
T1600 - Version LA1.00 - Active Configuration
 B1  E1  L1  M1  P   Q0  V1  X1  Y0
&C0 &D0 &G0 &J0 &L1 &Q6 &R3 &S0 &T4 &X1
S000:0    S001=0    S002=43   S003=13   S004=10   S005=8    S006=2    S007=40
S008=2    S009=6    S010=14   S011=70   S012=50   S018=0    S025=5    S026=1
S038=20   S039=0    S041=0    S045=0    S046=0    S047=4    S048=0    S050=50
S051=255  S056=17   S057=19   S058=3    S059=0    S060=0    S061=1    S062=15
S063=0    S064=0    S068=255  S069=0    S090=0    S093=8    S094=1    S100=0
S102=0    S104=0    S105=1    S111:41   S112=1    S180=2    S181=1    S183=25
S190=1    S253=10   S254=255  S255=255
```

E

LEASED LINE CONSIDERATIONS

When connecting the modem to private or leased lines, the modem output power level can be adjusted by changing a plug-in resistor on the modem board shown in Figure E-1.

The following table lists the resistor value which correspond to various output power levels.

Table E-1. Internal Resistor (R34) Values

Power Limit (dBm)	Resistor (1%)
0 dBm	6.65K
-1 dBm	7.50K
-2 dBm	8.45K
-3 dBm	9.31K
-4 dBm	10.5K
-5 dBm	11.8K
-6 dBm	13.3K
-7 dBm	14.7K
-8 dBm	16.5K
-9 dBm	18.7K
-10 dBm	21.0K
-11 dBm	23.7K
-12 dBm	26.7K
-13 dBm	79.4K
-14 dBm	33.2K
-15 dBm	37.4K

For leased line applications, the modems should be configured as shown in Table E-2.

Table E-2. Leased Line Modem Configuration

Originate Modem	Answer Modem
S7=255	S7=255
S50=6	S50=6
S0=0	S0=1
&L1	&L1

This configuration allows the modems to attempt to establish a connection in V.32 mode whenever DTR is raised and a carrier is not present. For additional information read the descriptions of the above registers and commands.

Refer to Chapter 5, *AT Command Descriptions,* for complete descriptions of the commands used in the Telebit Extended AT command set. Refer to Chapter 6, *AT Register Descriptions,* for complete descriptions of the registers used in the Telebit Extended AT command set.
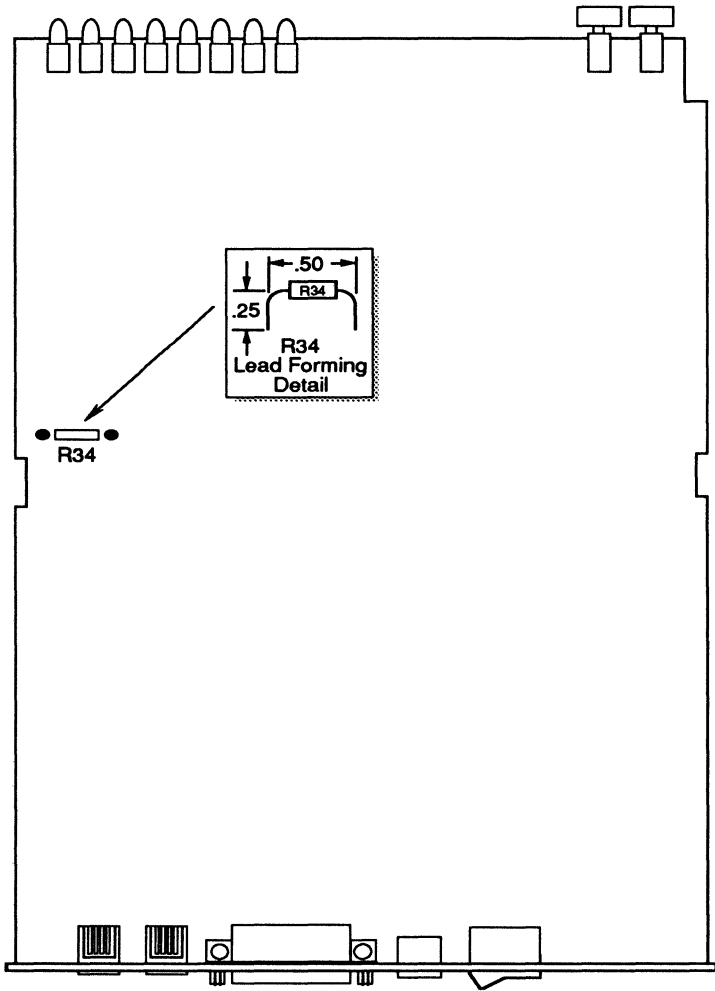
Figure E-1. Resistor R34.

