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**FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS**

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

1. Specifications

Standards — Bell 103, 212, 208, CCITT V.13, V.17, V.22, V.32, V.22 bis, V.25, V.32 bis, V.33, V.29, V.32terbo

Protocol — Sync and async

Data Rate — Up to 16.8 and 19.2 Kbps

Operation — Full duplex over 2- or 4-wire leased lines or dialup lines

Connectors — (1) DB25 female, (5) RJ-45 female, (1) 5-pin DIN

Configuration — AT Command set or front-panel

Error Correction/Data Compression — MNP 1-5, V.42, V.42 bis

Ringer Equivalence — 0.8 B

Environment — Ambient temperature: 32 to 122° F (0 to 50° C); Storage temperature: -4 to 158° F (-20 to 70° C); Relative humidity: 10 to 95%

Power — 90-132 VAC, 60 Hz

Size — 2.5"H x 10.1"W x 9.7"D (6.4 x 25.7 x 24.6 cm)

Weight — 4 lb. (1.8 kg)

2. Quick Start

This instruction manual applies to the Modem 32144.

All information applies to both the stand-alone and full-size rack-mount versions of the modem. Specialized low-profile rack-mount versions, designed for use in high-density rack enclosures, are described in Appendix A.

QUICK SETUPS FOR A QUICK START

The simplest and fastest way to set up the modem for immediate use is to select one of the factory-preset Quick Setup configurations. For most applications, once you have selected the proper Quick Setup, the modem will be ready for operation. You will not need to make further adjustments. Quick Setups are explained fully beginning in Section 2.3, following installation instructions and a brief introduction to the front panel display and controls.

2.1 Installation

2.1.1 UNPACKING

Keep the original shipping carton in case you need to return the modem for any reason.

Note that if you ordered the Modem 32144 Card, all you will receive is the Card itself. It does not come with the power transformer or cables listed below.

If you ordered the Modem 32144, in addition to the modem, the shipping carton should contain—

- A power transformer (with cable attached)
- A two-conductor crossover cable with an eight-pin modular connector on one end and a six-pin modular connector on the other end
- A four-conductor cable with two six-pin modular connectors on each end and spade lugs on the other end

Two cables are supplied with the modem, but both cables aren't always needed, depending on the application. You will need an EIA RS-232 interface cable (not supplied) to connect the modem to the DTE (data terminal equipment, usually a computer). If the modem will be operated in a manual dial mode, you will also need a standard telephone set.

3. Options: Customizing the Modem Setup

3.1 Methods for Selecting Options

The modem allows you to easily select options in order to tailor the modem's operation to suit a particular application. Options can be selected in any of the following ways:

- **Quick Setup.** This is the easiest way to set up the modem. Quick Setup (explained in **Chapter 2**) automatically sets all options according to a preset configuration.
- **Front-panel option selection.** This is the easiest and most commonly used method for selecting individual option choices. Typically you would select an overall configuration via Quick Setup and then modify it to suit your application by changing selected options from the front panel. Changes are made by accessing individual option screens on the front panel LCD and then making selections using the control pushbuttons. (An alternate way to change options from the front panel is to use the modem's Summary Setup feature, which is described below.)
- **Summary Setup.** This is the fastest way to selectively change multiple options. All options are accessed using just a few of the LCD screens. However, because these screens show numerical codes with very little explanation, Summary Setup is recommended only for experienced users. Summary Setup is explained in **Appendix B**.

3.2 Front-Panel Options

This chapter describes the standard instead of selecting options from the front panel. An alternate method for selecting options from the front panel (Summary Setup) is explained in **Appendix B**.

3.2.1 PUSHBUTTONS AND THE LCD

Options are selected from the front panel by pressing the front panel pushbuttons (**Fig. 3-1**). The possible choices for each option are shown on the liquid-crystal display (LCD).

4. General Operation and Special Features

This chapter describes the following features and operational modes (listed here in the order in which they are presented):

- Quick reset
- Phone number storage
- Automatic fallback
- Dumb mode and Bell 208 operation
- V.13 operation
- DTR dialing
- Dial Line Auto-Recovery
- Leased Line Auto-Recovery
- Security operation
- Modem-controlled remote control
- Diagnostic interface control

The status screens, which display data concerning the operational status of the modem, are discussed in **Section 7.6**. Instructions for using the pushbutton controls and LCD are included in **Section 3.2**.

4.1 Quick Reset

For a reset of the modem, whereby option settings are not changed but the modem is cleared for a new start and the ROM memory chip is checked, select RESET from MAIN MENU screen 3. The modem will display the power-on screen for a few seconds and then the EIA status screen. This feature enables you to reset the modem without powering down the unit.

4.2 Storing Phone Numbers

4.2.1 USES

The front panel PHONE screen allows you to store a single phone number to be used later for—

- Autodialing from the front panel or using the Hayes or V.25 bis mode autodialer
- DTR dialing
- Leased-line or dial-line auto-recovery.

5. Hayes Emulation Mode

For easy reference, the following tables appear consecutively at the end of this chapter:

- Hayes-Compatible Commands (Table 5-1)
- Hayes Mode Result Codes (Table 5-2)
- S Register Functions (Table 5-3)

5.1 Hayes Mode Autodialer

When the Hayes emulation mode is enabled, the modem emulates a Hayes autodialer and functions much like a Hayes modem. Commands are issued from the computer keyboard (or other DTE), and the modem is compatible with software written to drive a Hayes-style “AT” command set.

5.1.1 ENABLING THE HAYES MODE AUTODIALER

The Hayes mode autodialer can be enabled in either of two ways—by using the Quick Setup feature or by selecting HAYES from the DIALER screen:

- **QUICK SETUP.** If you select 2-Wire Dial (Hayes) by using the Quick Setup feature, the Hayes mode autodialer will be enabled, and all modem options will be automatically set

to a preset configuration suitable for typical Hayes mode applications. To select the 2-wire dial Hayes Quick Setup, access QUICK SETUP screen 1 on the LCD and press pushbutton 2.

- **DIALER MODE.** If you enabled the Hayes mode autodialer using the Dialer Mode option, no other options will be changed. To enable the autodialer this way, select DIALER from SETUP screen 2. Then select HAYES from the DIALER screen.

5.1.2 COMMAND GUIDELINES

The following guidelines for using Hayes-compatible AT commands also provide a summary of the fundamentals of Hayes mode autodialer operation.

NOTE

Although carriage returns are not shown in the examples in this chapter, a carriage return is required at the end of each command line.

6. V.25 bis Autodialer

For international compatibility, the modem can be configured to function as a V.25 bis autodialer. In V.25 bis mode, the modem is compliant with CCITT Recommendation V.25 bis, an internationally recognized standard for serial automatic call origination and answering.

The V.25 bis autodialer uses the dialing command set defined by the V.25 bis Recommendation. It allows you to store and dial phone numbers from the DTE in both synchronous and asynchronous applications. You can dial numbers directly or you can instruct the modem to automatically dial a previously stored number.

6.1 Enabling the V.25 bis Autodialer

The V.25bis autodialer can be enabled in either of two ways—by using the Quick Setup feature or by selecting one of the Dialer Mode options.

6.1.1 QUICK SETUP

Three Quick Setup configurations are available for 2-wire dial V.25 bis operation. Selecting any of the three V.25 bis Quick Setups (via QUICK on SETUP screen 1) enables the V.25 bis autodialer and causes all modem options to be automatically set to a preset configuration. Each V.25 bis Quick Setup is suitable for a typical V.25 bis application, depending on the DTE to be used.

To select a 2-wire dial V.25 bis Quick Setup, access QUICK SETUP screen 2, 3, or 4 (for asynchronous; synchronous, character-oriented; or synchronous, bit-oriented operation, respectively) on the LCD, and then press pushbutton 2. After selecting the desired V.25 bis Quick Setup configuration, you can reset individual options to suit your application, if desired, as explained in **Chapter 3**.

In accordance with the CCITT V.25 bis Recommendation, the modem V.25 bis asynchronous Quick Setup sets the character length to 10 bits, including 1 even parity bit. Both V.25 bis synchronous Quick Setups set the modem for odd parity. (For synchronous operation, the character-length option setting has no effect.)

7. Diagnostics

The troubleshooting information in this chapter applies to all modem applications (all dialup and leased-line modes), unless specifically stated otherwise.

For specific test procedures, turn to one of the following sections in this chapter:

- **Section 7.8, Local Modem Diagnostics**
- **Section 7.9, Remote Diagnostics**

7.1 When and Why to Test

If you are experiencing communications difficulties, the overall objective in correcting the problem should be to specifically isolate the defective component in your communications system. This typically involves three steps: Identifying the symptoms and scope of the problem, performing a physical inspection of all units and connections in the system and, finally, conducting diagnostic tests. Very often the diagnostic testing capabilities of the modem can help identify the specific faulty component, whether it is the modem, the DTE or telephone line.

7.2 Symptoms and Scope of the Problem

As a first step toward isolating the problem, carefully consider each of the following questions:

- When did the problem begin?
- What is malfunctioning? Try to isolate the component or components of your system that are malfunctioning.
- Has there been a recent change in the system?
- Has the modem been reconfigured?

You can quickly find out if the modem has been reconfigured by checking the checksum shown in the SUMMARY screen (accessed via SETUP screen 6) and comparing it with the checksum displayed when the modem was operating properly—if you made a note of the previous checksum. If the checksum is different from the original checksum, one or more option settings have been changed. If you previously recorded the number strings (i.e., option parameters) displayed in the setup screens accessed via the SUMMARY screen, you should be able to determine which option settings have been changed (by comparing the previous and current option parameters).

Contents

- 1. Specifications.....10
- 2. Quick Start.....13
 - 2.1 Installation13
 - 2.1.1 Unpacking.....13
 - 2.1.2 Connections14
 - 2.1.3 Jumpers15
 - 2.2 Front-Panel LCD and Controls16
 - 2.2.1 Power-On Screen17
 - 2.2.2 EIA Status Screen.....17
 - 2.3 Quick Setup18
 - 2.3.1 How to Select a Quick Setup18
 - 2.4 Basic Operation25
 - 2.4.1 2-Wire Dial Hayes Mode (Quick Setup 1)25
 - 2.4.2 2-Wire Dial V.25 bis Mode (Quick Setup 2-4).....26
 - 2.4.3 2-Wire Dial Dumb Mode (Quick Setup 5).....27
 - 2.5 Leased Line (2- or 4-Wire) Mode (Quick Setup 6-9)29
 - 2.6 V.33 Leased Line Operation (Quick Setup 10)29
 - 2.7 2-Wire Dial Bell 208 Operation (Quick Setup 11-12).....30
 - 2.8 Two Types of Bell 208 Operation31
 - 2.8.1 Bell 208 Operation (Exclusive)31
 - 2.8.2 V.32/208 Auto-Select Mode32
 - 2.9 4-Wire Leased Line V.29 Mode (Quick Setup 13)32
 - 2.9.1 V.32 Dial Backup.....33
 - 2.10 V.29 Fast Master and Slave Modes (Quick Setup 14-15)33
 - 2.11 If You Have Problems.....35
 - 2.11.1 All Modes.....35
 - 2.11.2 All Dial Modes (Hayes, V.25 bis, Dumb, Bell 208,
and V.32/208)35
 - 2.11.3 All Asynchronous Modes.....37
 - 2.11.4 Hayes Mode.....37
 - 2.11.5 All Leased-Line Modes (2-Wire, 4-Wire, V.33,
and V.29)37
 - 2.11.6 Leased Line (Excluding V.33 and V.29 Operation)37
- 3. Options: Customizing the Modem Setup.....38
 - 3.1 Methods for Selecting Options38
 - 3.2 Front-Panel Options.....38
 - 3.2.1 Pushbuttons and the LCD38

Appendix A: Quick Setup Configurations

Table A-1 shows the modem configuration—i.e., the default setting for each option—for each of the Quick Setup modes. When you select a Quick Setup, the modem automatically sets all options as indicated in the table. The options are listed in the same order in which they appear on the LCD flow chart.

Instructions for selecting Quick Setups are included in **Chapter 2**.

Some options can be selected via Summary Setup only. These options are not listed in **Table A-1**. The factory-default settings for these options are shown in **Appendix B**.

Appendix B: Summary Setup

Summary Setup is an advanced feature designed to allow experienced users to quickly change option settings for any mode. Most options can be viewed from and changed using a single LCD screen. Summary Setup is the fastest way to selectively change multiple options; however, because the Summary Setup screens show numerical codes with very little explanation, this method of options selection is recommended only for experienced users.

Even though Summary Setup offers these advantages, it is recommended only for experienced users because there is very little guidance on the LCD screen to indicate which option is being changed.

Changes made through Summary Setup modify the active modem configuration and are saved to memory when you exit Summary Setup.

B.1 Summary Setup LCD Screens

Summary Setup (SUMMARY) is accessed from screen 6 of the SETUP menu. From the SUMMARY screen, choose SETUPS to change options—but for Hayes mode operation (only), choose AT to change options for which there are associated AT commands (**Table B-1**).

If you select AT, the AT PROFILES screen will be displayed. When you select a Hayes mode configuration profile (user profile) from the AT PROFILES screen, the MODEM displays a setup screen for the selected profile. The selected profile is used as the active configuration and is also designated as the default user profile. Select 0 (pushbutton 1) to select profile 0; select 1 (pushbutton 2) to select profile 1. Pushbutton 3, with the AT PROFILES screen displayed, enables you to select the default configuration profile: By pressing pushbutton 3, you can toggle (switch) between profile 0 or profile 1 as the default—the effect is the same as issuing the &Y command (&Y0 or &Y1).

The SUMMARY screen includes a four-digit checksum value to the right of the word “SUMMARY.” This number will change if any of the option settings are changed, so it allows you to determine if any of the modem’s option settings have been changed, although you cannot determine from this number which options have been changed. After setting up the MODEM, record this number for possible later reference.

Appendix C: Connectors, Adapters, and Jumpers

This appendix provides a detailed description of all modem connectors, including pin assignments. It also includes a description of the modem jumper functions and a diagram that shows you where to find the jumpers.

C.1 Connectors and Adapters

The modem includes the following connectors (labeled on the rear panel as indicated below):

- DTE—25-pin (DB25) RS-232/D female cable connector, for connection to DTE (computer or terminal)
- DIAG—RJ-45 modular jack (diagnostic connector), for diagnostic port control (optional)
- POWER—Five-pin DIN connector for AC power
- TX DIAL—RJ-45 modular jack for connection to a dial line
- RX DIAL—(Ignore “RX DIAL” label.) RJ-45 modular jack for alternate leased line connection (when an 8-pin connector is required)
- LEASED LINE—RJ-11 modular jack, for (6-pin) leased line connection
- PHONE—RJ-11 modular jack, for connection to a telephone handset (optional)

These connectors are illustrated in **Chapter 2**, which explains how to install the modem and how to make the connections referred to above.

The modem includes an edge connector for optional rack mounting. When the modem is rack mounted, the edge connector performs the functions of all the connectors listed above (and the other connectors are not used).

C.1.1 CONNECTOR PIN ASSIGNMENTS

For users who need to know connector pin assignments, this information is provided in **Figure C-1** (DIAG, TX DIAL, RX DIAL, LEASED LINE, and PHONE connectors) and in **Table C-1** (DTE interface connector).

Appendix D: DC Voltage Models

D.1 Introduction

The modems with codes MD833A-D12, MD833A-D24, and MD833A-D48 are pre-configured for DC voltage operation. The MD833A-D12 is pre-configured for use with a -12 VDC power source, the MD833A-D24 is pre-configured for use with a -24 VDC power source, and the MD833A-D48 is pre-configured for use with a -48 VDC power source.

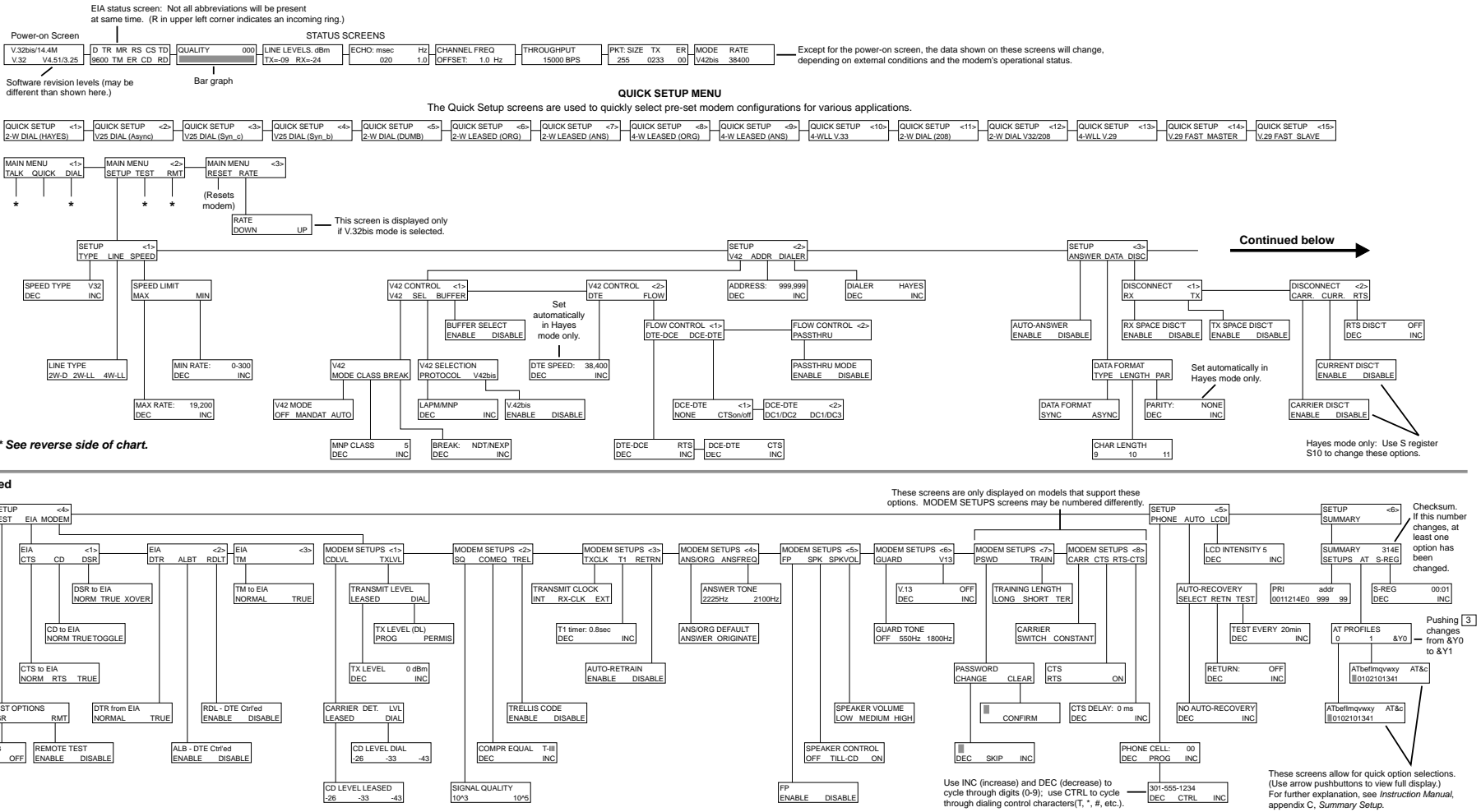
This addendum provides installation and jumper information for the DC pre-configured modems for applications where an external DC power source will be used (i.e., not DC power provided from a rack enclosure). If the modem is to be installed in a rack, refer to the instruction manuals for the modem and the rack.

CAUTION


The -48 VDC model should be used *only* with an *external* DC power source.

For modems using an external DC power source, the information in this addendum about installation and jumper settings supersedes the information in the rest of the Modem 32144 manual. However, all other information in the instruction manual is applicable.

Appendix E: LCD Flow Chart

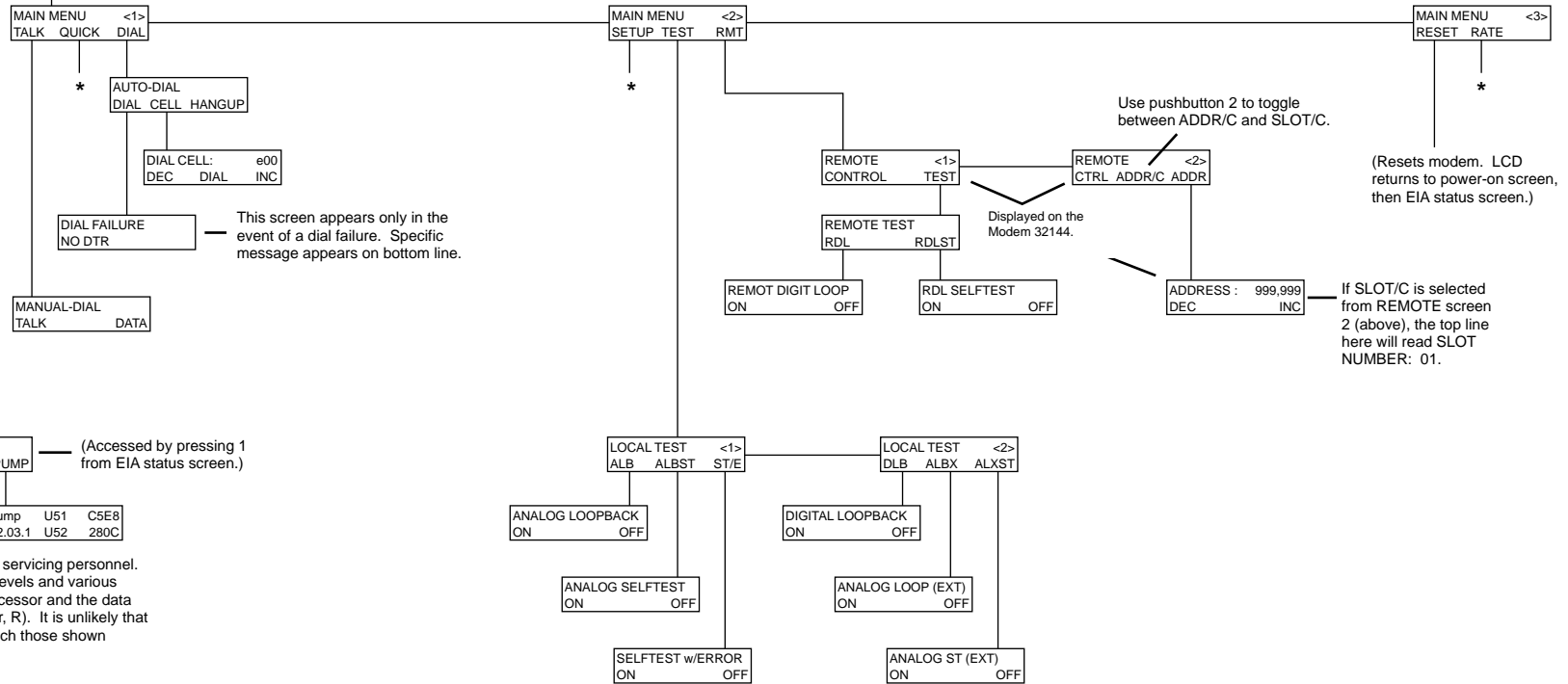


Power-on Screen

V.32bis/14.4M	D TR MR RS CS TD	QUALITY 000	LINE LEVELS. dBm	ECHO: msec	Hz	CHANNEL FREQ	THROUGHPUT	PKT. SIZE TX	ER	MODE	RATE
V.32 V4.51/3.25	9600 TM ER CD RD		TX=-09 RX=-24	020	1.0	OFFSET: 1.0 Hz	15000 BPS	255 0233 00		V42bis	38400

Software revision levels (may be different than shown here.)