F
TECHNICAL SPECIFICATIONS

Environmental Limits

Operating Temperature	50 to 120° Fahrenheit
	10 to 50° Celsius
Storage Temperature	-40 to 149° Fahrenheit
	-40 to 65° Celsius
Relative Humidity	5 to 95% non-condensing
Altitude (maximum)	20,000 feet (6,096 meters)

Power Requirements

60 Hz Operation	115 VAC (+10%/-15%)
	@ 0.5 Amps maximum
50 Hz Operation	230 VAC (+10%/-15%)
	@ 0.25 Amps maximum

Physical Dimensions

Height	2.4 inches (6.1 cm)
Width	8.5 inches (21.6 cm)
Depth	13.0 inches (33.0 cm)
Weight	2.8 pounds (1.27 Kg)

Interface

Serial Port	25- pin RS-232D
Phone Line	8 -pin RJ11C

Operation

Asynchronous or synchronous binary

Transmission Modes

Bell 103 or V.21 (300 bps)
Bell 212A or V.22 (1200 bps)
V.22 bis (2400 bps)
V.32 (9600, 4800 bps)

Standard Character Format	1 start bit, 7 or 8 data bits, plus 1 parity bit, and 1 stop bit
Modulation	FSK (Bell 103, V.21, V.23) DPSK (Bell 212A, V.22) QAM (V.22 bis, V.32)
Receiver Sensitivity	-45 dBm

Frequencies

Bell 103	Tx Frequency	Rx Frequency
Originate Mode	1070 Hz = space	2025 Hz = space
	1270 Hz = mark	2225 Hz = mark
Answer Mode	2025 Hz = space	1070 Hz = space
	2225 Hz = mark	1270 Hz = mark

Bell 212A/V.22/V.22bis	Tx Frequency	Rx Frequency
Originate Mode	1200 Hz (carrier)	2400 Hz (carrier)
Answer Mode	2400 Hz (carrier)	1200 Hz (carrier)

V.32	Tx Frequency	Rx Frequency
Originate Mode	1800Hz (carrier)	1800Hz (carrier)
Answer Mode	1800Hz (carrier)	1800Hz (carrier)

V.21	Tx Frequency	Rx Frequency
Originate Mode	1180Hz = space	1850Hz = space
	980 Hz = mark	1650Hz = mark
Answer Mode	1850Hz = space	1180Hz = space
	1650Hz = mark	980Hz = mark

Frequency Offset	Can tolerate up to ± 7 Hz
Certifications	FCC Part 15J Class A, part 68 ER95WS-17716-MD-E DOC CS-03, Issue 05 CSA #LR66104-7 UL #E104318 (S)

GLOSSARY

GLOSSARY

A

ACK — Control character transmitted by a receiving device as an affirmation to a sending device.

alphanumeric — Letters (alphabetic) and numbers (numeric).

ANSI — American National Standards Institute. Primary standards development body in the U.S.A.

ASCII — American Standard Code for Information Interchange. a 7-bit code established by ANSI for representing alphanumeric and control characters.

asynchronous transmission — Digital transmission technique characterized by start and stop bits at the beginning and end of each character and not synchronized by a clock signal.

autobaud — Determines the speed and parity of any properly entered command line prefix, AT. The modem uses the A in the prefix to determine the serial interface speed and the T to determine the parity.

B

baud rate — Number of discrete signaling events per second; not necessarily the same as bits per second.

bit — An acronym for binary digit. A bit is the smallest unit of digital information represented by the choice of one of two possible states – one (mark) or zero (space).

block — Group of characters treated as a unit for the purpose of data transmission.

bps (bits per second) — The most common unit of measure for specifying the data transfer rate in a communication network.

break — Signal used by computer equipment to interrupt some process, usually represented by 12 or more consecutive bits.

buffer — Temporary storage area used to compensate for a difference in the rate of data flow into and out of a device.

byte — A grouping of bits to specify a single character usually consisting of eight consecutive bits.

C

carrier — An analog signal that is modulated by another signal containing information to be transmitted.

Carrier Detected (CD) — RS-232D control signal used by the DCE to inform the DTE that it has detected a valid carrier signal.

CCITT — Consultive Committee for International Telephone and Telegraph. A standard organization that sets standards for worldwide voice and data communications.

CCITT V.XX — International standards in communications concerned with modem interfaces, speeds, and transmission modes.

channel — An electronic communications path. A voice grade channel generally ranges from 300 to 4000 Hz.

character — A letter, number, or other symbol contained in a message or used in a control function.

character set — The characters that can be coded or used by a particular machine.

Clear to Send (CTS) — An RS-232D control signal sent by the DCE to indicate that the DTE may begin a transmission.