STATUS SCREENS



D.2 Installation

Use the supplied cable to attach the modem to the external DC power source, as shown in **Fig. D-1**.

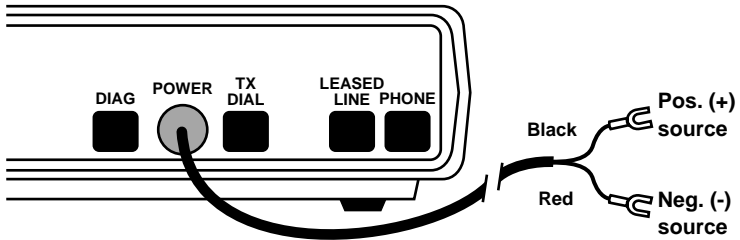


Fig. D-1. Attaching the supplied cable to the DC power source.

Refer also to **Section 2.1, Installation** but ignore information about the AC power transformer cable.

D.3 Jumper Settings

The power jumpers have been pre-set at the factory for DC voltage operation as shown in **Tables D-1**.

Table D-1. Jumper Settings for -12/-24/-48 VDC Operation

Jumper(s)	Setting
JP2	Pins 2 and 3 connected
JP3, JP4 (set to same position)	Pins 1 and 2 connected

For other jumper settings, refer to the rest of this manual. (But for the DC modems, ignore the information in the manuals for jumpers JP2, JP3, and JP4.)

D.4 Jumper Locations

The jumper locations are shown below for your information; however, since the jumper settings are pre-configured, you should not have to change them.

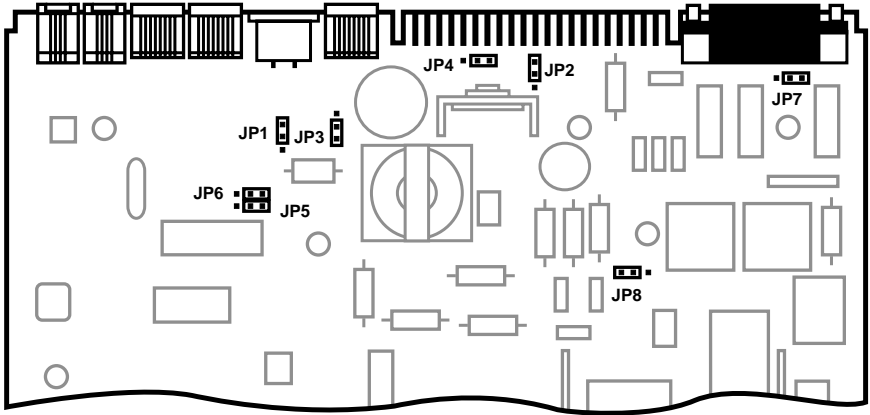


Fig. D-2. Partial view of modem circuit board, showing jumper locations.

For each jumper, pin 1 is identified by a “1” on the modem circuit board. (The JP2 pin 1 label may be difficult to read; JP2 pin 1 is the pin closest to the edge connector.)

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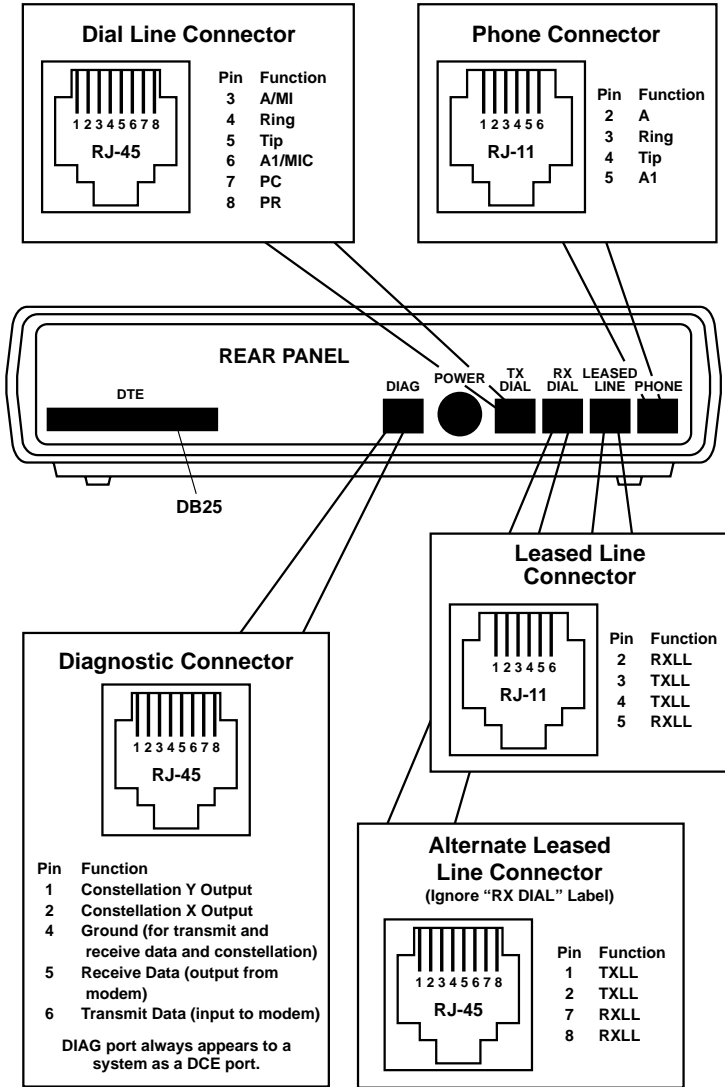


Figure C-1. Connector Pin Assignments.

All connectors are shown as viewed from the back of the modem. Pins not included in the listings above are not used.

Table C-1. Pin Assignments—DB25 TIA/EIA Interface Connector

Pin	Function	Designation			Source
		EIA	ITU-T	LCD	
1	Frame ground—not connected	AA	101		
2	Transmit (send) data (TD)	BA	103	TD	DTE
3	Received data (RD)	BB	104	RD	Modem
4	Request to send (RTS)	CA	105	RS	DTE
5	Clear to Send (CTS)	CB	106	CS	Modem
6	Data Set (modem) Ready (DSR)	CC	107	MR	Modem
7	Signal ground (SG)	AB	102		Ground
8	Carrier detect (CD)	CF	109	CD	Modem
9	Testing voltage, +10V	+P			Modem
10	Testing voltage, -10V	-P			Modem
15	Transmit clock (TC)	DB	114		Modem
17	Receive clock (RC)	DD	115		Modem
18	Analog loopback (ALB) control ¹	CN			DTE
20	Data terminal ready (DTR)	CD	108/2	TR	DTE
21	Remote digital loopback (RDL) control ¹	CN			DTE
22	Ring indicator (RI)	CE	125	R	Modem
24	External transmit clock (XTC)	DA	113		DTE
25	Test mode indicator (TM) ²	CN		TM	Modem

¹+ voltage activates indicated loopback test (but only if ALB-DTE Ctrl'ed or RDL-DTE Ctrl'ed option is enabled);—voltage disables test.

²Alternately, pin 25 may be used for analog loopback (ALB) control.

C.2 Jumpers**WARNING**

Jumpers should be switched only by qualified service personnel.

For most applications, there is no need to reset the modem's internal jumper switches. However, a jumper switch will have to be reset if you need to—

Connect frame ground to signal ground, Switch from A/AI control to MI/MIC control, Strap the modem for use in a DC rack enclosure, or Change the function of EIA interface pin 25.

If you need to reset a jumper switch, refer to the following page to determine the jumper that should be switched, where it is located, and how it should be set. The jumpers are numbered on the circuit board; for example, JP4 is jumper 4. To access the jumpers, unscrew the four screws on the bottom of the modem and carefully lift off the cover.

WARNING

Improper setting of AC and DC power jumpers could result in serious damage to the modem.

Table C-2. Jumper Switch Functions

Jumper(s)	Position¹	Function
JP1	FG Alternate position (no legend)	Frame and signal ground connected Not connected
JP2, JP3 (Set to same position)	A1 MI	A/A1 control MI/MIC control
JP4, JP5, JP8 (Set to same position)	AC Alternate position	AC power DC power (for Telco 48 VDC battery)
JP7	TM (output) AL (input)	Pin 25 used as test mode indicator Pin 25 used for analog loopback
¹ As indicated by legend printed on modem circuit board. Factory settings are shown in boldface.		

B.2 Changing Options via Summary Setup

The appearance of the three setup screens selected via SETUPS and AT (profile 0 or 1) is essentially the same: Brief descriptive information on the top line and a long string of numbers on the bottom line. The numbers are broken down into groups, with each group representing a category of options (dial line options, EIA interface options, etc.).

Each digit position represents an option, and the number in each digit position indicates the current option setting (parameter). To change an option setting, use the front panel pushbuttons to change the parameter (number), as explained in the following section.

The diagrams on the following pages show—

- Which options are included in each option group
- Which option is indicated by each digit position within the group
- The possible parameters for each option

B.2.1 SUMMARY SETUP PUSHBUTTON FUNCTIONS

The three Summary Setup screens are different from all other modem screens in that you can scroll across the string of numbers; also, the pushbutton functions are different. For the three Summary Setup screens only, the modem pushbuttons function as follows:

- Pushbutton 1 moves the cursor to the left. Pushbutton 3 moves the cursor to the right. If the cursor is at the end of the screen, the screen will scroll one character at a time.
- Pushbutton 2 increments the blinking value (i.e., the parameter, or current option setting). The value will cycle through the highest possible parameter value and then back to 0 or 1.
- The right arrow button moves the screen to the beginning of the next group of options to the right. The left arrow button moves the screen to the beginning of the next group of options to the left. Groups of options are separated by blank spaces on the LCD.

NOTE

On the Summary Setup screens that show AT profiles 0 and 1, the cursor location is indicated by a solid black box when the cursor is positioned in a blank cell (one with no characters).

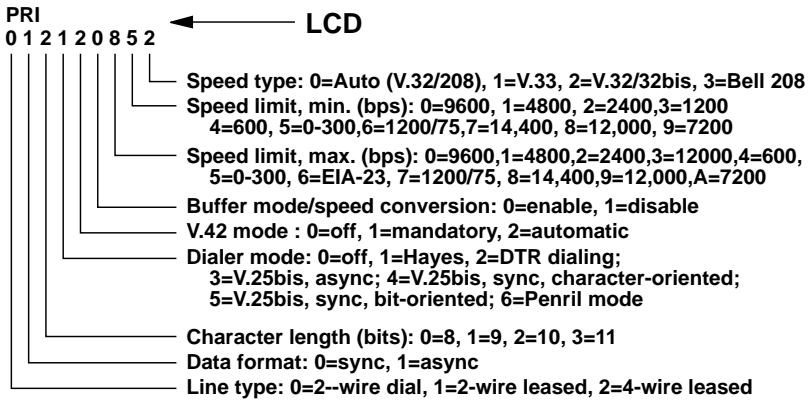
B.2.2 EXPLANATION OF SUMMARY SETUP SCREENS

Note that options are identified on the Summary Setup screens only by the relative positions of the numbers within the number string, as indicated in the following diagrams. Each digit position represents an option, and the number in each digit position indicates the current option setting (parameter).

The string of numbers in each diagram shows the factory default setting for each option (i.e., the Hayes mode default settings). Each diagram also identifies all possible settings for each option.

NOTE

Numbers that are not identified in the following diagrams represent option settings that are reserved for future use or factory use. These settings should not be changed.



NOTES: Speed limit, min., and speed limit, max.: 7200 bps parameters are available only if V.32bis mode is enabled.
 ALX V.32 and ALX V.32M only: Available speed limit selections: Max., 0-7 and A; min., 0-6 and 9. Default max. speed limit setting: 0 (9600 bps).
 Speed type: Settings 0, 1 and 3 are not available on all ALX models.

Fig. B-1. Primary Options.

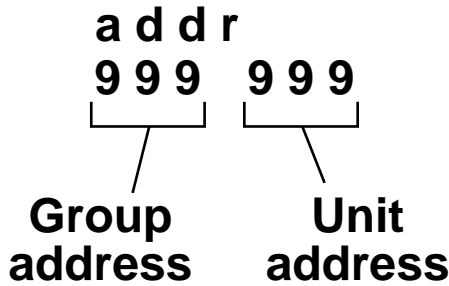


Fig. B-2. Address.

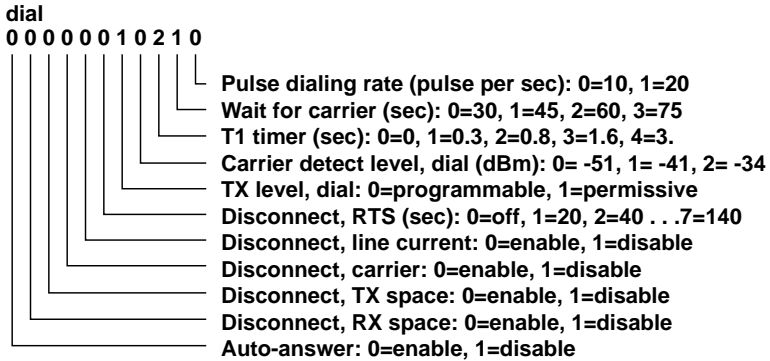


Fig. B-3. Dial Line Options.

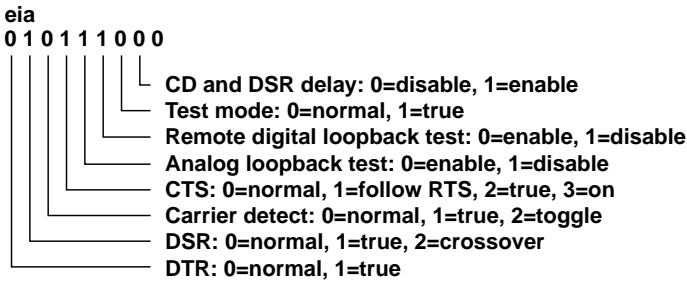


Fig. B-4. EIA Interface Options.

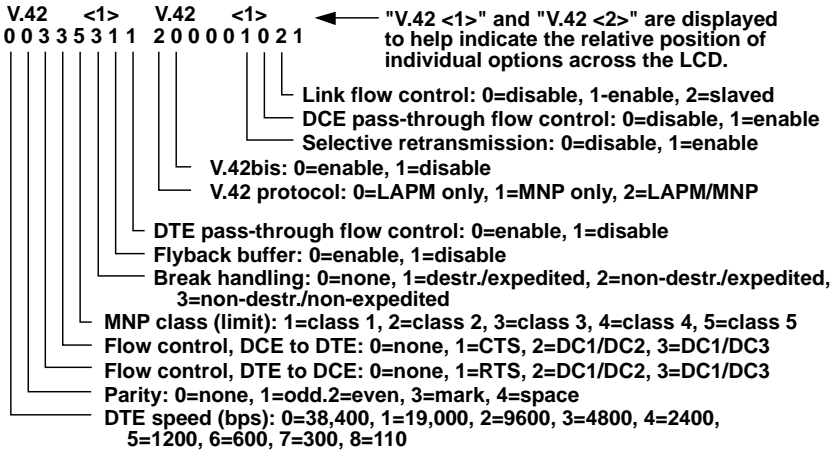
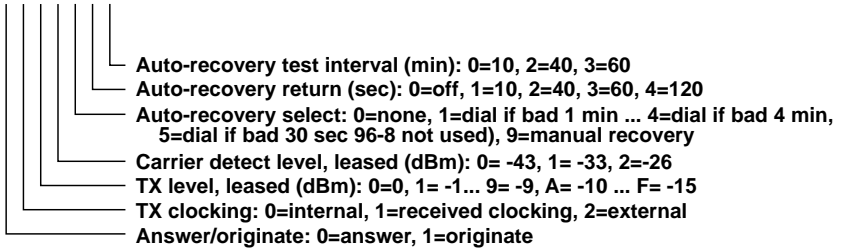


Fig. B-5. V.42 Error Correction Options.

L. L.**1 0 0 2 0 0 1 0****Fig. B-6. Leased Line Options.**

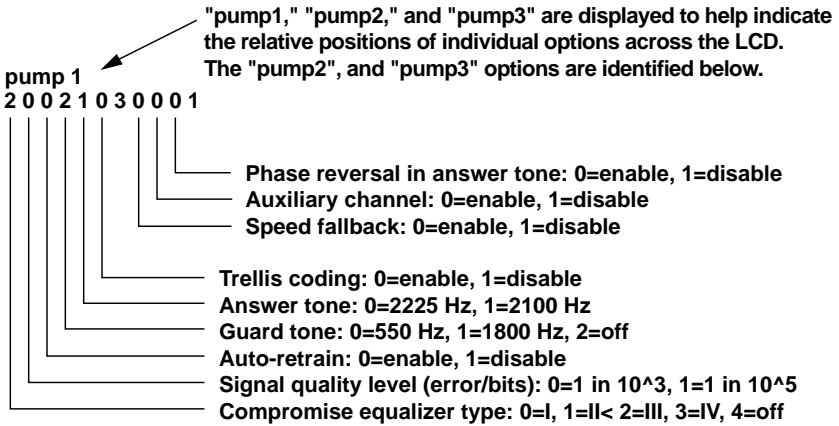


Fig. B-7. Data Pump 1 Options.

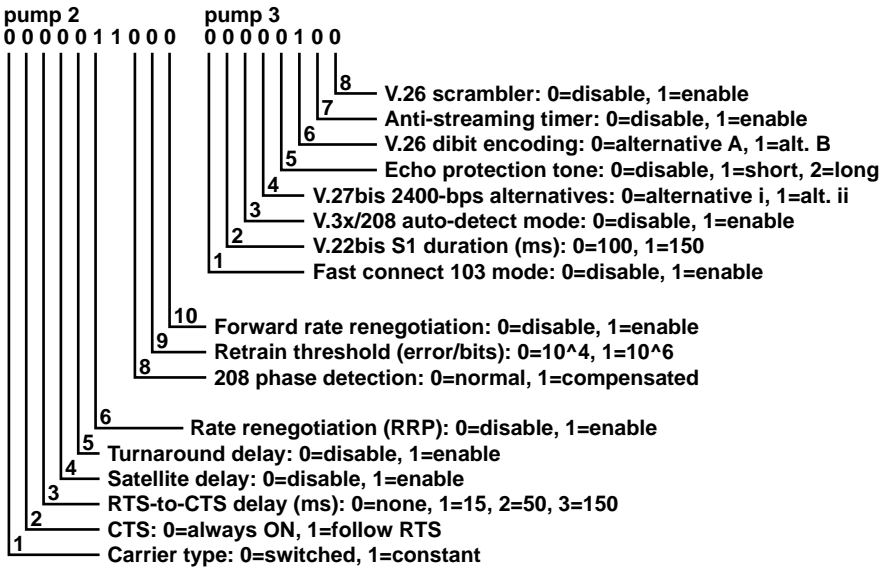


Fig. B-8. Data Pump 2 and 3 Options.

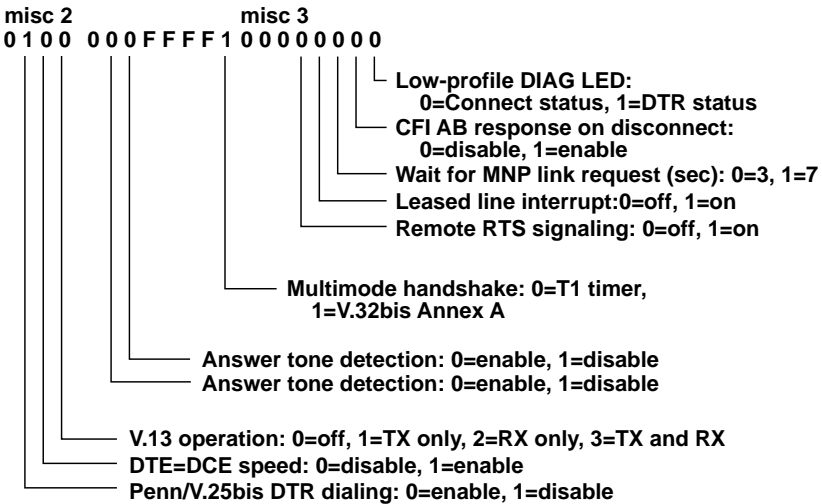
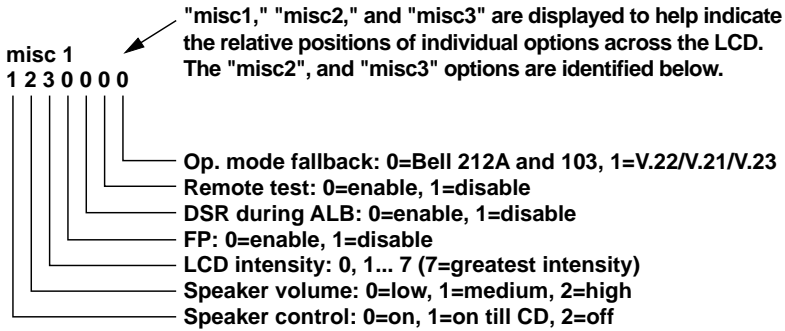


Fig. B-9. Miscellaneous Options.

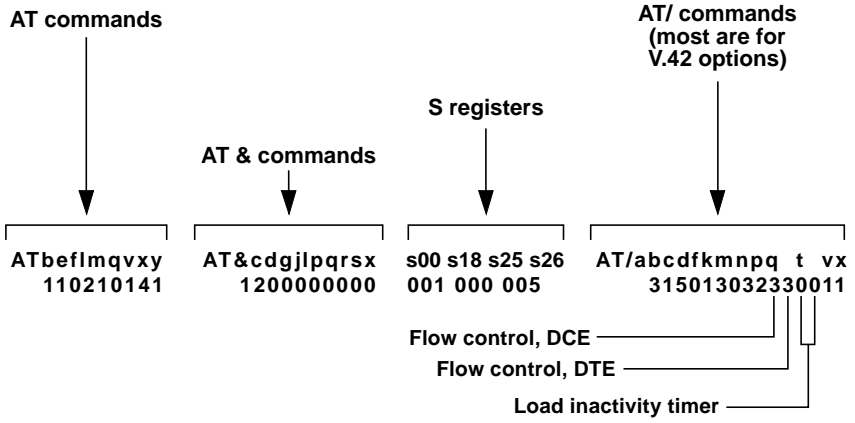


Fig. B-10. Hayes Mode Options—For Each AT Profile.

Table A-1. Quick Setup Configurations

Option	Default settings listed by Quick Setup mode						
	Hayes	V.25bis async ¹	Dumb	2-wire leased ²	4-wire leased ²	V.33 ³	Bell 208 ⁴
(Miscellaneous)							
LINE TYPE	2W-D	2W-D	2W-D	2W-LL	4W-LL	4W-LL	2W-D
Speed (data rate) options							
SPEED, MAX	14400 ⁵	14400 ⁵	14400 ⁵	14400 ⁵	14400 ⁵	14400	4800
SPEED, MIN	300	300	300	4800	4800	12000	4800
SPEED TYPE	V.32	V.32	V.32	V.32	V.32	V.33	208
V.42 error correction options							
V.42 MODE	Auto	Auto ¹	Auto	Auto	Auto	OFF	OFF
MNP CLASS (LIMIT)	5	5	5	5	5	5	5
V.42 BREAK HANDLING	NDT/ NEXP	NDT/ NEXP	NDT/ NEXP	NDT/ NEXP	NDT/ NEXP	NDT/ NEXP	NDT/ NEXP
V.42 PROTOCOL	LAPM/ MNP	LAPM/ MNP	LAPM/ MNP	LAPM/ MNP	LAPM/ MNP	LAPM/ MNP	LAPM/ MNP
V.42bis	Enable	Enable	Enable	Enable	Enable	Enable	Enable
BUFFER	Enable	Enable ¹	Enable	Enable	Enable	Disable	Disable
DTE SPEED	38400	38400	38400	38400	38400	38400	38400
FLOW CONTROL, DTE-DCE	DC1/DC3	DC1/DC3	DC1/DC3	DC1/DC3	DC1/DC3	DC1/DC3	DC1/DC3
<p>¹V.25bis synchronous configurations (character- and bit-oriented) are the same as the V.25bis asynchronous configuration except as follows: V.42 MODE is OFF, BUFFER is disabled, DATA FORMAT is synchronous, PARITY is ODD; DIALER MODE (V25bis) is Sync_c for character-oriented mode, Sync_b for bit-oriented mode.</p> <p>²Leased line originate and answer Quick Setups [(ORG) and (ANS) on the LCD] are the same except that ANS/ORG DEFAULT is set to ORIGINATE for the originate Quick Setups and is set to ANSWER for the answer Quick Setups (2-wire or 4-wire).</p> <p>³ALX V.32/14.4 and ALX V.32/14.4M only.</p> <p>⁴ALX V.32/14.4, ALX V.32/14.4M and certain models of the ALX V.32M only. The V.32/208 auto-mode Quick Setup configuration is the same as the Dumb mode Quick Setup configuration except as follows: SPEED TYPE is AUTO, DATA FORMAT is synchronous, V.13 OPERATION is set to TX and RX, CARRIER is constant; Summary Setup V.32/208 option (data pump options group) is set to 1 (enable).</p> <p>⁵Maximum speed for the ALX V.32 and ALX V.32M is 9600 bps.</p>							

Table A-1. Quick Setup Configurations (continued)

Option	Default settings listed by Quick Setup mode						
	Hayes	V.25bis asyn ¹	Dumb	2-wire leased ²	4-wire leased ²	V.33 ³	Bell 208 ⁴
FLOW CONTROL, DCE-DTE	DC1/DC3	DC1/DC3	DC1/DC3	DC1/DC3	DC1/DC3	DC1/DC3	DC1/DC3
FLYBACK BUFFER	Disable	Disable	Disable	Disable	Disable	Disable	Disable
DTE PASS-THR FLOW CTRL	Disable	Disable	Disable	Disable	Disable	Disable	Disable
(Miscellaneous)							
ADDRESS	999,999	999,999	999,999	999,999	999,999	999,999	999,999
DIALER MODE	Hayes	V25bis/ Asyn ¹	OFF	OFF	OFF	OFF	OFF
AUTO ANS	Enable	Enable	Enable	Disable	Disable	Disable	Enable
Data format options							
DATA FORMAT	Async	Async ¹	Async	Sync	Sync	Sync	Sync
CHAR LENGTH	10	10	10	10	10	10	10
PARITY	None	Even ¹	None	None	None	None	None
Disconnect options							
RX SPACE DISC'T	Enable	Enable	Enable	Enable	Enable	Enable	Enable
TX SPACE DISC'T	Enable	Enable	Enable	Enable	Enable	Enable	Enable
CARRIER DISC'T	Enable	Enable	Enable	Enable	Enable	Enable	Enable
LINE CURR DISC'T	Enable	Enable	Enable	Enable	Enable	Enable	Enable
RTS DISC'T	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Test options							
DSR DURING ALB	ON	ON	ON	ON	ON	ON	ON
REMOTE TEST	Enable	Enable	Enable	Enable	Enable	Enable	Enable

APPENDIX A: Quick Setup Configurations

Table A-1. Quick Setup Configurations (continued)

Option	Default settings listed by Quick Setup mode						
	Hayes	V.25bis async ¹	Dumb	2-wire leased ²	4-wire leased ²	V.33 ³	Bell 208 ⁴
EIA options							
CTS TO EIA	RTS	True	Normal	Normal	Normal	Normal	Normal
CD TO EIA	Normal	Normal	Normal	Normal	Normal	Normal	Normal
DSR TO EIA	True	Normal	Normal	True	True	True	Normal
DTR FROM EIA	Normal	Normal	Normal	True	True	True	Normal
ALBT DTE CTRL'ED	Disable	Disable	Disable	Disable	Disable	Disable	Disable
RDLT DTE CTRL'ED	Disable	Disable	Disable	Disable	Disable	Disable	Disable
TM TO EIA	Normal	Normal	True	True	True	True	True
Modem setup options							
CD LEVEL, LEASED	-26 dBm	-26 dBm	-26 dBm	-26 dBm	-26 dBm	-26 dBm	-26 dBm
CD LEVEL, DIAL	-51 dBm	-51 dBm	-51 dBm	-51 dBm	-51 dBm	-51 dBm	-51 dBm
TX LEVEL, LEASED	0 dBm	0 dBm	0 dBm	0 dBm	0 dBm	0 dBm	0 dBm
TX LEVEL, DIAL	Permis.	Permis.	Permis.	Permis.	Permis.	Permis.	Permis.
SIGNAL QUAL LEVEL	10 ^{^3}	10 ^{^3}	10 ^{^3}	10 ^{^3}	10 ^{^3}	10 ^{^3}	10 ^{^3}
COMPR EQUAL	T-III	T-III	T-III	T-III	T-III	T-III	T-III
TRELLIS CODE	Enable	Enable	Enable	Enable	Enable	Enable	Enable
TRANSMIT CLOCKING	Internal	Internal	Internal	Internal	Internal	Internal	Internal
T1 TIMER	0.8 sec	0.8 sec	0.8 sec	0.8 sec	0.8 sec	0.8 sec	0.8 sec
AUTO- RETRAIN	Enable	Enable	Enable	Enable	Enable	Enable	Enable
ANS/ORG DEFAULT	ORIG	ORIG	ORIG	See footnote 2	See footnote 2	ORIG	ORIG
ANSWER TONE	2100 Hz	2100 Hz	2100 Hz	2100 Hz	2100 Hz	2100 Hz	2100 Hz

Table A-1. Quick Setup Configurations (continued)

Option	Default settings listed by Quick Setup mode						
	Hayes	V.25bis async ¹	Dumb	2-wire leased ²	4-wire leased ²	V.33 ³	Bell 208 ⁴
FRONT PANEL	Enable	Enable	Enable	Enable	Enable	Enable	Enable
SPEAKER CONTROL	Till-CD	Till-CD	Till-CD	Till-CD	Till-CD	Till-CD	Till-CD
SPEAKER VOLUME	High	High	High	High	High	High	High
GUARD TONES	OFF	OFF	OFF	OFF	OFF	OFF	OFF
V.13 OPERATION	OFF	OFF	OFF	OFF	OFF	OFF	OFF
V.33 and Bell 208A/B options (MODEM SETUP options for V.33 and Bell 208 operation only)							
CARRIER	Switched	Switched ⁶	Switched	Switched	Switched	Constant	Switched
CTS	RTS	RTS ⁶	RTS	RTS	RTS	ON	RTS
RTS-CTS DELAY	0	0 ⁶	0	0	0	0	150 ms
Auto-Recovery options							
AUTO-RECV SELECT	None	None	None	None	None	None	None
AUTO-RECV RETURN	OFF	OFF	OFF	OFF	OFF	OFF	OFF
AUTO-RECV TEST INT'VL	20 min	20 min	20 min	20 min	20 min	20 min	20 min
(Miscellaneous)							
LCD INTENSITY	3	3	3	3	3	3	3
⁶ Effective for synchronous modes only.							

APPENDIX A: Quick Setup Configurations

Table A-2. Additional Quick Setup Configurations

Default settings listed by Quick Setup mode				
Option	Bell 208¹	4-wire leased V.29	V.29 fast master	V.29 fast slave
Communication Standard option				
STD	208	V.29	V.29	V.29
Speed Limit option, V.32, V.32M, V.32/14.4, V.32/14.4M, V.32/19.2, V.32/19.2M				
MAX DCE RATE	4800	9600	9600	9600
MIN DCE	4800	4800	4800	4800
Default settings listed by Quick Setup mode				
Option	Bell 208¹	4-wire leased V.29	V.29 fast master	V.29 fast slave
BUFFER	Disable	Disable	Disable	Disable
DTE SPEED	38.4 Kbps	38.4 Kbps	38.4 Kbps	38.4 Kbps
FLOW CONTROL DTE-DCE	RTS	RTS	RTS	RTS
FLOW CONTROL DCE-DTE	CTS	CTS	CTS	CTS
DTE PASS-THRU FLOW CTRL	Disable	Disable	Disable	Disable

Table A-2 (continued). Additional Quick Setup Configurations

(Miscellaneous)				
ADDRESS ²	999,999	999,999	999,999	999,999
DIALER MODE	OFF	OFF	OFF	OFF
AUTO ANSWER	Enable	Enable	Disable	Disable
Data Format Options				
DATA TYPE	Sync	Sync	Sync	Sync
CHAR LENGTH	10	10	10	10
PARITY	None	None	None	None
Disconnect Options				
RX SPACE DISC'T	Disable	Disable	Disable	Disable
TX SPACE DISC'T	Disable	Disable	Disable	Disable
CARRIER DISC'T	Enable	Enable	Enable	Enable
LINE CURR DISC'T	Enable	Enable	Enable	Enable
RTS DISC'T	OFF	OFF	OFF	OFF
² Quick Setup does not change the address to the default address, but a factory reset does.				

Table A-2 (continued). Additional Quick Setup Configurations

Test Options				
DSR DURING ALB	ON	ON	ON	ON
REMOTE TEST	Enable	Enable	Enable	Enable
EIA Options				
CTS to EIA	Normal	Normal	Normal	Normal
CD to EIA	Normal	Normal	Normal	Normal
DSR to EIA	Normal	True	True	True
DTR from EIA	Normal	True	True	True
ALBT DTE CTRL'ED	Disable	Disable	Disable	Disable
RDL DTE CTRL'ED	Disable	Disable	Disable	Disable
TM to EIA	True	True	True	True
Modem Setup Options				
CD LEVEL, LEASED	-26 dBm	-26 dBm	-26 dBm	-26 dBm
CD LEVEL, DIAL	-43 dBm	-43 dBm	-43 dBm	-43 dBm
TX LEVEL, LEASED	0 dBm	0 dBm	0 dBm	0 dBm
TX LEVEL, DIAL	Permis.	Permis.	Permis.	Permis.
SIGNAL QUAL LEVEL	10 ⁴	10 ⁴	10 ⁵	10 ⁴

Table A-2 (continued). Additional Quick Setup Configurations

COMPR EQUAL	T-III	T-III	T-III	T-III
TRELLIS CODE	Enable	Enable	Enable	Enable
TRANSMIT CLOCKING	Internal	Internal	Internal	Internal
T1 TIMER	0.8 sec	0.8 sec	0.8 sec	0.8 sec
Default settings listed by Quick Setup mode				
AUTO- RETRAIN	Enable	Enable	Disable	Disable
ANS/ORG DEFAULT	ORIG	ORIG	ORIG	ANS
ANS TONE	2100 Hz	2100 Hz	2100 Hz	2100 Hz
FRONT PANEL	Enable	Enable	Enable	Enable
SPKR CTRL	Til-CD	Til-CD	Til-CD	Til-CD
SPKR VOL	Medium	Medium	Medium	Medium
GUARD TONES	OFF	OFF	OFF	OFF
V.8 PROC	Enable	Enable	Enable	Enable
V.13 OPERATION	OFF	OFF	OFF	OFF
TRAINING LENGTH	Long	Long	Short	Short
CARRIER	Switched	Constant	Constant	Switched
CTS	RTS	RTS	RTS	RTS
RTS-CTS DLY	150 ms	0	0	0

Table A-2 (continued). Additional Quick Setup Configurations

Auto-Recovery Options				
AUTO-RECV SELECT	None	None	None	None
AUTO-RECV RETURN	OFF	OFF	OFF	OFF
AUTO-RECV TEST INT'VL	20 min	20 min	20 min	20 min
AUTO-RECV TEST TYPE	INTER	INTER	INTER	INTER
LCD Intensity Option				
LCD INTENSITY	5	5	5	5

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3.3	Selecting Options from the Front Panel	40
3.3.1	DEC/INC (Decrease/Increase) Screens	41
3.3.2	Example of How to Select an Option	42
3.3.3	How to Return to the EIA Status Screen	43
3.3.4	Automatic Configuration Save Feature.....	43
3.3.5	How to Return to Default Settings	43
3.4	Options.....	44
3.5	Speed (Data Rate) Options	44
3.6	V.42 Error Correction Options.....	48
3.7	Address.....	54
3.8	Dialer Mode	55
3.9	Auto-Answer Option	55
3.10	Data Format Options	56
3.11	Disconnect Options.....	57
3.12	Test Options.....	58
3.13	EIA Options	58
3.14	Modem Setups	60
3.15	V.33 and Bell 208A/B Options.....	65
3.16	Options Accessible Only via Summary Setup.....	67
3.16.1	Dial Line Options	67
3.16.2	V.42 Error-Correction Options	67
3.16.3	Data Pump Options.....	69
3.16.4	Miscellaneous Options	70
4.0	General Operation and Special Features	74
4.1	Quick Reset.....	74
4.2	Storing Phone Numbers	74
4.2.1	Uses.....	74
4.2.2	How to Store a Phone Number	75
4.3	Automatic Fallback.....	77
4.3.1	Operating-Mode Fallback	77
4.3.2	Automatic Rate Adjustment.....	79
4.4	Dumb Mode and Bell 208 Operation	80
4.4.1	Manual Originate/Answer Operation	80
4.5	V.32/208 Auto-Detect Mode.....	81
4.5.1	V.32/V.32 bis Operation.....	81
4.5.2	Bell 208 Operation	82
4.5.3	Automatic Fallback	82
4.6	V.13 Operation	82
4.7	DTR Dialing.....	82
4.7.1	Dialing a Stored Number	83
4.7.2	Answer Mode Operation.....	83

- 4.8 Dial Line Auto-Recovery83
 - 4.8.1 Setting Up the Modem for Dial Line Auto-Recovery83
 - 4.8.2 Recovery Procedure84
- 4.9 Leased Line Auto-Recovery84
 - 4.9.1 Autodial Backup85
 - 4.9.2 Exit from Leased Line Auto-Recovery85
 - 4.9.3 Leased-Line Auto-Recovery Options.....86
- 4.10 Modem Security Operation.....87
- 4.11 Automatic Password Protection (APP)87
- 4.12 Configuring Modems for APP89
 - 4.12.1 APP Without Callback.....89
 - 4.12.2 APP With Callback.....89
 - 4.12.3 Password Screens89
 - 4.12.4 Valid Password Characters90
 - 4.12.5 APP with Callback: Storing the Password with Callback Number.....91
- 4.13 Disabling APP91
 - 4.13.1 Temporarily Disabling APP.....91
 - 4.13.2 Clearing the Password92
- 4.14 Manual-Response Password Protection (MPP)92
- 4.15 Commands for Enabling MPP.....93
- 4.16 How to Use Password Commands.....94
- 5. Hayes Emulation Mode97
 - 5.1 Hayes Mode Autodialer97
 - 5.1.1 Enabling the Hayes Mode Autodialer.....97
 - 5.1.2 Command Guidelines97
 - 5.2 Result Codes99
 - 5.3 Transmission Speed.....100
 - 5.4 Hayes Compatible Commands101
 - 5.5 S Registers107
 - 5.5.1 Reading and Setting Registers.....107
 - 5.5.2 S Register Functions.....108
 - 5.6 Saving Option Selections110
 - 5.7 Facsimile (Fax) Transmission111
 - 5.8 Hayes Mode Reference Tables111
- 6. V.25bis Autodialer127
 - 6.1 Enabling the V.25bis Autodialer.....127
 - 6.1.1 Quick Setup127
 - 6.1.2 2=Dialer Mode (DIAL V.25 bis Screen)128
 - 6.1.3 DTR Dialing in V.25 bis Mode128
 - 6.2 V.25 bis Autodialer Commands128
 - 6.3 Dialing Parameters.....132
 - 6.4 V.25 bis Result Codes134

6.5	Message Format	136
6.5.1	Asynchronous.....	136
6.5.2	Synchronous, Character-Oriented	136
6.5.3	Synchronous, Bit-Oriented	137
7.	Diagnostics.....	138
7.1	When and Why to Test.....	138
7.2	Symptoms and Scope of the Problem.....	138
7.3	Physical Inspection	139
7.4	Overview of Modem Diagnostics.....	139
7.5	How to Select and Activate Tests	140
7.5.1	Front-Panel Control	140
7.5.2	Running Tests in Hayes Mode	140
7.5.3	Remote Test Control	140
7.6	Diagnostic Monitoring: Status Screens.....	140
7.6.1	EIA Status Screen	140
7.6.2	Other Status Screens	141
7.7	Rate Change Screen.....	143
7.8	Local Modem Diagnostics	144
7.8.1	Analog Loopback (ALB) Test.....	144
7.8.2	Analog Loopback Self-Test (ALBST)	145
7.8.3	Analog Loopback Self-Test with Errors (ST/E)	147
7.8.4	External Analog Loopback (ALBX) Test.....	147
7.8.5	External Analog Loopback Self-Test (ALXST)	149
7.8.6	Digital Loopback Test (DLB)	151
7.9	Remote Modem Diagnostics.....	153
7.9.1	Remote Digital Loopback (RDL) Test.....	153
7.9.2	Remote Digital Loopback Self-Test (RDLST)	154
Appendix A:	Quick Setup Configurations	156
Appendix B:	Summary Setup	166
B.1	Summary Setup LCD Screens	166
B.2	Changing Options via Summary Setup.....	167
B.2.1	Summary Setup Pushbutton Functions.....	167
B.2.2	Explanation of Summary Setup Screens	168
Appendix C:	Connectors, Adapters, and Jumpers	176
C.1	Connectors and Adapters	177
C.1.1	Connector Pin Assignments.....	178
C.2	Jumpers.....	179

Appendix D: DC Voltage Models	181
D.1 Introduction.....	181
D.2 Installation	182
D.3 Jumper Settings	183
D.4 Jumper Locations	184
Appendix E: LCD Flow Chart	185

7.3 Physical Inspection

The next step in isolating a defective component is to inspect the system. If you have been able to trace the problem to a specific site, examine that site. Check the installation of the modem and DTE. Are all cables in good condition and fully connected? Are all components in the system receiving power? Inspect the system as thoroughly as possible.

7.4 Overview of Modem Diagnostics

Once you have identified the symptoms and conducted a physical inspection of the sites in question, you can use diagnostic monitoring and testing to further isolate the problem. The modem is equipped with diagnostic capabilities that will often enable the user to locate faults quickly and easily. The diagnostic features of the modem fall into two categories—local and remote—as listed below.

There are six types of local modem diagnostics:

- Analog loopback (ALB)
- Analog loopback self test (ALBST)
- Analog loopback self test with errors (ST/E)
- External analog loopback (ALBX)

- External analog loopback self test (ALXST)
- Digital loopback (DLB)

There are two types of remote diagnostics:

- Remote digital loopback (RDL)
- Remote digital loopback self test (RDLST)

The sequence in which diagnostic tests should be conducted depends upon the symptoms that have been identified as well as the availability of personnel at the remote site and external test equipment. The self test pattern generator and pattern detector built into the modem alleviates the requirement for external test equipment. With the non-self tests, either a standard DTE or an external bit error rate test (BERT) is used to generate test data and compare it with received data.

Because more transmission errors occur at higher speeds on marginal transmission facilities, begin testing at 14.4 Kbps. If errors occur, reduce the speed and try again. If you cannot correct the problem, contact Technical Support for assistance.

7.5 How to Select and Activate Tests

7.5.1 FRONT-PANEL CONTROL

Tests are accessed and activated in the same way options are selected: by using the LCD and front-panel pushbuttons (as explained in **Chapter 3**). To find the LCD screen for a specific test, refer to the LCD flow chart (**DIAGNOSTIC AND CONTROL FUNCTIONS**) included with this manual. Once you have accessed the screen for a specific test, press pushbutton 1 to begin the test (select ON). A test status screen will then be automatically displayed. To deactivate a test, press the ENT pushbutton and then pushbutton 3. (The ENT button cannot be used to exit the text screen until the test has been deactivated.)

NOTE

For valid test results, error correction must be disabled before diagnostic tests are run. To disable error correction, set the V.42 Mode option to OFF.

7.5.2 RUNNING TESTS IN HAYES MODE

In Hayes emulation mode only, most of the diagnostic tests available on the modem can be activated via the DTE keyboard by using the &T commands listed in **Section 5.4**. The duration of a test can be set by assigning a value to register S18. For example, AT S18=30 sets the test time to 30 seconds. The command &TO terminates a test. For further information, see **Section 5.4**.

7.5.3 REMOTE TEST CONTROL

You can configure the modem to ignore or accept requests from remote modems to initiate tests on your modem. To access the remote test control option, select TEST from SETUP screen 4. Then select RMT from the TEST OPTIONS screen. From the REMOTE TEST screen, select ENABLE to allow remote test initiation or DISABLE to refuse remote test requests.

7.6 Diagnostic Monitoring: Status Screens

To obtain additional information about the status of the communications system, observe the status screen described in the following sections. To view these screens, push the ENT button until the EIA status screen appears. Use the right arrow pushbutton to advance to other status screens.

7.6.1 EIA STATUS SCREEN

The EIA status screen indicates the operational status of the modem as well as the condition of certain EIA RS-232 leads. The abbreviations that may appear are identified below; however, typically, only a few of these abbreviations will be displayed during actual operation.

D	TR	MR	RS	CS	TD
9600		TM	ER	CD	RD

D=Dial line occupied

R=Ringling (R appears in same position as D.)

S=Connection secured by security handshake (S appears in same position as D. S and D may flash alternately.)

TR=Data Terminal Ready

MR=Data Set Ready

RS=Request to Send

CS=Clear to Send

TD=Transmit Data

9600, 4800, etc. = Data speed ("idle"—meaning the modem is off-line—or H-01, H-14, etc., may also be displayed in the data speed position; see following text.)

TM=Test mode

ER=Error (poor signal quality)

CD=Carrier Detect

RD=Receive Data

Handshake Display

When two modems establish a connection, they engage in an exchange known as a handshake. While a handshake is taking place, the modem displays several codes ranging from H-01 to H-28 in the lower left corner of the EIA status screen. A handshake typically lasts for up to 12 seconds and is accompanied by various audible tones.

Checksum Screens

By pressing pushbutton 1 while the EIA status screen is displayed, you can access two checksum screens, one for the main checksum and one for the data pump transmitter and receiver checksums. These checksums provide data intended for use by servicing personnel. The checksum screens also show the software revision levels (which are also shown on the power-on screen).

7.6.2 OTHER STATUS SCREENS

QUALITY SCREEN. The quality screen displays the quality of the received signal carrier as a numeric value and as a horizontal bar graph. A low numeric value indicates good signal quality. The best possible signal quality is indicated when the bar graph extends all the way to the right edge of the LCD.

LINE LEVELS SCREEN. This screen shows the preset level of the transmit signal (TX) and the measured level of the receive signal (RX).

The RX value is the approximate local receive level of the incoming signal. The range of measurement for RX is from 0 to -43 dBm in 1.5-dBm increments. If the signal level is less than the carrier detect threshold, <CD will be displayed.

ECHO CHARACTERISTICS SCREEN. This screen displays the characteristics of the echo portion of the receive signal. Specifically, it shows milliseconds of delay and the offset frequency in Hertz.