clock — Source of timing signals used in synchronous transmission.

code — A predefined set of rules that specifies the way data is to be represented by the transmitting and receiving device.

common carrier — Telephone company that furnishes communications services to the general public.

conditioning — The addition of equipment to a leased voice grade line to improve the transmission characteristics of the line.

console — Part of a computer system, usually a video display terminal, used by the operator to communicate with the computer.

contention — Condition arising when two or more devices try to transmit at the same time using the same channel.

control character — Character that initiates some control function on the receiving device.

CPU — Central Processing Unit. The computer hardware that processes software instructions to control the computer system and its peripherals.

CRT — Cathode Ray Tube. This term is commonly used to stand for the video display terminal.

Cyclic Redundancy Check (CRC) — An error detection technique in which a data validation value is mathematically derived from a block of data and transmitted at the end of the block. The receiving end recomputes the value and if it matches the value sent, the data is assumed to be valid (error-free). If not, the receiver notifies the transmitter that an error has occurred and the block is retransmitted.

D

Data Carrier Detected (CD) — RS-232D control signal used by the DCE to inform the DTE that it has detected a valid carrier signal.

Data Communications Equipment (DCE) — The equipment that provides all the functions required to establish, maintain and terminate a connection, and provides the signal conversion required for communications between the Data Terminal Equipment and the Telephone Network.

data compression — An encoding technique that provides for the transmission of fewer data bits without the loss of information. The receiving end expands the data received to its original form.

data set — *See modem.*

Data Set Ready (DSR) — An RS-232D control signal used to indicate the readiness of the DCE to accept data from the DTE.

Data Terminal Equipment (DTE) — The equipment that provides the data source and/or receiving end of a data transmission link. The DTE may be a CRT or teletype terminal, a personal computer, a printer, a front-end processor to a large mainframe computer, or any other device that can transmit or receive data.

Data Terminal Ready (DTR) — An RS-232D control signal used to indicate the readiness of the DTE for data transmission.

decibel (dB) — Unit of measure indicating the logarithmic ratio of output signal power to input signal power.

dedicated line — A communications line that is not dialed. Also known as leased line or private line.

demodulation — The process of recovering digital information from a modulated analog carrier waveform.

dial-up line — A communication circuit that is established by a switched circuit connection using the telephone dial network.

dibit — A grouping of two bits.

digital signal — A signal composed of discrete signal levels as opposed to the continuous signal levels of an analog signal.

distortion — Undesired change in a signal's original waveform resulting from the characteristics of the transmission circuits or other external influences.

dumb terminal — Terminals that do not contain an intelligent microprocessor and usually send data one character at a time.

E

EBCDIC — Extended Binary Coded Decimal Interchange Code. An 8- bit code used primarily by IBM equipment.

echoplex — Method of verification of transmitted data by echoing the characters transmitted back to the source device for verification.

EEPROM — Electrically Erasable Programmable Read Only Memory.

EIA — Electronic Industries Association. Standards organization in the U.S. that sets standards for the functional characteristics of electronic interfaces.

ENQ — Control character used to enquire as to the identification or status of a remote device.

ETX — Control character that indicates the end of text in a transmitted message.

F

FCC — Federal Communications Commission.

firmware — Computer program stored permanently in Read Only Memory.

Forward Error Correction (FEC) — Technique of transmitting additional information with the original data such that if small errors are detected, the correct information can be re-created by the receiving end without requiring a retransmission.

frame — *see block*.

front-end processor — Computer equipment designed primarily for communications control associated with a large mainframe.

full duplex — Method of transmission in which transmissions can occur in both directions at the same time.

G

guard band — Narrow frequency bands left unused between adjacent channels to minimize interference.

guard tone — A tone used to signal the presence of a carrier.

H

half duplex — Method of transmission in which communications can occur in both directions but not at the same time.

hardware — The electronic or electromechanical devices in a computer system as opposed to the programs or software.

HDLC — High Level Data Link Control. Communications protocol developed by the International Standards Organization.

header — In communications protocols, this is the control information that precedes the message or text portion of a block of data.

Hertz (Hz) — Unit of frequency; one cycle per second.

Horizontal Redundancy Checking (HRC) — Technique in which redundant information is included with a block of data for validating the transmitted data at the receiving end.

host computer — The main computer system in a data communications system.

I

Interface — A shared boundary defined by common physical interconnection characteristics, signal characteristics, and meaning of interchanged signals.

Interference — Undesirable disturbances or distortions in a data transmission signal.

ISO — International Standards Organization.

J

K

Kermit — A data communications protocol. *Also see protocol.*

L

leased line — Telephone line reserved for the exclusive use of a single customer.