CHANNEL FREQUENCY OFFSET. This screen displays the frequency offset of the receive signal in Hertz.

THROUGHPUT SCREEN. This screen functions only if error correction has been enabled. It shows the rate (in bits per second) at which characters are being accepted by the modem from the DTE.

PACKET SCREEN. The packet screen functions only when error correction is enabled. It has three components, as explained next.

- **SIZE.** Shows size of data packets (MNP) or blocks (V.42/V.42 bis) currently being transmitted. MNP uses “shorter” packets to transmit through noisy lines and “longer” packets (which allow greater throughput) when line conditions are good. The maximum MNP packet size is 256 characters (MNP classes 4 and 5) or 64 (MNP classes 1-3). The block size for V.42/V.42 bis is fixed at 128 characters.
- **TRANSMITTED (TX).** Number of packets or blocks transmitted since the connection was established (or since counter reset).
- **ERRORS (ER).** Number of retransmissions (due to data errors) since the connection was established (or since the counter was reset).

To reset the TX and ER counters, press pushbutton 2 while the packet screen is displayed.

MODE AND RATE SCREEN. This screen shows the following data:

- **MODE.** Below MODE, this screen indicates the error-correction status:
 - **NORMAL,** Error correction and buffer mode are both inactive.

- V42, V.42 error correction (LAPM) is active.
- V42 bis, V.42 bis error correction (LAPM with data compression) is active.
- MNP 01 – MNP 05, MNP error correction is active.
- BUFFER, Buffer mode is active.
- OFFLINE, Modem is off-line.
- RATE. This screen shows the data rate of the DTE.

7.7 Rate Change Screen

If V.32bis mode and the Rate Renegotiation Procedure (RRP) option are both enabled, the modem will automatically adjust during data transmission to a higher or lower data rate, depending on the receive signal quality. For diagnostic purposes, the RATE screen (accessed from screen 3 of the MAIN MENU) may be used to manually initiate speed renegotiation from the front panel, as explained below.

The RATE screen is displayed only if V.32 bis mode is enabled (via Summary Setup, V.32 Mode option).

If you select DOWN from the RATE screen, the modem will fall back to the next lower speed. If you select UP, the modem will fall forward to the next higher speed—if the signal quality is good enough. The range within which the modem can fall forward or fall back is limited by the minimum and maximum rates set via the Speed Limit option. After you select UP or DOWN, the LCD will automatically switch to the EIA status screen so you can see the result of the rate change request (i.e., the current data rate, which is displayed in the lower left corner of the EIA status screen). However, if the local modem has reached the minimum or maximum speed, it will not switch to the EIA status screen.

NOTE

A request to increase the data rate may result in no change in the data rate if the signal quality is poor.

If you manually initiate speed renegotiation with RRP enabled, the modem will automatically renegotiate the speed (again) after receiving good signal quality for 4 seconds. If the originate modem attempts to negotiate a rate that is lower than the minimum rate setting of the answer modem, the answer modem will disconnect (GSTN clear-down).

7.8 Local Modem Diagnostics

Local modem diagnostics are for testing the modem and its adjoining system. These tests are accessed from the main menu and are easily performed if the modem is attached to DTE or an external BERT.

7.8.1 ANALOG LOOPBACK (ALB) TEST

Analog loopback testing allows the user to test the local modem and its associated terminal independently from the telephone interface and the remote modem. **Fig. 7-1** shows the connections automatically made during the test.

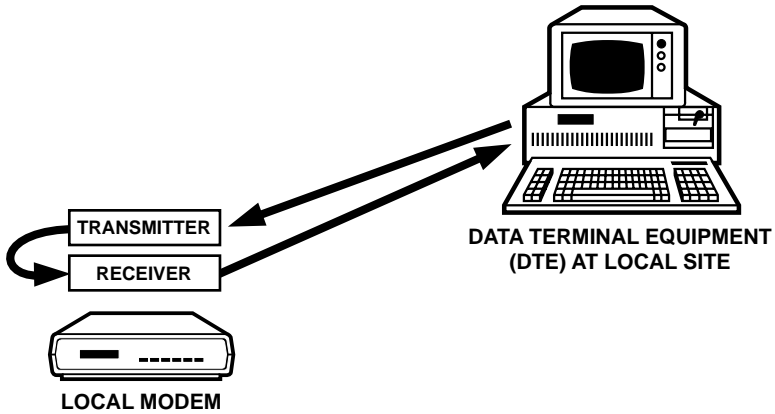


Fig. 7-1. Analog Loopback Test.

In Hayes emulation mode only, the ALB test can be initiated using the command &T1 (preceded by AT). In any mode, the ALB test can be initiated by using the modem's front panel controls, as explained in the following paragraphs.

Make sure the modem is idle, that the data rate is the same as that of the DTE and that the DTR circuit is on. (If TR is present on the EIA status screen, the DTR circuit is on.)

From screen 2 of the LCD MAIN MENU, select TEST. This will take you to screen 1 of the LOCAL TEST menu, where ALB will be displayed as one of the test selections. Select ALB.

The ANALOG LOOPBACK screen will be displayed, with ON and OFF as the possible selections.

Select ON to activate the test. (In general, the DSR during ALB test option discussed in chapter should be left ON—the default selection—to avoid disrupting the DTE and DTE software operations.)

The EIA status screen will be displayed while the test is being conducted. Ensure that test data is being generated. Watch for data errors. By transmitting test data and comparing it with the received copy, the DTE and modem are checked for proper operation.

To end the test, press the ENT pushbutton to return to the ANALOG LOOPBACK screen, and then select OFF.

7.8.2 ANALOG LOOPBACK SELF-TEST (ALBST)

In the analog loopback self-test, the modem is placed in analog loopback and data is sent and received by an internal 511-bit pattern generator and receiver; therefore, no DTE or external BERT is necessary. **Fig. 7-2** shows the data flow for this test.

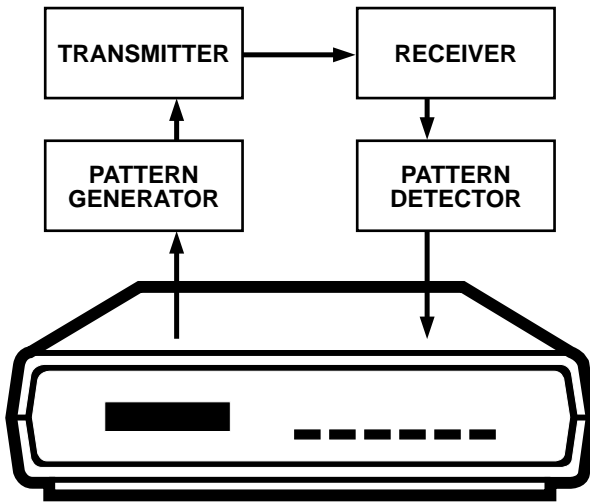


Fig. 7-2. Analog Loopback Self Test (ALBST).

In Hayes mode only, the ALBST can be initiated using the command &T8 (preceded by AT). In any mode, the ALBST can be initiated by using the modem's front-panel controls, as follows:

From screen 2 of the LCD MAIN MENU, select TEST. This will take you to screen 1 of the LOCAL TEST menu, where ALBST will be visible as one of the selections. Select ALBST.

The SELFTEST screen will be displayed, with ON and OFF as the possible selections. Select ON to activate the test. The EIA status screen will be displayed while the test is being conducted. If "ER" is present on the front panel, data errors have occurred. The ER indicator may flash on when the test is first turned on, but it should quickly go out and remain off until the end of the test.

To end the test, press the ENT pushbutton to return to the SELFTEST screen, and then select OFF.

7.8.3 ANALOG LOOPBACK SELF-TEST WITH ERRORS (ST/E)

In the analog loopback self test with errors, data is sent and received by an internal 511-bit pattern generator and receiver; therefore, no DTE or external BERT is necessary. This test differs from the ALBST in that errors are injected into the data flow every few seconds. The data flow is the same as that shown in figure -2 (the ALBST).

To run this test, follow these steps:

From screen 2 of the LCD MAIN MENU, select TEST. This will take you to screen 1 of the LOCAL TEST menu, where ST/E will be visible as one of the selections. Select ST/E.

The SELFTEST W/ERROR screen will be displayed, with ON and OFF as the possible selections. Select ON to activate the test. The EIA status screen will be displayed. The ER indicator should flash every few seconds, indicating that the pattern generator and detector are working. Errors are injected every few seconds. To end the test, press the ENT pushbutton to return to the SELFTEST W/ERROR screen, and then select OFF.

7.8.4 EXTERNAL ANALOG LOOPBACK (ALBX) TEST

The external analog loopback test is available for 4-wire leased line mode only.

The ALBX test allows the user to test the local modem and its associated terminal and to verify the availability of the leased line circuit. The test circuit does not include the remote modem.

Fig. 7-3 shows the connections automatically made during the ALBX test.

NOTE

The ALBX test may result in errors or may fail altogether even where conditions are satisfactory for normal operation. This is because the test channel presented to the modem during the ALBX test includes all impairments of both the inbound and outbound channels (amplitude distortion, delay distortion, noise, etc.). The main purpose of the ALBX test is to verify that the modem is connected to the leased line and that the leased line circuit is complete. The test is not meant to assess the suitability of the leased line.

The ALBX test can be initiated by using the modem's front panel controls, as explained in the following paragraphs.

Make sure the local modem is not in communication with the remote modem, that the data rate is the same as that of the DTE and that the DTR circuit is on. (If TR is present on the EIA status screen, the DTR circuit is on.)

From screen 2 of the LCD MAIN MENU, select TEST. Go to screen 2 of the LOCAL TEST menu and select ALBX.

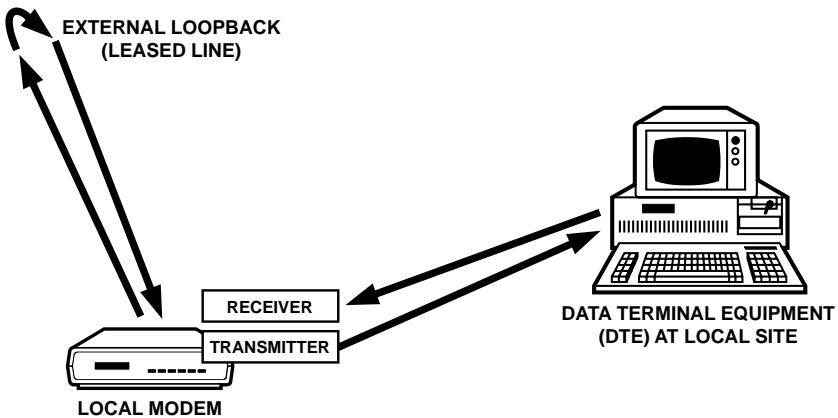


Fig. 7-3. External Analog Loopback (ALBX) Test.

The ANALOG LOOP(EXT) screen will be displayed, with ON and OFF as the possible selections.

Select ON to activate the test. (In general, the DSR during ALB test option discussed in chapter should be left ON—the default selection—to avoid disrupting the DTE and DTE software operations.)

The EIA status screen will be displayed while the test is being conducted. If no external loopback is present, the status screen will display an “IDLE” message. If a loopback is present, handshake-sequence codes will appear (H-01, etc.), followed by the modem speed. Make sure that test data is being generated. Watch for data errors. By transmitting test data and comparing it with the received copy, the DTE and modem are checked for proper operation. During the ALBX test, RD (receive data) may appear on the status screen even though no data is being received—this is normal.

On a flat line, the MODEM modem in ALBX test mode will train and remain running across the following range of signal loss: in V.32 mode, 0–51 dBm (0–52 dBm at 12.0 Kbps); for V.33 operation, 0–47 dBm; and for Bell 208A/B operation, 0–37 dBm. If signal loss exceeds these limits, the test may not start or may be halted.

During the ALBX test, the modem will attempt to retrain upon loss of carrier. In switched carrier mode, the modem will attempt to retrain upon loss of RTS.

To end the test, press the ENT pushbutton to return to the ANALOG LOOP(EXT) screen, and then select OFF.

7.8.5 EXTERNAL ANALOG LOOPBACK SELF-TEST (ALXST)

The external analog loopback self test is available for 4-wire leased line mode only.

The ALXST places the modem in analog loopback and causes data to be sent and received by an internal 511-bit pattern generator and receiver; therefore, no DTE or external BERT is necessary. As shown in **Fig. 7-4**, the test circuit includes the leased lines (the external loopback).

NOTE

The ALXST may result in errors or may fail altogether even where conditions are satisfactory for normal operation. This is because the test channel presented to the modem during the ALXST includes all impairments of both the inbound and out-bound

channels (amplitude distortion, delay distortion, noise, etc.). The main purpose of the ALXST is to verify that the modem is connected to the leased line and that the leased line circuit is complete. The test is not meant to assess the suitability of the leased line.

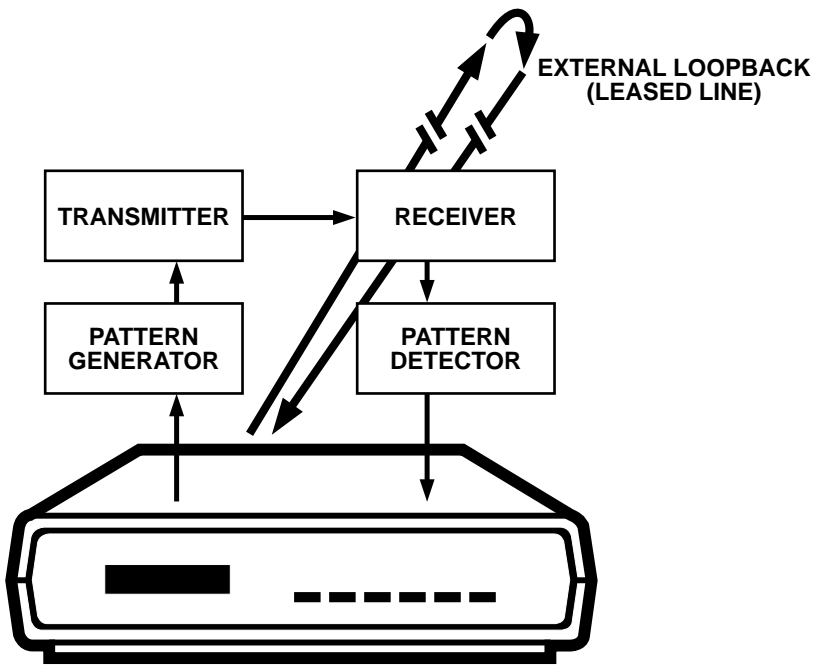


Fig. 7-4. External Analog Loopback Self Test (ALXST).

The ALXST can be initiated from the modem's front panel, as follows:

From screen 2 of the LCD MAIN MENU, select TEST. Go to screen 2 of the LOCAL TEST menu and select ALXST.

The ANALOG ST (EXT) screen will be displayed, with ON and OFF as the possible selections. Select ON to activate the test.

The EIA status screen will be displayed while the test is being conducted. If no external loopback is present, the status screen will display an "IDLE" message. If a loopback is present, handshake sequence codes will appear, followed by the modem speed. If "ER" is present on the front panel, data errors have occurred. The ER indicator may flash on when the test is first turned on, but it should quickly go out and remain off until the end of the test.

The information at the end of the previous section (for the ALBX test) concerning signal loss, loss of carrier and loss of RTS also apply to the ALXST.

To end the test, press the ENT pushbutton to return to the ANALOG ST (EXT) screen, and then select OFF.

7.8.6 DIGITAL LOOPBACK TEST (DLB)

Digital loopback testing determines the operational performance of the local modem, the remote modem, and the telephone line as a composite system. For this test, data must be sent and received at the remote modem. This test regenerates the data and loops it back to the remote modem. As with the ALB test, a comparison of the results of the DLB test can indicate whether or not the DTE is performing satisfactorily. A comparison of the results of the ALB and DLB tests can help determine whether the modem or the telephone line is defective.

In the DLB test, the data to be sent and received is originated and checked by the DTE or external BERT. **Fig. 7-5** shows the data flow for this test.

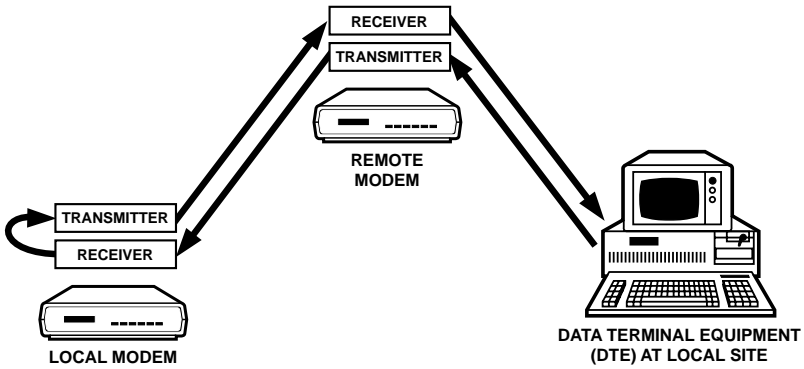


Fig. 7-5. Digital Loopback (DLB) Test.

In Hayes mode only, the DLB test can be initiated using the command `&T3` (preceded by `AT`). In any mode, the DLB test can be initiated using the modem's front-panel controls, as follows:

From screen 2 of the LCD MAIN MENU, select TEST. Go to screen 2 of the LOCAL TEST menu and select DLB.

The DIGITAL LOOPBACK screen will be displayed, with ON and OFF as the possible selections. Select ON to activate the test. The EIA status screen will be displayed while the test is being conducted. Make sure that test data is being generated. Watch for data errors. By transmitting test data and comparing it with the received copy, the DTE is checked for proper operation. To end the test, press the ENT pushbutton to return to the DIGITAL LOOPBACK screen, and then select OFF.

7.9 Remote Modem Diagnostics

The modem is capable of performing two tests on compatible remote modems: remote digital loopback (RDL) and remote digital loopback self-test (RDLST). If a problem is encountered and the local modem passes all diagnostic tests, the local modem can test the remote modem.

There are two (noncontiguous) REMOTE TEST screens on the modem LCD: (1) The remote tests are initiated from the REMOTE TEST menu. (Select RMT from MAIN MENU screen 2, and then select TEST. Then select the test type.) (2) A remote test cannot be initiated unless the Remote Test option is enabled on the remote modem. This option (also REMOTE TEST on the LCD) is accessed via SETUP screen 4.

7.9.1 REMOTE DIGITAL LOOPBACK (RDL) TEST

The RDL test (**Fig. 7-6**) allows testing of the local modem, remote modem and telephone line from the local site.

In Hayes mode only, the RDL test can be initiated using the command `&T6` (preceded by `AT`). In any mode, the RDL test can be initiated from the modem's front panel, as follows:

Both modems should be on-line and should be tested at the data rate used by the DTE. Ensure that the DTR circuit is on. (If TR is present on the EIA status screen, the DTR circuit is on.)

From screen 2 of the MAIN MENU, select RMT, and then select TEST. From the REMOTE TEST menu, select RDL.

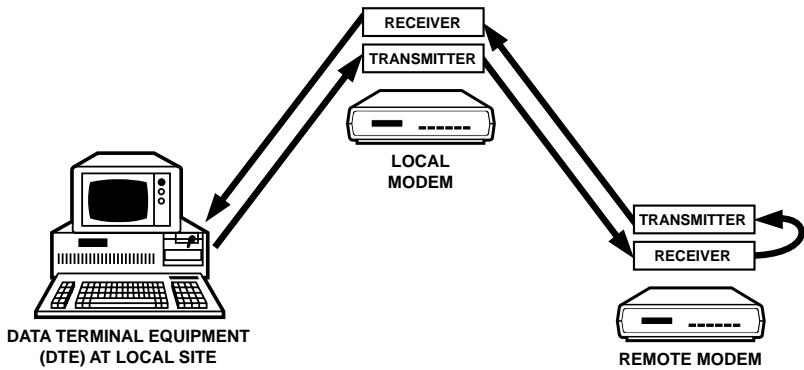


Fig. 7-6. Remote Digital Loopback (RDL) Test.

From the REMOTE DIGIT LOOP screen, select ON to activate the test. The status screen will be displayed as the test is being conducted. Make sure that test data is being generated. Watch for data errors. By transmitting test data and comparing it with the received copy, the modems as well as the telephone line can be checked for proper operation.

To end the test, press the ENT pushbutton to return to the REMOTE DIGIT LOOP screen, and then select OFF.

7.9.2 REMOTE DIGITAL LOOPBACK SELF-TEST (RDLST)

The RDLST allows testing of the local modem, remote modem and telephone line from the local site as did the previous test, except that the test data is generated by internal modem circuitry as opposed to a DTE or external BERT. Fig. 7-7 shows the connections automatically made during the test.

In Hayes mode only, the RDLST can be initiated using the command &T7 (AT &T7). In any mode, the RDLST test can be initiated from the front panel as follows:

Both modems must be on-line.
 From screen 2 of the MAIN MENU, select RMT, and then select TEST.
 From the REMOTE TEST menu, select RDLST.

From the RDL SELFTEST screen, select ON to activate the test. The status screen will be displayed as the test is being conducted. If "ER" is present on the status screen, the modem is detecting errors. If numerous errors are detected, steps should be taken to try to identify their source.

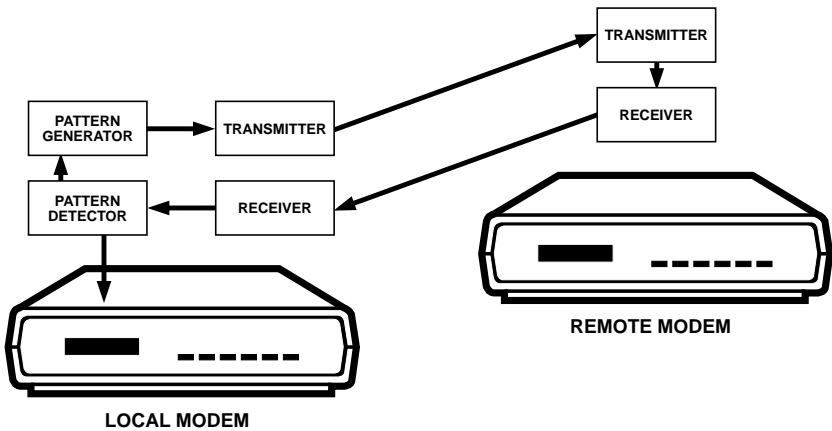


Fig. 7-7. Remote Digital Loopback Self Test.

6.1.2 2 = DIALER MODE (DIAL V.25 BIS SCREEN)

If you enable the V.25 bis autodialer using the Dialer Mode option, no other options will be changed. To enable the autodialer this way, select DIALER from SETUP screen 2. Then press the right arrow pushbutton to go to the DIAL V25 bis screen (screen 2). Select the V.25 bis data protocol that is appropriate for the DTE to be used: asynchronous (Asyn); synchronous, character-oriented (Syn_c); or synchronous, bit-oriented (Syn_b).

6.1.3 DTR DIALING IN V.25 BIS MODE

An alternative to using the V.25bis CRS command to dial a stored number is to use the DTR dialing option. With DTR dialing enabled, the autodialer will dial the number stored in phone cell 0 when DTR goes high for at least 50 ms.

To enable V.25 bis DTR dialing, use the Summary Setup feature (as described in appendix) to change the parameter for Penril/V25 bis DTR dialing to 0. Do not select DTR dialing via the front-panel DIALER screen; this will not enable DTR dialing for V.25 bis mode. The Summary Setup Penril/V25 bis DTR dialing option applies to either V.25 bis mode or Penril mode—whichever is enabled; therefore, for V.25 bis DTR dialing, the V.25 bis autodialer must be enabled.

6.2 V.25 bis Autodialer Commands

In asynchronous applications, V.25 bis commands are issued directly from the DTE keyboard or through communications software. In synchronous applications, the V.25 bis commands can be used to facilitate computer-controlled communications.

Punctuation and spaces may be used with V.25 bis commands for clarity, but they are not required. If used, they will be ignored by the modem. One exception is the colon (:), which instructs the autodialer to wait for a dial tone.

The V.25 bis commands are described below and are summarized in **Table 6-1**. See **Table 6-3** for explanation of the codes that may be displayed in response to commands.

CIC - CONNECT NEXT INCOMING CALL. The CIC command instructs the autodialer to answer the next incoming call. After the modem goes off hook, the modem will answer the next call only if auto-answer is enabled from the front panel.

CRN - CALL REQUEST, NUMBER PROVIDED. (Syntax: CRN 5557979) By using the CRN command, you can dial a number directly from the DTE keyboard. Numbers from 0 through 9 can be dialed, and if tone dialing is enabled, the characters A, B, C, D, # and * can also be dialed.

The dialing parameters listed in table -2 can be used with the CRN command to specify how or when a number should be dialed. For example, the command line CRN :T3331234 instructs the autodialer to wait for a dial tone (:) and then tone dial (T) the number 333-1234.

CRS - CALL REQUEST, ADDRESS PROVIDED. (Syntax: CRS 2) The CRS command allows you to dial a stored number simply by specifying its memory address (phone cell). In the example given above, the autodialer will dial the number stored in phone cell 2. The number must first be stored in the specified phone cell using the PRN command (**Table 6-1**).

DIC - DISREGARD INCOMING CALLS. The DIC command instructs the autodialer not to answer incoming calls. The DIC command is canceled when the CIC command is issued or the modem is reset. In the event of a reset, the modem will answer if auto-answer is enabled from the front panel.

PRN - PROGRAM NORMAL (STORE NUMBER). (Syntax: PRN 1;5551212) The PRN command is used to store a number or dial string in a phone cell so it can be dialed later by specifying only the phone cell number. As shown above, PRN is followed by the phone cell number, a semicolon and the phone number to be stored. After a number is stored, it can be dialed using the CRS command. Any of the characters listed in **Table 6-2** may be stored.

Ten phone cells (0-9) are available for phone number storage. Each cell can hold a maximum of 25 characters, although cells 1 through 9 will automatically expand to the next empty phone cell if loaded with more than 25 digits. Even if a stored number is continued to another cell, the maximum number of characters that can be stored is 36. You cannot store a number in a phone cell unless it is empty. To clear a cell, enter PRN and the phone cell number, without a phone number. Only cell 0 can be accessed from the modem's front panel (via the PHONE LCD screen).

RLN - REQUEST STORED NUMBER(S). RLN can be used to request a list of all stored numbers or to show the number stored in a specific phone cell. RLN, used alone, requests a list of all stored numbers. The DTE display will show the stored numbers as follows:
LSN 0; 301 555 1234
LSN 1; 301 123 4567
LSN 2; 301 555 5555

(and so on through phone cell 9)

If a phone cell number is specified after RLN, e.g., RLN 5, the DTE display will show only the number stored in the specified phone cell.

How to Disconnect a Call

To disconnect a call locally, use your communication software to force DTR to go low, or select HANGUP from the front-panel AUTO-DIAL screen.

Table 6-1. V.25bis Autodialer Commands

Command	Function
CIC	Connect next incoming call.
CRN n	Call request—dial number (n) entered on DTE keyboard.
CRS m	Call request—dial number stored in specified memory address (m).
DIC	Disregard incoming calls.
PRN m; n	Program normal—store number or dial string n in memory address m.
RHA	Switch to Hayes dialing mode (also resets modem configuration).
RLN	Request list of all stored numbers.
RLN m	Request to see number stored at address m.
<p>n represents a number to be dialed or stored (e.g., 5557979); m represents a memory address where a number is stored (0-9).</p> <p>A comma (,) can be included in a dial string to effect a pause.</p> <p>A colon (:) can be included to instruct the autodialer to wait for a dial tone before proceeding.</p>	

6.3 Dialing Parameters

Table 6-2 lists dialing parameters that may be used with the CRN command to modify dialing operations.

Table 6-2. V.25 bis Dialing Parameters
 (Table also applies to Dumb mode and Bell 208 operation)

Characters that can be pulse or tone dialed: 0-9 Can only be tone dialed: A, B, C, D, #, and *	
L	Links a phone number to another number to be dialed as an alternate when the primary number is busy or does not answer. See L—Link in Section 5.4 .
P	Sets pulse dialing mode.
T	Sets tone dialing mode.
W or : (colon)	Wait 30 seconds for dial tone before proceeding.
[CR] or . (carriage return or period)	Required at end of dial command line. [CR] is sent from DTE keyboard. Dumb/208 mode only: period has same function, but may be entered via the front panel (PHONE LCD screen).
, (comma) or <	Pause before processing next character in dial string.

Table 6-2. V.25 bis Dialing Parameters
 (Table also applies to Dumb mode and Bell 208 operation)

Characters that can be pulse or tone dialed: 0-9 Can only be tone dialed: A,B, C, D, # and *	
@	Wait for silence.
! (exclamation)	Flash hook
L, P, T, and W may be entered as upper or lowercase letters. Spaces or hyphens (-) may be used as separators for clarity; they will have no effect.	

6.4 V.25 bis Result Codes

Table 6-3 explains the result codes, or responses that may be displayed on the DTE monitor in response to V.25 bis commands.

Table 6-3. V.25 bis Result Codes

Code	Meaning	Sent by—¹
CFI AB	Call failure—call aborted because of loss of DTR or because HANGUP was selected from front-panel AUTO-DIAL screen.	ORG
CFI CB	Call failure because DCE is busy. (Modem dialing or handshaking as a result of a front-panel dial request.)	ORG
CFI ET	Call failure because of busy signal. (Engaged tone.)	ORG
CFI ND	Call failure—no dial tone. Modem did not detect dial tone or line current during dialing or handshaking.	ORG
CFI NS	Call failure—call request specified an address that does not contain a stored number. (No stored number.)	ORG
CFI NT	Call failure—no answer tone. Remote unit answered but did not issue answer tone.	ORG

¹Column 3 indicates which modem sends the result code. (ANS/ORG indicates answer and/or originate modem.)

A semicolon is used to separate parameters, e.g., LSN 4;5559797.

Table 6-3. V.25bis Result Codes (continued)

Code	Meaning	Sent by— ¹
CFI RT	Call failure—ring tone. Ringback detected, but no answer.	ORG
CNX	Call connecting.	ANS/ORG
INC	Incoming call.	ANS
INV CU	Invalid—command unknown.	ANS/ORG
INV MS	Invalid message (command) syntax.	ANS/ORG
INV PS	Invalid parameter value. Specified parameters are out of range for command used.	ANS/ORG
LSN	List of stored numbers. LSN is followed by memory address, stored number, next memory address and stored number, etc.	ANS/ORG
VAL	Valid—command accepted; waiting for next command.	ANS/ORG

6.5 Message Format

The message format for V.25 bis DTE-to-DCE communications is summarized below:

6.5.1 ASYNCHRONOUS

MARK|MESSAGE|CR|LF|MARK

This format uses one start bit, 8-bit data units, and a 1-unit stop bit. The 8-bit data units are formed by a 7-bit IA5 character and an even parity bit.

6.5.2 SYNCHRONOUS, CHARACTER-ORIENTED

|SYN|SYN|STX|MESSAGE|ETX|

This format uses consecutive 8-bit data units formed by a 7-bit IA5 character and an odd parity bit.

6.5.3 SYNCHRONOUS, BIT-ORIENTED

FLAG ADDR CTRL MESSAGE FCS FLAG

Consecutive 8-bit data units are used within the message and submitted to the HDLC framing (zero insertion). The 8-bit data units are formed by a 7-bit IA5 character and an off parity bit.

- **ESCAPE SEQUENCE (+++).**

The escape sequence causes the modem to escape from the data transfer mode so it can interpret commands.

(Alternate characters for the escape sequence can be assigned via S register S2.)

- **ATTENTION CODE. AT,** the attention code, must begin all command lines. There are a few exceptions—but only a few.

- **COMMAND SEQUENCE.** For dialing, a command line begins with AT and is followed by D and the phone number. Other commands should be placed before the dial command—or after the dial command if it is terminated with a semicolon—for example:

```
AT M2 V1 D 555-1212; S2=1O
```

This instructs the modem to: Keep speaker on (M2), send word result codes (V1), dial (D) 555-1212, end dial command (;), set register 2 to 1 (S2=1), and go on-line and wait for carrier (O).

Characters not in the command set are ignored during the dial command. For this reason, punctuation or spaces can be included in the telephone number to make it easier to read:

```
AT DT 9,(212)555-1234 or AT DT  
9, 212 555 1234
```

- **A/ COMMAND.** Repeats the commands included in the previous command line. Because the AT is also repeated, no AT is needed to begin this command, nor is a carriage return needed. A/ is useful for redialing a telephone number.

- **BACKSPACE KEY.** The backspace key deletes the last character entered (provided there is no intervening carriage return) and can be used for simple editing.

- **CARRIAGE RETURN [CR].** A carriage return is required at the end of a command line. The modem will not execute a command without it. A carriage return is sent from the DTE keyboards; a period, which may be entered via the modem's front panel (PHONE LCD screen), has the same function. (On most keyboards, the carriage return [CR] key is labeled "Enter" or "Return.")

- **DIAL COMMAND MODIFIERS.** Several modifiers can be used with the basic D (dial) command to alter dialing operations. These modifiers are listed and explained briefly below—they are explained in detail in **Section 5.4**

Dial command modifiers:

L—Links a phone number to another number to be dialed as an alternate.

P—Sets pulse-dialing mode.

S=m—Dial number stored at memory location m.

T—Sets tone-dialing mode.

W or : (colon)—Pause for 2 seconds.

, (comma)—Pause for 2 seconds.

; (semicolon)—Return to command state after dialing.

@—Wait for silence.

! (exclamation)—Flash hook

With few exceptions, dial command modifiers will function only if they are used in a command line with the D command or included in a stored number. A carriage return or period must be used at the end of a dial string. An example of a command line with two dial modifiers is:

```
AT DT 9,555-1212
```

The modifier T instructs the modem to tone dial, and the comma instructs it to pause after dialing 9 before dialing the remaining digits.

MISSING PARAMETER. A missing parameter is interpreted as a zero. For example, the E command (echo) can be sent as either E0 or E1, but if an E alone is sent, the modem will interpret it as if an E0 was sent.

COMMAND BUFFER. The command buffer can hold a maximum of 40 characters. If the command line exceeds 40 characters, the modem refuses to execute any portion of the command line and sends an error message. The AT at the beginning of the command line, control characters, and spaces do not take up space in the command buffer. Punctuation (except for spaces) does take up space in the command buffer.

5.2 Result Codes

Result codes (Table 5-2) are messages sent by the modem to the DTE monitor in response to your commands. Result code options are selected using the V and X commands, as explained below.

Result codes may be words (V1 command) or digits (V0). Word codes are preceded and followed by a carriage return, line feed sequence. Digit codes are only followed by a carriage return.

Result codes 0-4 comprise the basic result code set: OK, CONNECT, RING, NO CARRIER, and ERROR. Codes 5-43 provide additional response information, as explained in **Table 5-2**. Various combinations of these codes can be enabled or disabled by using the X command and its four parameters, as explained later under X—SELECT RESULT CODE.

NOTE

With the default Hayes mode settings in effect, the modem transmits result codes to the DTE. In some installations, this may cause undesirable interaction with the attached DTE. If such interaction occurs, result codes for incoming calls should be suppressed (using the command AT Q2).

5.3 Transmission Speed

This section applies only to connections made without error correction or buffering (V.42/V.42 bis, MNP and Buffer Mode options).

Transmission speed is governed by the speed of the system with which you wish to communicate. You must set the transmission speed of your computer by setting a switch in the hardware or by issuing a software command. (Refer to your computer documentation.) When the modem originates a call, it automatically detects and adjusts

to the transmission speed set when the communication port was initialized.

When answering a call, the modem determines the transmission speed from the carrier signal of the originating modem. Change the speed (baud) setting of your equipment to match that of the remote system. Otherwise, unintelligible data will appear on your screen. (Depending on the parameter used with the X command, the speed will be indicated by the CONNECT response code.)

Autobaud

When a call is originated in Hayes mode, the AT attention code causes the modem to autobaud. The speed at which the modem autobauds defines the speed limit for subsequent connections and overrides any front panel Speed Limit or DTE Speed settings. If the unit is not autobauded, the default interface rate is 38,400 bps.

NOTE

If AT is entered at one speed and followed by a carriage return [CR] at another speed, the modem will not recognize any further commands until a [CR] is entered at the same speed of the AT.

5.4 Compatible Commands

All that can be used with the modem are listed in **Table 5-1** (near the end of the chapter.) More detailed information is provided below for selected Hayes commands—particularly those used to answer and originate calls, and other commonly used commands. For Hayes commands that control modem options, additional information on options may be found in **Chapter 5**. Commands are listed in alphabetical order in this section and in **Table 5-1**.

For most commands there are parameters—numerical values used with the commands that specify the function of the command. For example, the command **L** controls the modem's speaker volume. **L2** sets the volume to medium. The default value is a predetermined value which is in effect the first time the modem is powered up or when a reset command is given. The possible parameters and default value for each command are shown in **Table 5-1**.

A—ANSWER. The **A** command immediately puts the modem into the answer mode. The modem will not execute any command entered in the command line after **A**.

The **A** command is used to manually answer an incoming call or to transfer a call between two individuals to a communication between their computers: One person enters **AT A** while the other enters **AT D**.

A/-REPEAT PREVIOUS COMMAND. **A/** is most commonly used to redial a telephone number that results in a busy signal. The **AT** prefix is not used with **A/**, and no carriage return is required. Commands are available for repetition in the command buffer only until **AT** is entered or power to the unit is turned off. **A/** will not work following an **AT** or power **OFF-power ON**.

D-ORIGINATE MODE FOR DIALING. The modem dials the number that follows and attempts to go on-line. The dial command **D** is followed by—

- A telephone number to be dialed, or
- A string consisting of a phone number and dial command modifiers (e.g., **T**, **P**, and **;**).

An example of the **D** command is **AT D3331234**.

In response to this command, the modem dials the telephone number 333-1234, and then waits for a carrier tone from the distant modem (default wait time, 30 seconds). If the modem is able to establish a call, it gives a CONNECT result code, indicating that it is on-line. If it cannot connect, it will use a different result code, such as NO CARRIER, BUSY, or NO DIALTONE.

The characters that can be dialed are 0 through 9, A, B, C, D, #, and *.

The dial command modifiers are listed in the preceding Command Guidelines section.

AT D—the dial command without a telephone number causes the modem to pick up the telephone line without dialing a number.

DS—DIAL STORED NUMBER. The DS command instructs the modem to dial a phone number or dial string previously stored using the &Z command. The syntax is DS=m, where m specifies the memory location where the number to be dialed will be stored. Up to ten numbers may be stored in memory locations 0-9. S=m may be placed anywhere in the dial string for example, AT D2345S=2 will dial 2345 and the number

stored in memory location 2.

H—TELEPHONE SWITCH HOOK. The H command on-hook is used to terminate a call. (On-hook corresponds to off-line.) H may also be used to alternate between voice and data transmission during the same call (if your communication software supports this capability).

The H1 command (off-hook) activates the telephone line relay, causing a dial tone to be sent (after a 2-second delay). For most purposes, this command is not necessary, since the switch hook is automatically activated when the modem originates or answers a call.

L—LINK. The L dial modifier is used to link one phone number to another so that one may be designated as an alternate number to be dialed if a connection cannot be made to a primary number. The L parameter must be used after a phone number, and prior to a carriage return or period. A number is used after L to specify ;the memory address (0-9) that contains the number to be linked to the first number:

AT D 555-1212 L5

NOTE

L may also be used in V.25 bis mode with the CRN command (instead of AT D), in Dumb mode and in 208 operation. In Dumb mode or 208 operation, L is stored via the PHONE screen. In all cases, L is used the same way and has the same function as described here (except that AT D is not used.)

Two or more addresses may be linked in a cyclic fashion to alternate dialing until a connection is established.

Contents of memory location 0:
555-1212 L1

Contents of memory location 1:
444-1234 L2

Contents of memory location 2:
888-5555 L0

With the memory locations loaded as shown above, if the command AT DS=0 is issued, the autodialer will go to location 0 and dial the number stored there. If unable to connect, the L1 command stored in location 0 will direct the autodialer to dial the number in location 1. In similar fashion, the L2 stored in memory location 1 directs the autodialer to location 2 (assuming a connection cannot be made); and the L0 command stored in location 2 directs the autodialer back to location 0. The numbers will be

dialed in a loop until a connection can be established or until 10 calls have been attempted.

O—FORCED ON-LINE. This command applies to asynchronous operation only. When the modem is on-line, you can return to the command state by entering the escape code (+++). After the desired command has been executed, use the O command to force the modem from the command state to the on-line state.

P—PULSE DIAL. The P command instructs the modem to pulse dial. It can be entered anywhere in the dialing string: AT P5551212; or it can be entered alone, followed by a carriage return, AT P, in which case all subsequent telephone numbers will be pulse dialed. If the dial command does not specify which dialing mode to use, the modem defaults to the last mode specified.

S—MODIFY S REGISTER. This command is used to write information to a specified S register. The syntax is Sr=n, where r is the number of the register to be modified and n is the value to be written to it; for example:

AT S7=30

This command would change the value of register S7 to 30. If you enter just =5, the autodialer will change the value of the last register used to 5. More information on S registers is included later in this chapter.

S?—**READ S REGISTER.** This command instructs the autodialer to read the contents of the specified S register. The syntax is Sr?, where r specifies the register to be read. For example, S7? reads the value of register S7. The value is displayed on the computer or terminal monitor. If you enter ? by itself, the autodialer will display the value of the last register used; if = is entered by itself, the autodialer will display the number of the last register used (e.g., S2). For information on how to interpret S register values, see **Table 5-3**.

T—**TONE DIALING.** This command causes a telephone number in the dial command string to be dialed using tone signals. (See the P command above for additional information.)

W—**WAIT FOR DIAL TONE.** The W command (or colon) is used in a dial string to instruct the modem to wait for a dial tone before proceeding. The wait time (30 seconds by default) can be adjusted by changing the value in register S7. If no dial tone is detected within the specified time, the modem will hang up and give a NO DIALTONE result code (if this

result code is enabled by the X command).

Z—**RECALL STORED USER PROFILE.** The Z command resets the modem and recalls a profile of the modem configuration settings previously saved using the &W command. The profile is designated as profile 0 or profile 1 when it is saved using the &W command.

,—**PAUSE.** A comma causes the modem to pause for 2 seconds (or time specified in register S8) before processing the next character in a dial string or command. This command is used to place an outside call through a PBX switchboard, where 9 has to be dialed to gain outside access—the pause allows time for the dial tone to occur before the modem dials the number.

AT D9,3331234

Similarly, a comma may be used to cause the modem to wait for a second dial tone before beginning to dial a telephone number. Multiple commas may be used to increase the pause time.

;—**FORCED COMMAND STATE.** A semicolon placed at the end of a dial command causes the modem to return to the command state after dialing without disconnecting.

The following examples illustrate how the ; command is used:

The first example is a banking transaction: The command `AT D333-1234;` dials the bank's phone number and returns the modem to the command state. After the `OK` prompt is displayed on the DTE, the command `AT D T 0901#` is entered. This transmits the identification number 0901 to the bank, and again returns the modem to the command state. An account number and other data may be transmitted in the same way.

The second example illustrates one method of autodialing: Enter a dial string that ends with a semicolon, for example, `AT DT9, 3331234`. During the ring signal or when the call is answered, pick up the phone and enter `AT H`. You may then use a telephone connected to the modem for voice communication.

@—WSAIT FOR SILENCE BEFORE DIALING. The `@` command is used to gain access to a system that does not provide a dial tone. It tells the modem to wait for 30 seconds or the time specified by a register `S7` for one or more rings followed by 5 seconds of silence before processing the next symbol in the dial string.

!—INITIATE FLASH HOOK. The `!` command causes the modem to go on-hook for 1/2 second. This has the same effect as holding the switch-hook button on your telephone down for 1/2 second.

You may be able to use this command for transferring calls.

&F—RECALL FACTORY CONFIGURATION. The `&F` command restores the modem to its original factory configuration, using data stored in ROM. However, this change is not permanent. If the modem is turned off or reset, the recalled configuration will be replaced with the default stored profile. (See the `&Y` command.)

&V—VIEW ACTIVE CONFIGURATION, ETC. This command displays the active modem configuration, user profiles stored using the `&W` command, and phone numbers stored using the `&Z` command. When `&V` is invoked, the DTE displays the configuration commands last issued, including parameters used, and the values currently stored in the `S` registers. The `&V` command should be issued as the last command on a line.

&W—WRITE PROFILE TO MEMORY. The `&W` command saves the storable parameters of the modem's active configuration by writing the configuration profile to non-volatile memory. By selecting either `&W0` or `&W1`, two different user profiles can be saved (profile 0 or 1). One of these profiles will be automatically restored whenever the modem is powered on or when the `Z` command is issued. (See the `&Y` and `Z` commands.)

The &W command cannot be used to write changes to the user profiles if the modem front panel has been disabled by the Front Panel Control option.

The parameters listed below cannot be stored—they are all set by changing S register values (as indicated in **Table 5-3**):

- S1—Ring count
- S2—Escape-sequence character (ASCII 43)
- S3—Carriage-return character (ASCII 13)
- S4—Line-feed character (ASCII 10)
- S5—Backspace character (ASCII 08)
- S6—Wait time before blind dialing
- S7—Wait time for carrier/dial tone
- S8—Pause duration (effected by comma)
- S9—Carrier detect response time
- S10—Delay: Lost carrier until hangup time
- S11—DTMF tone duration
- S12—Escape-sequence guard time
- S25—DTR detection

When the &W command is used to save a configuration profile, stored phone numbers are not saved as part of the profile.

&Z—STORE TELEPHONE NUMBER. The &Z command is used to store a telephone number that can be subsequently dialed

using the DS (dial stored number) command. The syntax is &Zm=n, where m specifies the memory location where the phone number or dial string will be stored and n is the number or dial string to be stored. For example, AT &Z5=T1 (301) 555-1212 will store the specified number at memory location 5. Ten memory locations are available: 0-9.

(The &Z command is also used to store passwords, as explained in **Section 4, Security Operation.**)

For pulse dialing, digits 0 through 9 can be stored; for tone dialing, 0 through 9, A through D, # and * can be stored. The dial command modifiers listed in the Command Guidelines section can also be stored.

Each memory location can hold a maximum of 24 digits, although locations 1 through 9 will automatically expand to the next empty location if loaded with more than 24 digits. Even if a stored number is continued to another location, the maximum length is 36 characters. (Attempting to dial a dial string of more than 36 characters will result in an ERROR message.) A memory location cannot be used for storage unless it is empty. To delete an entry, enter AT&Zm=, where m is the memory location number. Only location 0 can be accessed from the modem's front panel (via the PHONE LCD screen).

\S—VIEW STATUS OF V.42-RELATED CONFIGURATION.