link — A circuit or transmission path, including all equipment, between a sender and a receiver.

Longitudinal Redundancy Check (LRC) — Error detection technique that consists of a byte where each bit is calculated on the basis of the parity of all bits in the block in the same position.

loopback — Directing signals sent back toward the source at some point in the communications path.

M

mainframe — Large scale computer system composed of large number of peripherals and comprehensive software.

mark — One of the two possible states of a binary data element. The closed circuit and idle condition in a teleprinter circuit. *Also see space.*

MNP — Microcom Networking Protocol. *Also see protocol.*

modem — MOdulator/DEModulator. A type of DCE that converts digital data to an analog signal for transmission on telephone circuits. A modem at the receiving end converts the analog signal to digital form.

modulation — The process of varying some characteristic of the carrier wave in accordance with the data to be transmitted.

multidrop Line — Single communications circuit interconnecting many stations (nodes) each containing terminal devices.

N

NAK — Negative Acknowledgement. This control character indicates that the last block transmitted was in error and that the receiver is expecting a retransmission.

node — A point of interconnection on a circuit.

noise — Random electrical signals introduced by components of the circuit or natural disturbances that can produce errors in transmission.

nonvolatile memory — Memory that retains its contents even when no power is applied.

O

P

parity — A bit that is derived from a character's data bits and transmitted along with the character. The receiving end recalculates the parity and if it matches the transmitted parity that character is assumed to have been transmitted correctly. If the parity does not match, the character is deemed invalid.

PBX — Private Branch Exchange. Telephone switching equipment dedicated to one customer and connected to the public switched network.

point-to-point — A connection between two points as opposed to a multipoint or multidrop line.

private line — *See leased line.*

PROM — Programmable Read Only Memory.

propagation delay — The time required for a signal to travel from one end of a circuit to another.

protocol — The rules governing the orderly exchange of information between devices on a data link.

protocol convertor — Device that converts from one protocol to another.

public switched network — Telephone system providing circuit switching to many customers.

Q

R

RAM — Random Access Memory.

Received Line Signal Detector — *See Carrier Detected.*

redundancy check — Technique of error detection involving the transmission of additional data related to the message so that the receiving device can determine if the data transmitted is valid (error-free).

Request to Send (RTS) — RS-232D control signal used by the DTE to inform the DCE that it is ready to transmit data. When used for flow control between the DTE and modem, this signal indicates to the modem that the DTE is ready to accept data.

Ring Indicator (RI) — RS-232D control signal used by the DCE to inform the DTE that it is receiving a ringing signal.

ROM — Read Only Memory.

RS-232D — Recommended standard of the Electronics Industries Association for the interface between data terminal equipment and data communications equipment.

S

serial transmission — Method of transmission in which each data bit is transmitted sequentially.

software — Computer program or set of computer programs held in storage, and loaded into RAM for execution.

SOH — Start Of Header. Control character used in synchronous transmissions indicating the start of a header block.

space — One of the two possible states of a binary data element. The open circuit condition in a teleprinter circuit. *Also see mark.*

start bit — The first bit or element transmitted in asynchronous transmission of a character to synchronize the receiver.

stop bit — The last bit or element transmitted in asynchronous transmission of a character to return the circuit to an idle state.

STX — Start Of Text. Control character used in synchronous transmission that precedes the text portion of the data block.

SYN — Synchronous Idle. Control character transmitted when the line is idle in synchronous transmissions.

synchronous transmission — Transmission method in which the transmitter and receiver are continuously operating at a fixed rate with a clock signed, either derived from the data stream, or provided by the transmitter or receiver.

T

terminal — Any device capable of sending and/or receiving data over a communications channel.

text — The message portion of a data block in synchronous data transmissions.

Trellis Code Modulation —A method of modulating a carrier to reduce errors.

turnaround time — The time required to reverse the direction of transmission when operating in half- duplex mode.

U

UART — Universal Asynchronous Receiver Transmitter. An integrated circuit that performs the functions required for asynchronous communications.

USART — Universal Synchronous/Asynchronous Receiver Transmitter. An integrated circuit that performs the functions required for both synchronous and asynchronous communications.

V

Vertical Redundancy Check (VRC) — A method of character parity checking.

voice grade line — Channel with a frequency range of 300 to 3400 Hz suitable for the transmission of speech or data in analog form.

W

X

XMODEM— A file transfer protocol. *Also see protocol.*

XOFF/ XON — The control characters used to stop or resume transmissions.

Y

Z

INDEX

INDEX

A

B

C

D

E

F

G

H

I

J

K

L

M

P

Q

R

S

T

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