The \S command displays the active V.42 error correction configuration, stored V.42 profiles, and certain other data not displayed by the &V command.

5.5 Registers

The modem includes 28 registers (S0-S27) that can be used to control specific modem operations in Hayes mode only. Each register holds a value that serves as a specific operating instruction for the modem. Several of the S registers affect how the previously described commands will be executed.

The functions of the registers intended for user access are explained below and summarized in **Table 5-3**.

5.5.1 READING AND SETTING REGISTERS

Use the S command to read the value of a register or to change its value.

To read the current value of a register, use the command S?, where the number of the register is specified between the S and the ?, as follows: S9?. The decimal value of the register contents will then be displayed. Multiple registers may be read. For example, if you wish to read the current value in registers S0 and S7, enter

AT S0? S7?

A typical response might be 001,030, OK, meaning that the values stored in registers S0 and S7 are 1 and 30, respectively.

To set or change a parameter, use the command S=, where the number of the register follows S and a value between 0 and 255 (the range of values that can be assigned to the registers) follows the equal sign:

AT S0=5

This command will change the value stored in S0 to 5.

The S command can also be used without ? or = to point to a register that will be subsequently read from or written to without being specified. To illustrate this, if you enter

AT S7

a pointer is set to the address of register S7. As long as no other S command is entered, the register value can be requested at any time without specifying the number. If you enter AT? the modem displays the current value in the S7 register. Similarly, if you enter AT=8 the modem will change the value in the S7 register to 8.

5.5.2 S REGISTER FUNCTIONS

This section describes the function of individual S registers.

Table 5-3 lists the range of possible parameters and the default value for each S register. Only S registers that are intended for user access are listed.

S0—RING TO ANSWER ON.

The value in this register determines on what ring (first, second, third, etc.) the modem will answer on. Setting S0 to 0 disables auto-answer.

S1—RING COUNT. Register S1 counts the number of ring signals for each incoming call. If more than 8 seconds have passed since the last ring, S1 is cleared to zero.

S2—ESCAPE CODE CHARACTER. The escape code is effective for asynchronous operation only. Values greater than 127 will completely disable escape code detection and prevent you from issuing a hangup command.

S3—CARRIAGE RETURN. Register S3 is effective for asynchronous operation only. Normally, the ASCII carriage return value, 13, is used.

S4—LINE FEED. This register is effective for asynchronous operation only. The line-feed character follows the carriage

return only when word result codes have been selected (command V1). Line feed can be changed to a null but cannot be totally disabled.

S5—BACKSPACE. This register is effective for asynchronous operation only. The value in S5 defines the backspace character. Do not use values between 33 and 126.

S6—BLIND DIALING WAIT TIME. The value in S6 determines how long the modem will wait after picking up the telephone line (going off-hook) before it begins to dial. If S6 is set for less than 2 seconds, the modem still waits 2 seconds before dialing. If the X2 to X4 command is in effect, dial tone detection will be enabled and blind dialing will be disabled, meaning that the value in S6 will have no effect.

S7—CARRIER/DIAL TONE WAIT TIME. This register controls two wait times—wait time for carrier and, if W is included in the dial string, wait time for dial tone (or wait time for silence if @ is used).

S8—PAUSE TIME. The pause time effected by a comma in a dial string or other command line is controlled by register S8.

S9—CARRIER DETECT RESPONSE TIME. Register S9 determines how long a carrier tone must be present for the modem to

recognize the tone and indicate a carrier detect. (The time required for the absence of a carrier tone to be recognized is fixed at 0.5 second.)

S10—LOSS OF CARRIER DELAY. The value in register S10 determines how long the delay will be from the occurrence of a loss of carrier until the modem hangs up the telephone line. A value of 255 disables the modem's carrier disconnect option (and line current option), meaning that the modem will not hang up in the absence of carrier or line current.

S11—TONES. This register sets the spacing of tones used for dialing. The rate can be slowed by increasing the value of S11 to the maximum value, 255. This register has no effect on pulse dialing, which is fixed at 10 pulses per second.

S12—GUARD TIME. This register is effective for asynchronous operation only. The escape guard time delay is required immediately before and after entering the escape code; therefore, the three escape-code characters must be entered within the guard time delay of each other. The unit for this register is 1/50 second (or 20 ms), meaning that the default value of 50 equals 1 second.

If the guard time is zero, timing will not be a factor at all. The three escape characters can occur with

any timing relationship, but they must be consecutive. Be cautious when assigning small guard times, however. You may not be able to enter three characters fast enough, especially if the guard time is less than the time required to transmit one character at the current transmission rate.

S18—DIAGNOSTIC TIMER. The value in register S18 determines how long a diagnostic test will run. For example, if S18 is set to 120, the test (activated by one of the &T commands) will run for 120 seconds. If S18 is set to zero, the default, the test timer will be disabled and the test will run indefinitely. To terminate a test when the test timer is disabled, use the command &T0 or reset the modem. Register S18 is set to zero on powerup or by the command AT Z or AT S18=0.

S25—DELAY TO DTR. The effect of the value stored in register S25 is dependent on the operating mode, as explained below.

Synchronous mode 1: A delay occurs after a call is established before the modem examines the state of DTR. The duration of this delay is the value specified in S25 (in seconds). This allows the operator time to disconnect the modem from an asynchronous data terminal and attach it to a synchronous terminal without forcing the modem back into the command state.

Synchronous modes 1, 2, and 3:

A change in DTR (ON or OFF) which lasts for less than the value in register S25 (in 1/100ths of a second) is ignored by the modem.

S26—RTS TO CTS DELAY INTERVAL. This register affects synchronous operation only. With the command &R0 in effect, CTS is turned on in response to an OFF-to-ON transition of RTS from the local DTE—after the delay specified by the value in register S26 (but only if the modem is on-line and ready to receive synchronous data).

5.6 Saving Option Selections

Changes made to option settings will cease to be effective if power is removed from the modem or if a factory reset has occurred—unless the modem configuration (all option settings) is saved to nonvolatile memory. The storable parameters of the modem's configuration can be saved to user profile 0 or 1 using the &W command (&W0 or &W1). Upon powerup, the modem will recall either profile 0 or profile 1, depending on which has been designated as the default profile. (The modem is shipped from the factory with profile 0 as the default profile.)

As explained in the following sections, the modem is programmed to treat profile 0 and

profile 1 differently. Use profile 0 for your standard configuration and make it the default profile (&Y0). Profile 1 (optional) is intended to be used to store an alternate configuration (e.g., for an alternate application).

To view the contents of the user profiles, use the &V and \S commands.

User Profile 0

User profile 0 is linked to the modem's front panel (i.e., selections made using the front-panel LCD).

- If you make option changes using the front panel, the changes for options for which there are associated Hayes commands will be saved to profile 0 when you exit the SETUP menu.
- If profile 0 is recalled as the active configuration, the LCD screens will reflect the profile 0 configuration.
- If profile 0 is changed by means of Hayes commands or via the Summary Setup feature and then saved, the changes made will be reflected on the LCD and will be effective for all modes.

If you make option changes from the front panel but have not exited the SETUP menu, and then make option changes using Hayes

commands and save them to profile 0 using the &W command, the changes made using Hayes commands and saved to profile 0 will override the front-panel selections.

A Quick Setup will overwrite most modem option settings. However, certain option settings stored in user profile 0 are not altered by Quick Setup—unless you change the configuration from one Quick Setup type to another. The following parameters in user profile 0 are not affected by a Quick Setup of the same type: Option settings set by the Hayes compatible commands E, F, Q, V, X, &J, &L, &P, &M, &Q, &Z, and \V; and S register values in registers S18, S25, and S26. A factory reset will reset these parameters—and all others—to the factory-default settings.

User Profile 1

User profile 1 is not linked to the front panel.

- Option changes made from the front panel are not saved to profile 1. Profile 1 can be changed only by using Hayes commands or the Summary Setup feature.
- If profile 1 is recalled as the active configuration, the LCD screens will not be affected. (This means that when profile 1 is active, it is possible for the

LCD to display an option setting that does not reflect the setting currently in effect.)

- If profile 1 is changed by means of Hayes commands or via the Summary Setup feature, the changes will not be reflected on the LCD and will only affect Hayes mode operation.

If profile 1 is being used as the active configuration, the options marked with an asterisk (*) in **Table 5-1** should be controlled by using the AT commands listed in **Table 5-1** or by using the Summary Setup feature described in **Appendix B**. When profile 1 is active, these options can be changed via the front panel LCD, but the changes will not be effective for Hayes mode operation. (However, if profile 0 is subsequently recalled as the active configuration, the changes will be effective at that time.)

5.7 Facsimile (Fax) Transmission

Fax operation is available in Hayes mode only. The modem supports fax classes 1 and 2. You can use your modem with a fax program to transmit and receive facsimile data.

5.8 Hayes Mode Reference Tables

Table 5-1 lists the Hayes compatible commands that can be used with the modem.

Table 5-1. Hayes Compatible Commands

Command	Function/Explanation
A	ANSWER No parameters.
A/	REPEAT PREVIOUS COMMAND. No parameters.
B	BELL/CCITT COMPATIBILITY MODE*
B0	Selects CCITT V.22 mode (2100 Hz).
B1	Selects Bell 212A mode (2225 Hz).
C1	Modem displays OK; command has no other effect. (This response—instead of ERROR—maintains a degree of compatibility with older modems that support this command.)
D	ORIGINATE MODE FOR DIALING. No parameters.
DS	DIAL STORED NUMBER. Parameters are 0-9 (available memory locations).
E	ECHO
E0	No echo.
E1	Echoes all characters back to terminal screen when using a full duplex terminal and in local command mode.
F1	Modem displays OK. Command has no other effect—unless V.22bis/V.22/V.21/V.23 fallback operation has been enabled. (For details, see Automatic Fallback in Chapter 4 .)
H	TELEPHONE SWITCH HOOK
H0	On-hook (hang up).
H1 or H2	Off-hook.
<p>Default settings (where applicable) are in bold face.</p> <p>*If user profile is active, option can be controlled (for Hayes mode operation) only by given command or by using Summary Setup. Do not change via front panel (except via Summary Setup).</p>	

Table 5-1. Hayes Compatible Commands (continued)

Command	Function/Explanation
I	PRODUCT CODE OR CHECKSUM
I0	Requests product code.
I1	Requests checksum for the modem's software. (Only a portion of the checksum displayed via the front panel will be displayed, in decimal format.)
I2	Requests verification of software checksum.
I3	Requests the following for each EPROM (programmable memory unit): chip, part and revision number; checksum.
I4	Reserved.
L	SPEAKER VOLUME*
L0 or L1	Low speaker volume.
L2	Medium volume.
L3	High volume.
M	SPEAKER CONTROL*
M0	Speaker always OFF.
M1	Speaker ON until carrier is detected.
M2	Speaker always ON.
M3	Speaker OFF during dialing; otherwise ON until carrier is detected.
O	FORCED ON-LINE. Forces modem to on-line state.
P	PULSE DIAL. No parameters, but the default is T (for tone dial).
Q	SEND RESULT CODE
Q0	Send result codes.
Q1	Withhold result codes (quiet).
Q2	Withhold result codes for incoming calls only (quiet answer).

Table 5-1. Hayes Compatible Commands (continued)

Command	Function/Explanation
Sn=v	MODIFY S REGISTER. n is the register to be modified; v is the value to be written.
Sn?	READ S REGISTER. n is the register to be read.
T	TONE DIAL. No parameters.
V	WORD/DIGIT RESULT CODE
V0	Result codes are transmitted as digits.
V1	Result codes are transmitted as words.
W	WAIT FOR DIAL TONE No parameters, but default wait time (register S7) is 30 seconds.
X	SELECT RESULT CODE
X0	Selects basic result codes, 0-4. Modem will blind dial (without dial tone).
X1	No speed indication; no busy or dial tone detect.
X2	Selects result codes 0-6, 10, 11, 13, 14, 15, and 18.
X3	Same as X1 except busy signal detect is enabled. Selects result codes 0-5, 7, 10, 11, 13, 14, 15, and 18.
X4	Same as X1 except busy signal detect is enabled. Selects all result codes. Connection speed (up to 14,400 bps) indicated; busy signal and dial tone detect enabled. Note: Result code 8 is independent of the X command; it is displayed only when the @ dial modifier is used.
Y	LONG SPACE DISCONNECT*
Y0	Disables long space disconnect.
Y1	Enables long space disconnect.
Z	RECALL STORED USER PROFILE

Table 5-1. Hayes Compatible Commands (continued)

Command	Function/Explanation
Z0	Resets modem and recalls stored user profile 0.
Z1	Resets modem and recalls stored user profile 1.
, (comma)	PAUSE. No parameters, but default pause time (in register S8) is 2 seconds.
; (semicolon)	FORCED COMMAND STATE. No parameters.
@	WAIT FOR SILENCE BEFORE DIALING. No parameters, but default wait time (register S7) is 30 seconds.
! (exclamation)	INITIATE FLASH HOOK. No parameters.
&C	DATA CARRIER DETECT CONTROL*
&C0	DCD always ON when DTR is present.
&C1	DCD ON only in the presence of suitable data.
&C2	DCD ON when DTR is present; then toggles off for 500 ms upon disconnect.
&D	DATA TERMINAL READY CONTROL*
&D0	Ignore DTR.
&D1	Go on-hook, assume command state and disable auto-answer upon DTR loss.
&D2	Disconnect upon DTR loss.
&D3	Reinitialize upon DTR loss.
&F	RECALL FACTORY CONFIGURATION No parameters.
&G	GUARD TONE CONTROL*
&G0	Guard tone disabled.
&G1	Enables 550-Hz guard tone.
&G2	Enables 1800-Hz guard tone.
&J	Modem displays OK result code; command has no other effect. (The modem is configured for A/A1 control or MI/MIC control via jumpers JP2 and JP3, as detailed in Appendix C.)

Table 5-1. Hayes Compatible Commands (continued)

Command	Function/Explanation
&L	Modem displays OK result code; command has no other effect. (The modem is configured for leased line or dialup line operation via the front-panel QUICK SETUP and/or LINE TYPE screens.)
&M	Can be substituted for &Q.
&P	Modem displays OK result code; command has no other effect. (The pulse dialing ratio is factory-set, depending on whether the modem is a US or international model.)
&Q	ASYNCHRONOUS/SYNCHRONOUS MODE
&Q0	Asynchronous mode.
&Q1	Synchronous mode 1— Synchronous/asynchronous mode.
&Q2	Synchronous mode 2—OFF-to-ON DTR causes the modem to automatically dial a stored number.
&Q3	Synchronous mode 3—Synchronous mode with manual dial. (A manually dialed call will switch immediately to synchronous mode.)
&R	RTS AND CTS OPTIONS*
&R0	CTS follows RTS.
&R1	CTS follows DTR from the DTE.
&R2	CTS is on while the modem is on-line.
&S	DATA SET READY CONTROL*
&S0	DSR always on.
&S1	DSR operates on according to RS-232 specification.
&S2	Options DSR operation for a crossover connection.

Table 5-1. Hayes Compatible Commands (continued)

Command	Function/Explanation
&T	TEST COMMANDS
&T0	Terminates a test in progress. &T0 must be the last command in a command line.
&T1	Initiates a local analog loopback test.
&T3	Initiates a local digital loopback test.
&T4	Allows the local modem to accept a request from the remote modem for a remote digital loopback test.
&T5	Prevents the modem from accepting a request from the remote modem for a remote digital loopback test self-test.
&T6	Initiates a remote digital loopback test.
&T7	Initiates a remote digital loopback test self-test.
&T8	Initiates a local analog loopback self-test.
&V	VIEW ACTIVE CONFIGURATION, ETC.
&V0	Displays modem configuration, user profiles, and phone numbers stored in memory locations 0-5.
&V1	Displays all stored phone numbers (contents of memory locations 0-9).
&W	WRITE PROFILE TO MEMORY
&W0	Saves storable configuration parameters as user profile 0.
&W1	Saves storable configuration parameters as user profile 1.
&X	TRANSMITTER CLOCKING*
&X0	Selects internal clocking.
&X1	Selects external clocking.
&X2	Selects receive-mode (slaved) clocking.

Table 5-1. Hayes Compatible Commands (continued)

Command	Function/Explanation
&Y	DEFAULT USER PROFILE
&Y0	Stored user profile 1 will be recalled on powerup.
&Y1	Stored user profile 1 will be recalled on powerup.
&Z	STORE TELEPHONE NUMBER. Parameters 0-9 (available memory locations).
\A	KEYBOARD ABORT (answer unit only)
\A0	Enables keyboard abort. When keyboard abort is enabled, pressing any key on the answer unit will abort handshaking (and thereby prevent a connection from being made).
\A1	Disables keyboard abort.
\B	BUFFER MODE/SPEED CONVERSION* ¹
\B0	Disables speed conversion.
\B1	Enables speed conversion
\C	MNP CLASS (LIMIT)* ¹
\C1	Limits operation to MNP class 1.
\C2	Limits operation to MNP classes 1 and 2.
\C3	Limits operation to MNP classes 1 through 3.
\C4	Limits operation to MNP classes 1 through 4.
\C5	Limits operation to MNP classes 1 through 5.
\D	DIALING MESSAGE
\D0	Disables "DIALING" message.
\D1	Enables "DIALING" message.
\F	MNP FLYBACK BUFFER* ¹
\F0	Enables flyback buffer.
\F1	Disables flyback buffer.
\K	V.42 BREAK HANDLING* ¹
\K0	Selects normal break handling.
\K1	Selects destructive/expedited break handling.

Table 5-1. Hayes-Compatible Commands (continued)

Command	Function/Explanation
\K2	Selects non-destructive/expedited break handling.
\K3	Selects non-destructive/non-expedited break handling.
\M	V.42 bis OPERATION* ¹
\M0	Enables V.42bis operation (error correction with data compression).
\M1	Disables V.42bis operation.
\N	V.42 MODE* ¹
\N0	Disables error correction.
\N1	Enables mandatory mode for error correction.
\N2	Disables error correction.
\N3	Enables automatic mode for error correction.
¹ Option can be changed only when the modem is disconnected from the phone line.	
\P	V.42 PROTOCOL* ¹
\P0	Selects LAPM protocol only.
\P1	Selects MNP protocol only.
\P2	Selects LAPM/MNP protocol (MNP as alternate).
\Q	V.42 FLOW CONTROL* ¹
	Two parameters may be used (e.g., \Q0,1; \Q3,2, etc.). First parameter specifies DCE-DTE flow; second (optional) specifies DTE-DCE flow control.
0	None (no flow control).

Table 5-1. Hayes-Compatible Commands (continued)

NOTE: DTE speed and parity are set automatically. Auto-answer is enabled or disabled by S register S0.

Command	Function/Explanation
1	CTS on/off or RTS on/off (CTS for DCE-DTE flow control, RTS for DTE-DCE).
2	DC1/DC2 flow control.
3	DC1/DC3 flow control (default for DCE-DTE and DTE-DCE).
%E0	Disables auto-retrain.
%E1	Enables auto-retrain.
-L0	Selects permissive transmit level.
-L1	Selects programmable transmit level.
\S	VIEW STATUS OF V.42-RELATED CONFIGURATION. No parameters.
\T	LOAD INACTIVITY TIMER
\T0	Disables inactivity timer.
\Tn	Sets inactivity timer to n minutes (where n=0 to 60).
\V	V.42 RESULT CODES ¹
\V0	Activates regular V.42 result codes.
\V1	Activates extended V.42 result codes.
%V0	Switches from Hayes mode to V.25bis mode, asynchronous.
%V1	Switches to V.25bis mode, sync bit oriented (HDLC).
%V2	Switches to V.25bis mode, synchronous character oriented.
\X	V.42 PASS-THROUGH FLOW CONTROL* ¹
\X0	Enables pass-through flow control.
\X1	Disables pass-through flow control.

Table 5-2. Hayes Mode Result Codes

Digit code	Word code	Meaning
0	OK	Command line executed without errors
1	CONNECT	Carrier detected at 0-300, 1200, or 2400 bps (basic code set)
2	RING	Ringing signal detected (in answer mode). (When the modem detects a ring, it sends a RING result code unless it is in the process of accepting a command. However, the modem will answer the call only if it is set for automatic answer or is given an A command.)
3	NO CARRIER	Carrier lost or never detected.
4	ERROR	Error in command line, invalid command, command line exceeds 40 characters, or invalid character format.
5	CONNECT 1200	Carrier detected at 1200 bps.
6	NO DIALTONE	No dial tone detected.
7	BUSY	Busy signal detected.
8	NO ANSWER	No period of silence detected. This code will appear only if @ ("wait for silence before dialing") has been included in the dial string.

Table 5-2. Hayes Mode Result Codes (continued)

Digit code	Word code	Meaning
9	CONNECT 0600	Carrier detected at 600 bps.
10	CONNECT 2400	Carrier detected at 2400 bps.
11	CONNECT 1275	Modem is on-line in V.23 mode (1200/75 bps).
12	CONNECT 7200	Carrier detected at 7200 bps.
13	CONNECT 12.0	Carrier detected at 12,000 bps.
14	CONNECT 14.4	Carrier detected at 14,400 bps.
15	CONNECT 4800	Carrier detected at 4800 bps.
18	CONNECT 9600	Carrier detected at 9600 bps.
20	LINKING	Modem is dialing numbers that've been linked using the L (link) dial modifier.
21	CONNECT 16.8	Carrier detected at 16.8 Kbps.
22	CONNECT 19.2	Carrier detected at 19.2 Kbps.
72	DIALING	Modem is dialing.
73	CONNECT 21.6	Carrier detected at 21.6 Kbps.
74	CONNECT 24.0	Carrier detected at 24.0 Kbps.
75	CONNECT 26.4	Carrier detected at 26.4 Kbps.
76	CONNECT 28.8	Carrier detected at 28.8 Kbps.
<p>NOTE: Four additional word codes are "BUFFER," "MNP," "V42" and "V42bis" followed by the DTE interface speed. These codes indicate if the modem is in buffer, MNP, or LAPM (V.42/V.42 bis) mode. The corresponding digit codes and speeds they indicate are listed on the next page (with all speeds in bits per second).</p>		

Table 5-2. Hayes Mode Result Codes (continued)

BUFFER	MNP	V42	V42bis
28-19200	36-19200	44-19200	55-38400
29-9600	37-9600	45-9600	56-19200
30-4800	38-4800	46-4800	57-9600
31-2400	39-2400	47-2400	58-4800
32-1200	40-1200	48-1200	59-2400
33-600	41-600	49-600	60-1200
34-300	42-300	50-300	61-600
35-110	43-100	51-110	62-300
53-38400	54-38400	52-38400	63-110
64-57600	65-57600	66-57600	67-57600
68-1800	69-1800	70-1800	71-1800
77-115200	78-115200	79-115200	80-115200
82-230400	83-230400	84-230400	85-230400

Table 5-3. S Register Functions (only registers intended for user access are listed)

Register	Range	Units	Default	Description
S0	0-255	rings	1	Ring to answer on
S1	0-255	rings	0	Counts the number of rings
S2	0-127	ASCII	43	Escape code character
S3	0-127	ASCII	13	Carriage return character
S4	0-127	ASCII	10	Line feed character
S5	0-127	ASCII	8	Backspace character

Table 5-3. S Register Functions (only registers intended for user access are listed)

S6	2-255	sec	2	Wait time before blind dialing
S7	1-60	sec	30	Wait time for carrier or dial tone
S8	0-255	sec	2	Pause time for comma
S9	1-255	sec	6	Carrier detect response time
S10	1-255	1/10 sec	14	Delay time between loss of carrier and "hang-up"

Table 5-3. S Register Functions (only registers intended for user access are listed)

Register	Range	Units	Default	Description
S11	70-255	ms	70	Tone spacing
S12	0-255	1/50 sec	50	Escape code guard time
S18	0-255	sec	0	Test timer
S25	0-255	sec or 1/100 sec ¹	5	Delay to DTR
S26	0-255	1/100 sec	0	RTS-to-CTS delay (half duplex)
S43				Speed limit, maximum
S44				Speed limit, minimum
S46				CD level
S53	0-15	-dBm	0	Leased line transmit level
S61				DTE speed
¹ Depends on mode; see previous section, S25—Delay to DTR.				

The number stored via the PHONE screen is stored in phone cell 0 (zero). To autodial the front-panel phone number in Hayes or V.25bis mode, specify phone cell 0.

4.2.2 HOW TO STORE A PHONE NUMBER

To store a phone number using the modem's front panel controls, select PHONE from MODEM SETUPS screen 5. The following screen will be displayed:

DEC	CTRL	INC

If a number has been previously stored, the number will be displayed on the top line of the LCD (instead of dashes, as shown above). Only one phone number—24 characters maximum—can be stored via the front panel.

Enter the number to be stored by using the front-panel pushbuttons as follows:

- Use the right and left arrow pushbuttons to go to the position on the LCD where you want to enter or change a number or character. The number or character at the current cursor location flashes on and off.
- Use pushbutton 1 to decrease a number at the current cursor location or pushbutton 3 to increase a number.
- Use pushbutton 2 (CTRL) to cycle through the dialing control characters. The dialing control characters are listed in **Table 4-1**, in the order in which they appear on the LCD if you cycle through them. Dialing control characters can be saved with a phone number to perform the functions listed in **Table 4-1** when the number is dialed.

The phone number is saved when you return to the MAIN MENU.

**Table 4-1. Dialing Control Characters
(for use with front-panel PHONE screen)**

Character	Function
(space)	Used only for clarity.
(comma)	Effects 2-second pause.
W (or colon)	Wait 30 seconds for dial tone before proceeding.
P	Sets pulse dialing mode.
T	Sets tone dialing mode.
*	Dial * (tone dialing only).
#	Dial # (tone dialing only).
/ (diagonal)	Prefix required for use with R (/R).
A-D	Used in some PBX applications (tone dialing only).
R	Configures modem for Dial Line Auto-Recovery. Requires / prefix. See Dial Line Auto-Recovery section later in this chapter.
. (period)	Marks end of phone number.
L	Links a phone number to another number to be dialed as an alternate. See L—LINK in Section 5.4 .
: (colon, or W)	Wait 30 seconds for dial tone before proceeding.
- (dash)	Used only for clarity (no function).
<p>NOTES: A, B, C, and D are used in some private branch exchange (PBX) applications. The * and # symbols are sometimes used for access to remote computer systems.</p>	

4.3 Automatic Fallback

The modem incorporates three automatic fallback features that can be controlled by the user:

- **Operating-Mode Fallback**— Provides compatibility with modes that use any of several different operating modes.
- **Two options for automatic data rate adjustment: Rate Renegotiation Procedure (RRP) and Speed Fallback**— These features allow the modem to automatically select the highest possible data rate, depending on the signal quality.

4.3.1 OPERATING-MODE FALLBACK

This section applies to dial-line operation only.

When the modem originates or answers a call, it determines from the “handshake” routine with the other modem the most efficient operating mode that is supported by the other modem and automatically “falls back” to that mode. The modem supports two alternatives for operating-mode fallback: V.22 bis/Bell 212A/Bell 103 fallback operation (default setting) and V.22 bis/V.22/V.21/V.23 fallback operation. Operating-mode fallback functions when the modem is in either manual or automatic originate mode or manual or automatic answer mode.

For communication within the United States, use the default setting for Operating-Mode Fallback—V.22bis/Bell 212A/Bell 103.

V.22 bis/V.22/V.21/V.23 Fallback Operation

To configure the modem for V.22 bis/V.22/V.21/V.23 fallback operation, refer to **Appendix B, Fig. B-7**. Change the Operating Mode Fallback parameter shown in the diagram from 0 (the factory setting) to 1. (This is the only way the Operating Mode Fallback setting can be changed.)

Changing the Operating Mode Fallback parameter to 1 has the following effects:

- The modem will be configured for V.22 bis 2400-bps/V.22 1200- and 600-bps/V.21 300-bps/V.23 1200/75 bps fallback operation. As a result, 600 and 1200/75 bps will appear as additional selections on the SPEED LIMIT LCD screens.
- Fallback to V.22 bis Bell 212A and Bell 103 compatibility is disabled.
- An AT command is available (in Hayes mode only) that allows control over operating mode as follows: F0—Multi-mode operation (default); F1—V.21, 300 bps; F2—V.22, 600 bps; F3—V.23, 1200/75 bps; F4—

V.22, 1200 bps; F5—V.22bis, 2400 bps; F6—V.32 (highest common speed). Except for multi-mode operation, the mode and speed are limited to the mode and speed specified. Multi-mode operation allows the modem to automatically fall back to the most efficient mode that can be used by both modems.

Available Fallback Modes

The preferred mode is V.32/V.32bis (4800 bps or higher, asynchronous/synchronous, full duplex); however, if the other modem does not support V.32 or V.32 bis, the modem will fall back to one of the modes listed below. The fallback modes are listed in the order in which they are attempted by the modem in normal operation:

Table 4-2. V.22 bis/Bell 212A/Bell 103 Fallback (Default)

Mode	Description
V.22 bis	2400 bps asynchronous/synchronous
Bell 212A	1200 bps asynchronous/synchronous
Bell 103	0-300 bps asynchronous
All modes are full duplex.	

If V.22 bis/V.22/V.21/V.23 fallback operation is enabled, the following fallback modes are available. As in the previous list, the modes are listed in the order in which they are attempted by the modem.

Table 4-3. V.22 bis/V.22/V.21/V.23 Fallback

Mode	Description
V.22 bis	2400 bps asynchronous/synchronous
V.22	1200 and 600 bps asynchronous/synchronous
V.21	300 bps asynchronous
V.23	1200/75 bps asynchronous
All modes are full duplex.	

The operating mode can be controlled by the user through the SPEED LIMIT screens on the LCD in all modes except Hayes mode. See **Chapter 3** for details.

NOTE

If you want to select 1200/75 bps for both the maximum and minimum rate, V.22 bis/V.22/V.21/V.23 fallback must also be selected.

4.3.2 AUTOMATIC RATE ADJUSTMENT

Both sections below apply to both dial line and leased line operation.

Rate Renegotiation Procedure (RRP)

If Rate Renegotiation Procedure (RRP) is enabled, the modem will automatically fall back or fall forward to a lower or higher data rate at any time during data transmission (without retraining) in response to changes in signal quality. Data rate adjustments are limited to the range of 4800 to 14,400 bps and are also limited by

the minimum and maximum rate settings of the Speed Limit option. If satisfactory performance cannot be attained at any of the available data rates, the modem will initiate a GSTN clear-down (line disconnect). If the originate modem attempts to negotiate a rate that is lower than the minimum rate setting of the answer modem, the answer modem will initiate a GSTN clear-down.

RRP will function only if Speed Fallback is enabled (factory default) and if the V.32 Mode option is set to V.32 bis (factory default). (Both are Summary Setup options.)

The factory default setting for RRP is enabled. To change the RRP option, refer to **Appendix B, Fig. B-7**. Change the Rate Regeneration Procedure (RRP) parameter shown in the diagram to 0 (disable) or 1 (enable). (This is the only way the RRP option can be changed.)

4.4 Dumb Mode and Bell 208 Operation

Table 4-3 lists dialing parameters that may be used to modify Dumb mode or Bell 208 dialing operations.

4.4.1 MANUAL ORIGINATE/ANSWER OPERATION

When the modem is operating in Dumb mode or configured for Bell 208 operation, data calls may be manually originated from a phone set. (Plug the phone into the modem jack marked "PHONE.")

For manual-originate operation, the remote modem may be configured for either automatic or manual answer. For manual-originate/answer operation, one modem must be set to ANSWER and one must be set to ORIGINATE via the ANS/ORG DEFAULT screen. For either type of operation, use the Quick Setup to configure the modem. (The Dumb mode Quick Setup defaults to asynchronous operation; the Bell 208 and V.32/208 Quick Setups default to synchronous operation.)

Any of these three Quick Setups will set the modem to originate mode. If you want to set your modem to answer mode, use the front panel controls to access the ANS/ORG DEFAULT screen (MODEM SETUPS screen 4). Then select ANSWER (answer mode).

Originating a Data Call Manually

To manually originate a data call, select TALK from MAIN MENU screen 1. The MANUAL-DIAL screen will now be displayed. Select TALK again. This puts the modem in talk mode. Lift the handset and listen for the dial tone. Dial the phone number of the remote modem.

When you hear a high-pitched answer tone, select DATA from the MANUAL-DIAL screen, and place the handset back on the cradle. The LCD will display the status of the communication. Typically it will appear as follows:

D	TR	MR	RS	CS
9600				CD

The data link between the two modems is now established, and data transfer can begin.

Answering a Data Call Manually

An incoming call may be answered manually or automatically, although to answer a data call manually, the Auto-Answer option must be disabled. Before the call is received, the modem must be set to TALK, as explained in the previous section. The unit that will be switched to DATA mode first must be set for answer mode (using the answer/originate option). The other unit must be set for originate mode.

NOTE

If you set the modem to talk mode, the phone will ring, but the modem will not answer, even if the Auto-Answer option is enabled.

After the phone has rung, and you have answered it, the modem must be set for data mode: With the MANUAL-DIAL screen still displayed, select DATA. This puts the modem in data mode.

The first person to go to data mode will hear his telephone disconnect as his modem connects. The other person must wait until he hears an answer tone, and then switch to data mode (select DATA). When both modems are in data mode, the data communication will begin. The LCD will display the status of the connection.

Terminating a Data Call

There are several ways a data call can be terminated. One way is through communication software—by following the software manufacturer's instructions. An alternate method is to switch to the TALK option (talk mode) on the MANUAL-DIAL screen, as described in the previous section. Another method is to drop the DTR signal from the DTE (by software control or by turning the DTE off).

4.5 V.32/208 Auto-Detect Mode

When V.32/208 auto-detect mode is enabled, the modem will automatically select either V.32 (V.32/V.32 bis) or Bell 208 operation. These two types of operation are described below.

4.5.1 V.32/V.32 BIS OPERATION

In V.32/208 auto-detect mode, an answering modem will, upon detection of a V.32 handshake, operate with the following options set as shown:

- Data format—synchronous
- V.13 operation—TX and RX
- Carrier type—constant
- CTS to EIA—RTS (CTS follows RTS)

4.5.2 BELL 208 OPERATION

In V.32/208 auto-detect mode, an answering modem will, upon detection of an originating Bell 208B modem, operate with the following options set as shown:

- Data format—synchronous
- V.13 operation—off
- Carrier type—switched

The originating Bell 208 modem must be configured to detect the Bell 208 answer tone before it goes to data mode. (Some 208 modems may not have this option.)

4.5.3 AUTOMATIC FALLBACK

When the modem is configured for V.32/208 auto-select mode and in answer mode, it will not handshake in V.22 bis, Bell 212/103 or V.21/V.22, V.23 mode.

4.6 V.13 Operation

The modem can be configured for CCITT V.13 operation (which emulates half duplex operation) for either point-to-point or multidrop applications. (The correct options for these applications are identified in **Chapter 3**.) The modem normally operates in full duplex; however, some applications (such as certain network environments) may require control of a remote CD signal by a local Request to Send (RTS) signal. V.13 operation allows

local RTS control of a remote CD signal without actual ON-OFF switching of the modem carrier.

The following explains how the modem will respond to RTS signals when it is configured for V.13 operation:

When RTS is raised high by the terminal, the V.13 ON PATTERN will be sent. The modem will then raise CTS (and data can be sent). When RTS is brought low, the V.13 IDLE PATTERN will be sent, and the modem will drop CTS. (If V.13 TX is enabled but the modem data pump is not ready to send, for example, if it is training or retraining, raising RTS will cause CTS to be raised, but the V.13 ON PATTERN will not be sent.) When V.13 RX is enabled, CD will turn ON if the V.13 ON PATTERN is detected; CD will turn OFF if the V.13 IDLE PATTERN is detected or if the modem retrains, loses carrier, or is reset.

4.7 DTR Dialing

NOTE

To use DTR dialing in V.25 bis or Penril mode, you must use the Summary Setup feature, as explained in Chapters 6 (V.25 bis) and 7 (Penril).

4.7.1 DIALING A STORED NUMBER

DTR dialing allows you to set up the modem to automatically dial a stored number even when the autodialer has not been enabled.

To enable DTR dialing, select DTR from the DIALER option screen.

When DTR dialing is enabled, an OFF-to-ON transition of DTR will cause the modem to automatically dial the number previously stored using the front panel LCD. DTR must remain on for at least 50 ms to effect automatic dialing. A 50-ms drop of DTR will abort the process or disconnect the call. When DTR goes high again for at least 50 ms, the automatic dialing process will begin again.

4.7.2 ANSWER MODE OPERATION

If the modem is set for DTR dialing, it will automatically answer without DTR. However, it will not be able to transfer data until DTR goes high. The call may be terminated by dropping DTR.

4.8 Dial Line Auto-Recovery

The Dial Line Auto-Recovery feature allows you to setup the modem for a dial-up application so it will automatically redial to restore a broken connection if the modem goes on-hook. In this way, the Dial Line Auto-Recovery feature emulates the reliability of a leased line connection.

4.8.1 SETTING UP THE MODEM FOR DIAL LINE AUTO-RECOVERY

Two steps are required to set up the modem for Dial Line Auto-Recovery: You must first enter or store the number to be dialed together with the /R command; then you must enable Dial Line Auto-Recovery.

Entering the /R Command

To configure the modem for Dial Line Auto-Recovery from the front panel, enter the phone number to be dialed followed by /R (the Dial Line Auto-Recovery command) on the PHONE screen:

T555-4545/R		
DEC	CTRL	INC

If you need assistance, see **Section 4.2, Storing Phone Numbers**.

An alternate way to configure the modem for Dial Line Auto-Recovery (in Hayes mode only) is to use the Hayes **AT &Z** command to store the phone number to be redialed and the /R command in memory location 0, by entering

AT &Z0=T555=4545/R

Enabling Dial Line Auto-Recovery

Dial Line Auto-Recovery will not be active until you select DIAL from the front panel AUTO-DIAL screen (or, in Hayes mode, use the command AT DS=0—or, in V.25 bis mode, use the command CRS 0). If power is removed from the modem, you will have to re-enable Dial Line Auto-Recovery. To disable Dial Line Auto-Recovery, select RESET from MAIN MENU screen 3.

4.8.2 RECOVERY PROCEDURE

If Dial Line Auto-Recovery is enabled and the modem goes on-hook, it will redial the stored phone number up to 10 times. It will redial 5 times at 30-second intervals, wait 2 hours, and then redial 5 additional times at 30-second intervals. The modem stops redialing after 10 attempts.

If a connection has been broken and re-established and is then broken again, the full sequence of 10 redial attempts will not occur unless the modem has been on-line for more than 1 hour. The modem will redial, but it is programmed not to exceed more than 10 redial attempts in 1 hour.

4.9 Leased Line Auto-Recovery

The Leased Line Auto-Recovery feature allows the modem to automatically restore operation for a leased line application by using dial lines as a backup when conditions on the leased lines deteriorate. The modem uses signal quality and loss of carrier detect to determine if line conditions are unsatisfactory. Leased Line Auto-Recovery is accessed via the AUTO-RECOVERY screen on the front-panel LCD.

The following conditions are required for Leased Line Auto-Recovery operation:

- Leased Line Auto-Recovery must be enabled (using the Leased Line Auto-Recovery Select option) on both communicating modems.
- The Leased Line Auto-Recovery Select, Return, and Test options must be set correctly on both communicating modems, as explained in the following sections.
- A dial backup line (or lines) must be installed.
- The phone number to be dialed (the backup line) must be stored in the originate modem, as explained in the previous section.
- Auto-answer must be enabled on the answer modem.

4.9.1 AUTODIAL BACKUP

The modem will automatically dial the stored number to connect over the backup line if it detects poor signal quality (ER) or a loss of carrier detect (CD) on the leased line. The criteria used by the modem in assessing the condition of the leased line depend upon the settings of the Signal Quality option (one error in 10^3 or 10^5 bits) and the Carrier Detect Level option (-43, 33, or -26 dBm).

Dial Backup Message

When dial backup occurs (either automatically or by operator intervention), the following message will flash on the front panel LCD of both modems:

**ATTENTION:
DIAL BACKUP**

This message will clear when the modem returns to the leased line. If you want to clear the message while the modem is still in dial-backup mode, press the ENT pushbutton.

4.9.2 EXIT FROM LEASED LINE AUTO-RECOVERY

If the Leased Line Auto-Recovery Return option is enabled (see below, the modem will automatically exit the Auto-Recovery mode when the leased line conditions are satisfactory. Any normal disconnects (such as loss of carrier or line current) may also disconnect the dial connections and return communication to the leased line.

To ensure the proper disconnect capabilities for Leased Line Auto Recovery mode, both of the following disconnect options must be enabled on both modems: line current disconnect (CURRENT DISC'T screen) and carrier disconnect (CARRIER DISC'T).

To manually exit the Leased Line Auto-Recovery mode and return to leased-line operation, select DIAL from MAIN MENU screen 1, and then select HANGUP for the AUTO-DIAL screen.

4.9.3 LEASED LINE AUTO-RECOVERY OPTIONS

Three options allow you to specify the criteria the modem will use in determining when to enter and exit the Leased Line Auto-Recovery mode:

Leased Line Auto-Recovery Select (Select)

This option determines the type of Leased Line Auto-Recovery desired. “DIAL IF BAD>(1, 2, 3, or 4) min” or “DIAL IF BAD>30 s (seconds)” means dial backup will occur if bad line conditions are present for the specified (selected) time period. To disable the Leased Line Auto Recovery, select NO AUTO RECOVERY. A sixth option, Manual Recovery, is discussed below.

NOTE

If “DIAL IF BAD>(1, 2, 3, or 4) min (or 30 s)” is selected, the Select option settings of the answer and originate units must be the same.

Manual Recovery

If both modems are set for MANUAL RECOVERY, the originate unit can be used to autodial the number stored via the PHONE screen without having to change the LINE TYPE setting on either unit. To autodial, access the AUTO-DIAL screen and select DIAL. To return to the leased line, select HANGUP from the AUTO-DIAL screen.

Return from Leased Line Auto-Recovery (RETN)

This option determines the criteria for exiting Leased Line Auto-Recovery mode.

“RETURN IF GOOD>(10, 40, 60, or 120)s” means the modem will automatically exit the Leased Line Auto-Recovery mode when it tests and finds the leased line in good condition for more than the time period specified (10, 40, 60, or 120 s). If the Return option is set to OFF, the modem will stay in the Auto-Recovery mode indefinitely, unless you select HANGUP from the AUTO-DIAL screen or unless a loss of line current or other normal disconnect occurs. Either event will return communication to the leased line.

NOTE

The Return option setting must be the same on both communicating units.

Test Interval (Test)

If the Return option has been enabled (10, 40, 60, or 120 s), the Test Interval selections control how frequently the modem will test the leased line conditions to determine if exit from the Leased Line Auto-Recovery mode is desirable (based on the criteria selected for return from Auto-Recovery). The modem can be set to test every 10, 20, 40, or 60 minutes.

NOTE

The Test option setting must be the same on both units.

4.10 Modem Security Operation**NOTE**

Security features described in this manual provide a deterrent to unauthorized access. No communications system can be made perfectly secure.

Two types of security operation are available to screen incoming calls:

- Automatic password protection (APP). Users do not have to enter a password, but both modems must be correctly configured to exchange the same password (as part of a security handshake), or they will not be able to connect.

- Manual-response password protection (MPP). Remote users attempting to connect to the modem are required to enter a password. Incoming calls are accepted only if the user enters a valid password.

4.11 Automatic Password Protection (APP)

The modem can be configured for two types of APP:

- APP without callback—The modem can be configured so that each time it receives a connect request from another modem, it automatically employs a security handshake that includes a user-assigned password. Connect requests will be accepted only from modems that have been programmed with the same password. APP without callback functions in any operating mode that uses trellis coding (normally 72, 090 bps and above).
- APP with callback—This type of password protection is the same as described above, except that the answer modem connects with the originating modem by calling it back. The connection can only be made if both modems are preprogrammed with the same password and if the answer modem is preprogrammed with the number of the originating modem (the callback phone number). APP with callback is for dialup applications only (synchronous or asynchronous).

With either type of APP, each incoming call is password-protected, yet there is no need for user to enter a password. Passwords are preprogrammed, sent over the modems' auxiliary channel, and automatically compared by the modem. The only time manual intervention is required is when the password (and callback number, if used) is established or changed.

If desired, the password can be disabled. This allows the modem to accept calls from modems that have not been programmed to send the correct password—including modems that do not support the modem security handshake.

The automatically invoked password (and callback number, if used) is established or changed.

If desired, the password can be disabled. This allows the modem to accept calls from modems that have not been programmed to send the correct password—including modems that do not support the modem security handshake.

The automatically invoked password (and callback phone number, if used) is stored in nonvolatile memory, so it will be maintained if the unit loses power or upon a quick (soft) reset. However, a factory reset will clear the automatic password (and callback number, if used) from memory.

NOTE

When APP is used, the modem will not fall back to speeds lower than 7200 bps.

After a connection has been established using the security handshake and automatic password (and callback phone number, if used), a flashing "S" will be displayed in the top left corner of the EIA status screen to indicate that a secure connection has been made. (If the modem is in a dial mode, "S"—and "D" for dial line occupied—will flash alternately.)

The APP process is summarized below. Answer modem refers to the local modem; originating modem refers to a remote modem; when it calls or attempts to call the answer modem.

- An originating modem calls the answer modem.
- The originating modem automatically sends the preprogrammed password via the security handshake.
- If the answer modem is configured for APP without callback, it confirms the password and connects.

For APP without callback, this is the end of the process. For APP with callback, the process continues:

- Both modems go on-hook.
- The answer modem calls the originating modem back.
- Modems exchange security handshake (again) and connect.

4.12 Configuring Modems for APP

The procedures for configuring the originating and answer modems for both types of APP are summarized below and then explained in detail in the subsequent sections.

4.12.1 APP WITHOUT CALLBACK

- Enter the same password in the front panel password screen (on the LCD) of the originating modem and answer modem.

4.12.2 APP WITH CALLBACK

- Enter a password in the front panel password screen of the originating modem (the user password).
- A password must be entered in the front-panel password screen of the answer modem (the master password). Any password will do (even a single character), except that it should not be the same as the user password, and it should not be the

same as any other password stored in the answer modem's memory (for APP or MPP). APP with callback will not function if the master password is removed.

- Use the Hayes AT &Z command to store the user password and callback phone number in the answer modem's memory.

4.12.3 PASSWORD SCREENS

For either type of APP, a password must be preprogrammed through the PASSWORD screen of both the answer and originating modems, as explained below.

For APP without callback, use the same password on both modems. For APP with callback, do not use the same password—see **Section 4.12.2**.

Establishing or Changing the Automatic Password

The automatic password can be changed (or initially established) using the front panel password screens shown below. These screens are accessed via the PASSWORD screen.

Change-Password Screen:

DEC	SKIP	INC
-----	------	-----

Clear-Password Confirmation Screen:**CONFIRM****NOTE**

The change-password and clear password confirmation screens will not be displayed if the front panel is disabled.

To change or establish the automatic password, select **CHANGE** from the **PASSWORD** screen. The change-password screen will be displayed. If a password has been previously programmed, it will be displayed.

Use the right and left arrow pushbuttons to move from one character position to the next. The character at the current cursor location will flash on and off. Use pushbutton 1 to change the character at the current cursor location to the next descending character or pushbutton 3 to change it to the next ascending character. Use pushbutton 2 to skip through groups of characters (ascending). Use the arrow pushbuttons to move on to the next character to be changed.

4.12.4 VALID PASSWORD CHARACTERS

Valid password characters are A through Z (upper case or lower case), 0 through 9 and the following symbols: ! " # \$ % & ' () * + , - . / Spaces function as valid password characters; therefore, a password that includes spaces will only match another password with spaces in the same positions. Note, however, that a space in the first character position will disable the password. When the LCD cursor is in the same position as a space, the space is shown on the LCD as a flashing black box; otherwise, spaces appear as void spaces.

The following paragraph applies only to the user password entered in the originating modem when configuring modems for APP with callback:

The only valid password characters are capital A through Z. If any characters outside this range are used, callback operation will not function. No spaces between the letters are allowed, except that the user password (as entered on the front panel) must end with a space.

Entering the Selected Password

When the new password is correctly displayed on the LCD, press the ENT pushbutton. This will cause the new password to take effect.

The modems are configured for APP without callback when matching passwords are entered in the front panel password screens of both modems.

4.12.5 APP WITH CALLBACK: STORING THE PASSWORD WITH CALLBACK NUMBER

If you have followed these instructions to this point, the user password will be stored in the front-panel password screen of the originating modem, and a different password (the master password) will be stored in the front-panel password screen of the originating modem, and a different password (the master password) will be stored in the front panel password screen of the answer modem. (The master password should be different from the user password, because it can be used to access the answer modem directly, without callback. The master password allows access for troubleshooting from a remote site.)

The final step in configuring the modems for APP with callback is to store the user password in the answer modem's memory, along with the callback phone number, as explained below.

From the DTE, use the Hayes AT &Z command and /S (a special command) to store the user password (capital A through Z, no spaces) and callback number in a specific memory location. Memory locations 0 through 9 may be used. The following example shows how to store a user password and callback number in memory location 3:

```
Enter AT &Z3=T5551212/SGRAPE
```

The callback number (phone number of the originating modem) in this example is 555-1212 (with T used to specify tone dialing). The user password is GRAPE. (When the user password is entered on the front panel password screen of the originating modem, a space is required at the end. Do not use a space at the end when storing the password with the AT &Z command.)

A remote user can now call from the specified callback number, 555-1212. The originating modem will send the preprogrammed password GRAPE as part of the security handshake. The answer modem will confirm the password and connect by calling the originating modem back.

4.13 Disabling APP

4.13.1 TEMPORARILY DISABLING APP

To temporarily disable either type of APP, select CHANGE from the

PASSWORD screen. The change-password screen will be displayed. With the cursor in the first character position, press pushbutton 2 (SKIP) until a space appears (flashing ■). Then press ENT. The password will be disabled.

With the password disabled, the answer modem can connect to another modem that is not equipped to use or is not configured to use APP (for example, one where a password has not been entered in the front-panel change-password screen). However, it will not be able to connect to a modem that is programmed with a password for APP without callback. To restore the password, replace the space with the first character of the password and press ENT.

4.13.2 CLEARING THE PASSWORD

To clear the front-panel password from memory, select CLEAR from the PASSWORD screen. The clear-password confirmation screen will be displayed. Press pushbutton 2 to confirm that you want to clear the password.

If no password is stored, the modem will be able to connect to other modems that are not equipped to use or are not configured to use an automatic password (APP). To temporarily disable the automatic password, see the previous section.

4.14 Manual-Response Password Protection (MPP)

The modem can be configured for two types of MPP:

- MPP without callback—The modem will pass a connection on to the DTE interface only after it receives a valid password.
- MPP with callback—The answer modem will call back an authorized user after he or she enters a valid password.

Both types of security operation provide security on incoming calls by requiring remote user to manually enter a valid password. In addition, access to Hayes-compatible commands for viewing and storing phone numbers is password protected.

The MPP process is summarized below.

- A remote (originating) modem calls the local (answer) modem.
- Local modem answers.
- Remote user sends carriage return [CR].
- Answer modem confirms password and grants access (if programmed for MPP without callback) or initiates security callback (if programmed for MPP with callback).

4.15 Commands for Enabling MPP

Modem configuration for MPP is controlled from the DTE by a special set of password commands. These commands are implemented by using the Hayes **AT &Z** command to store them in memory. If an administrative password has been implemented, the front panel will be disabled and the AT &Z command will not function until it (the AT &Z command) is unlocked. (The procedure for unlocking the AT &Z command is explained in **Section 41.6, How to Use Password Commands**.)

The modem incorporates 10 memory locations for storing telephone numbers, passwords, and/or the MPP password commands listed in **Table 4-4**. To implement a security command, use the Hayes AT &Z command to store the command in a specific memory location. The password commands are listed in **Table 4-4** and explained in detail in the sections that follow.

Table 4-4. Password Commands for MPP.

Command	Function	Example	Mem. loc.
/A	Set/change administrative password; password-protects use of certain Hayes commands.	/ASECURITY	1
/P	Set password for— MPP without callback or MPP with callback	/PYELLOW 4443535/PRED	2-9
/U	User-defined text string. Used to send a response to the remote terminal user after a valid password is received.	/UHELLP	0

¹Command string stored using AT &Z command.
²Each command will function only in the listed memory locations.

Rules for Using Passwords and Password Commands (MPP)

- Memory locations 0 and 2-9 may be used for storing phone numbers; locations 2-9 may be used to store passwords.
- The entire command string, including the AT &Z command, cannot exceed 40 characters.

Passwords

- Passwords and commands may be entered in capitals or lowercase letters. (However, they will be stored and subsequently displayed as capitals.) Do not include number or spaces.
- For MPP without callback, / must be the first character in a storage location; for MPP with callback operation, a phone number must be listed first in a storage location.
- Special characters (! @ ?, etc.) may be used for passwords entered via the DTE interface, but these characters cannot be entered via the modem's front panel.
- A phone number cannot be stored after /.

Commands

- Only one command (/A, /P, or /U) can be stored in each memory location.
- Do not leave a space after a command.
- When using the /U command, do not include spaces or control characters in the specified text string.

4.16 How to Use Password Commands*To Establish or Change the Administrative Password:*

For greatest security, an administrative password should be used. If implemented, the administrative password controls access to the Hayes-compatible &V and &Z commands. These commands are required to view or modify the modem's security configuration (as explained in the following sections).

To establish or change an administrative password:

Enter AT &Z1=/ASECURITY

but replace SECURITY with the password of your choice.

NOTE

The administrative password may only be stored in memory location 1. The command line, including AT &Z1=, cannot exceed 40 characters.

To Unlock the &V and &Z Commands:

If an administrative password has been implemented, the Hayes-compatible &V and &Z commands cannot be accessed unless they are first unlocked using the current administrative password. (&V is used to view the active modem configuration, stored phone numbers, password commands and passwords; &Z is used to store phone numbers, password commands, and passwords). To unlock the &V and &Z commands, enter

```
AT &Z=/ASECURITY
```

or substitute other current password in place of SECURITY.

The &V and &Z commands will now be accessible.

To re-lock the &V and &Z commands, enter AT Z. The DTE will respond with OK, and the &V or &Z commands will not function until they are unlocked.

To Program MPP without Callback Operation

Use the commands AT &Z and /P to specify the password to be used for MPP without callback operation. The following example programs memory location 5 for MPP without callback:

```
Enter AT &Z5=/PYELLOW
```

The password is YELLOW. After the modems connect, the remote user presses the DTE Enter key once. The DTE will then prompt the user to enter the assigned password by displaying the PASSWORD? query. If the user enters the correct password, YELLOW, the call will be connected.

NOTE

MPP Passwords may only be stored in memory locations 2 through 9.

To Program MPP with Callback Operation:

Use the commands AT &Z and /P to specify the callback phone number and password to be used. The following example programs memory location 3 for callback operation:

```
Enter AT
&Z3=T5551212/PCANARY
```

The callback number in this example is 555-1212 (with T used to specify tone dialing); the password is CANARY. A remote user can now call from the specified callback number, 555-1212. After the modems connect, the remote user presses the DTE Enter key once. The DTE will then prompt the user to enter the assigned password by displaying the PASSWORD? query. Upon receipt of the correct password, CANARY, the local modem will call back the remote user at 555-1212. Once this connection is established, data may pass freely.

NOTE

MPP passwords and call back numbers may only be stored in memory locations 2 through 9.

To Program a Response to a Correct Password:

Enter AT &Z0=/UNCONNECTED

but replace CONNECTED with the message of your choice.

The DTE will respond with the specified message when the modem receives a correct password.

NOTE

The /U command and message can only be stored in memory location 0.

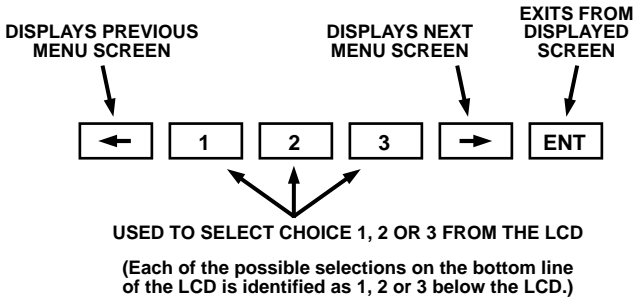


Fig. 3-1. Summary of Pushbutton Control Functions.

Arrow Pushbuttons

The left arrow (←) and right arrow (→) pushbuttons are used to display additional or previous screens that are part of the same menu. The right arrow pushbutton displays an additional menu screen (if there is one); the left arrow pushbutton displays the previous menu screen. With respect to how the LCD flow chart is set up, the arrow pushbuttons “move you” either right or left within the chart.

If a menu has more than one screen, each screen is numbered. The screen number is shown in the upper right corner of a screen (see the sample screen below.) If a menu has no screen number, it has only one screen. Additional menu screens (where present) show additional option selections.

```

MAIN MENU <2>
SETUP      TEST  RMT
    
```

Numbered Pushbuttons

Pushbuttons 1, 2, and 3 correspond to segments 1, 2, and 3 of the LCD screen. These segments (left, middle and right positions of the LCD screen) are numbered on the modem's front panel. To make a selection from a menu screen, simply push the button with the same number as the selection you want.

With respect to how the LCD flow chart is organized, pushbuttons 1, 2, and 3 will either take you to a lower level—or, where there is no route to a lower level, they will select an option.

ENT Pushbutton

To exit from a displayed screen, press the ENT (enter) pushbutton. With respect to how the LCD flow chart is set up, pushing the ENT button will move you upward through the chart (toward the MAIN MENU). If you become lost, pressing the ENT button repeatedly will return you to screen 1 of the MAIN MENU. Pressing ENT repeatedly after you have arrived at MAIN MENU screen 1 will cause the LCD to alternate between the EIA status screen and the MAIN MENU. (In the case of most tests, the ENT button cannot be used to exit the test screen once the test has been activated; you must first press the ENT button and then select OFF to end the test.)

3.3 Selecting Options from the Front Panel

This section applies to all option screens on the front panel LCD except the Summary Setup screens, which are explained in **Appendix B**.

Options are accessed from the SETUP menu. As shown in the LCD flow chart, the SETUP menu consists of six screens and is accessed from screen 2 of the MAIN MENU. (With screen 2 of the MAIN MENU displayed, push button 1 to select SETUP.)

Once you have located the screen that displays the option you want to access or change, select your choice by pushing the button with the same number as the selection you want. Each selection on the bottom line of the LCD is numbered either 1, 2, or 3 on the modem's front panel (not on the LCD), as shown in **Fig. 3-2**.

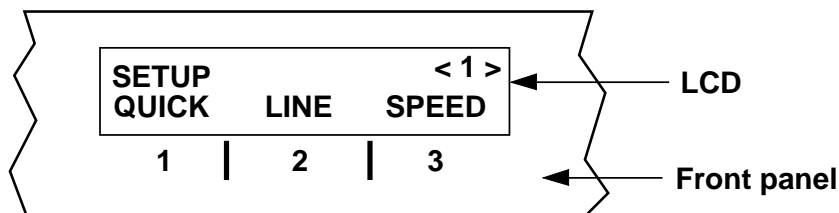


Fig. 3-2. The Front Panel.

When an option is first selected, it will flash on and off on the LCD. However, it will not take effect until you leave the SETUP menu. Simply accessing an option screen will not change the option, so do not be afraid to experiment with the LCD and pushbuttons.

Note the following important points—

- Selected options do not become active until you leave the SETUP menu.
- Changing some options will cause the modem to automatically reset.

- The option choices you select are automatically saved by the modem when you leave the SETUP menu.

3.3.1 DEC/INC (DECREASE/INCREASE) SCREENS

Several option screens show the abbreviations DEC and INC on the bottom line of the LCD display. This means that the numerical value shown on the top line (e.g., a stored phone number) can be changed. Selecting DEC (pushbutton 1) will decrease the value; selecting INC (pushbutton 3) will increase it.

3.3.2 EXAMPLE OF HOW TO SELECT AN OPTION

The example that follows illustrates how options are selected. As you follow the steps below, refer to the LCD flow chart (SETUP OPTIONS side). When you are done, you can easily restore default settings for the type of application you will be using by selecting the appropriate Quick Setup (**Table 3-1**).

The example shows how to change the volume of the modem's speaker from LOW or HIGH (the default setting) to MEDIUM. To make this adjustment, you must locate the SPEAKER VOLUME screen on the LCD. To reach this screen, you must first access MAIN MENU screen 2, then SETUP screen 4 and then MODEM SETUPS screen 5, as explained below:

After powering on the modem, press ENT to get the first screen of the MAIN MENU. Press the right arrow pushbutton (→) to go to screen 2 of the MAIN MENU (so the SETUP menu can be selected):

```

MAIN MENU      <2>
SETUP          TEST  RMT
  
```

Press pushbutton 1 to access the first page of the SETUP menu:

```

SETUP          <1>
QUICK LINE SPEED
  
```

Now press the right arrow pushbutton three times; this will cause SETUP screen 4 to be displayed:

```

SETUP          <4>
TEST  EIA  MODEM
  
```

Press pushbutton 3 to select MODEM (for MODEM SETUPS). The first MODEM SETUPS screen will be displayed:

```

MODEM SETUPS  <1>
CDLVL          TXLVL
  
```

Press the right arrow pushbutton four times to reach MODEM SETUPS screen 5:

```

MODEM SETUPS  <5>
FP  SPK  SPKVOL
  
```

Press pushbutton 3 to select SPKVOL (speaker volume). The SPEAKER VOLUME screen will be displayed:



The currently selected setting will be flashing on and off. Press pushbutton 2 to switch the volume setting to MEDIUM. “MEDIUM” will begin to flash on and off, indicating that this setting has been selected (although the new selection will not become active until you exit the SETUP menu). To return to the first screen of the MAIN MENU, press the ENT button several times.

3.3.3 HOW TO RETURN TO THE EIA STATUS SCREEN

Once your selection is complete, you will most likely want to return to the EIA status screen. Do this by pressing the ENT pushbutton several times—exactly how many times will depend on which screen you are exiting from. (If the modem is in a test mode, you must in most cases press ENT and then select OFF, which will end the test, before the ENT button can be used to exit the test screen.)

3.3.4 AUTOMATIC CONFIGURATION SAVE FEATURE

When you exit the SETUP menu, the modem automatically saves its current configuration (i.e., option setups, including any changes you have selected) to its internal memory. The saved configuration will remain in effect until it is changed—even if the modem loses power.

3.3.5 HOW TO RETURN TO DEFAULT SETTINGS

The factory default settings are different for each of the Quick Setup configurations available to the modem [2-wire dial Hayes, 2-wire dial V.25 bis, etc.]. To return to the factory-default settings for any of these configurations (except 2-wire dial Hayes), go to the QUICK SETUP menu and select the desired configuration.

The 2-wire dial Hayes Quick Setup does not recall the factory-default setting, it recalls the stored user profile 0 or 1, depending on which has been designated as the default; see &Y command.

To entirely reconfigure the modem to the state it was in when shipped from the factory, hold in the right arrow pushbutton as you power up the modem until the words “FACTORY DEFAULT” appear on the LCD.

3.4 Options

The rest of this chapter describes the options available from the modem front panel. The options are presented in the same order in which they appear in the LCD flow chart (which is shipped with the modem). For each option, all possible choices (available selections) are explained.

The line below each option heading indicates the applicability of the option: A mode (like Quick Setup mode) is listed only if the option is effective in that mode and if it can be of practical use in that mode.

For a concise summary of the modem options and option choices, see the LCD flow chart. The default settings for each option are listed in **Appendixes A and B**.

Quick Setups

All modes

The Quick Setups (one for each operating mode) are unique in that they affect the entire modem configuration. See **Chapter 2** and **Appendix A**.

Line Type

All modes

2W-D. This selection (2-wire dial line) is used for dialup applications.

2W-LL. This selection (2-wire leased line) is used for leased line applications that use 2-wire lines.

4W-LL. This selection (4-wire leased line) is for leased line applications that use 4-wire lines.

3.5 Speed (Data Rate) Options

Speed Limit

All modes

The Speed Limit option allows you to set a minimum and/or maximum data rate. The modem will automatically operate at the highest possible data rate within the limits selected, as indicated in **Table 3-1**. (In Hayes mode, the maximum rate of the originate modem is determined by the originate modem's DTE autobaud rate. See **Table 3-1**.)

EIA-23. This choice is available for setting the maximum rate only. If EIA-23 is selected, the rate will be set at either 9600 or 4800 bps, depending on the condition of pin 23 on the EIA interface: Pin 23 high (greater than or equal to +3 volts) = 9600 bps; pin 23 low (less than or equal to -3 volts) = 4800 bps.

Table 3-1. Effect of Speed Limit Settings on Data Rate.

Max rate setting, bps	Dialer option	Resultant data rate, bps
14,400 ¹	Leased line modes xx	14,400 ¹
19,200	xx	19,200
12,000 ¹	xx	12,000 ¹
9600	xx	9600
7200 ²	xx	7200 ²
4800	xx	4800
300 to 2400	xx	2400
EIA-CTRL	xx	9600 or 4800 ³
300 to 19,200	Dial modes—Answering xx	Negotiated between min. and max. setting
EIA-CTRL	xx	9600 or 4800 ³
300 to 19,200	Dial modes—Originating OFF or DTR	Negotiated between min. and max. setting
EIA-CTRL	OFF or DTR	9600 or 4800 ³
xx	HAYES ⁴	Negotiated between autobaud speed and minimum setting on originate modem ⁴
<p>xx Does not matter—setting does not affect data rate.</p> <p>¹Both 14,000 and 12,000 bps rates are available for the modem.</p> <p>²7200 bps is available only if V.32bis mode is enabled (via Summary Setup, V.32 Mode option).</p> <p>³9600 bps if EIA pin 23 is high, 4800 bps if pin 23 is low.</p> <p>⁴If SYNC AFTER DIAL is enabled (using the &Q1 command), the rate will be negotiated between the autobaud speed and 1200 bps.</p>		

Speed Matching

If speed conversion is not desired, the DTE interface rate should be set to follow the rate at which the modem connected (i.e., DTE rate = DCE rate, or speed matching). Change the Speed matching parameter shown in the diagram to 1 (enable).

NOTE

Speed matching is only effective for dial applications and will only function if error correction or buffer mode is enabled.

Speed Type

All modes

The V.32 master handshake normally used by the modem is incompatible with the CCITT V.33 and Bell 208 handshakes. However, the modem (only) can be configured for either V.33 or Bell 208 compatibility, and for Bell 208 operation. (To determine if a modem supports Bell 208 operation, see **Section 2.7.**)

V.33 or Bell 208 speed types can be set independently of other options via the SPEED TYPE screen; however, to ensure proper operation, it is recommended that you use the V.33, Bell 208, or V.32/208 Quick Setup configuration, as explained in **Chapter 2.**

The available speed-type selections are listed below. Use pushbuttons 1 (DEC) and 3 (INC) to cycle through the speed-type selections. The currently selected speed type is displayed in the SPEED TYPE screen (upper right corner), as shown in **Fig. 3-3.**

SPEED TYPE DEC	V.32 INC
-------------------	-------------

Fig. 3-3. Current Speed Type Selection.

V.32. The modem normally uses the V.32 handshake. (The modem also uses this handshake for V.32/14.4 Kbps operation.)

V.33 operation is available on the modem for 4-wire leased-line synchronous operation only. The available data rates are 14.4 and 12.0 Kbps. Either of these rates may be set as the maximum or minimum by using the Speed Limit MAXIMUM RATE and MINIMUM RATE screens.

Both connected modems must be set for V.33 leased line operation.

208. This selection (available only on models that support Bell 208 operation) provides Bell 208A compatibility for 2-wire or 4-wire leased line operation and Bell 208B compatibility for 2-wire dial operation. Operation is full duplex in 4-wire leased line mode only. In Bell 208B mode, synchronous V.25 bis autodialing is available, but Hayes operation is not. Calls may be originated from the front panel. The data rate is fixed at 4800 bps for 208A/B operation, and the data format is synchronous only.

Both connected modems must be set for 208A/B operation. For 2-wire applications, the carrier option must be set for switched carrier operation (SWITCH) via the CARRIER screen, and CTS must be set to follow RTS (CTS to EIA option).

V.29. This selection is available only on models that include the V.29/V.27/V.26 option. It configures the modem for V.29 operation (for data rates of 9600, 7200, or 4800 bps). To select a specific data rate, use the Speed Limit option to select 9600, 7200, or 4800 bps (only) as the minimum and/or maximum data rate (DCE RATE). In V.29 mode, the modem does not support automatic rate adjustment (fallback) or error correction.

AUTO. This selection configures the modem for V.32/208 auto-detect mode. This mode allows the modem to automatically select V.32 or Bell 208 operation, depending on the mode of the originating modem.

Note—

- To enable V.32/208 auto-detect mode, the Speed Type option must be set to AUTO and the V.32/208 auto-detect Summary Setup option must be set to 1 for enable. This option is shown in **Appendix B, Fig. B-6**.
- Selecting the V.32/208 Quick Setup automatically sets the speed type to AUTO—and enables the Summary Setup auto-detect option (sets it to 1).
- When the speed type is set to AUTO, the ALX will not handshake in V.22 bis, Bell 212/103 or V.21/V.22,V.23 mode.
- All information in the 208 section above applies to V.32/208 auto-detect mode.

Three options intended only for 208A/B and V.33 operation are accessible through MODEM SETUPS screen 7. These options allow you to select constant or switched carrier, set CTS to follow RTS or set CTS to be always on, or specify an RTS-CTS delay time. For further information, see the Carrier, CTS, and RTS-CTS Delay headings later in this chapter.

For further information on Bell 208 mode, see chapter (section titled Dumb Mode and Bell 208 Operation).

3.6 V.42 Error Correction Options

The modem supports both CCITT V.42 error correction and Microcom Networking Protocol (MNP) error correction (classes 1 through 5). V.42 and MNP both provide end-to-end error correction through an automatic repeat-transmission request algorithm. Both types of error correction enable the modem to detect data-transmission errors and automatically request retransmission of adversely affected data until it is received correctly.

Either error-correction standard (V.42 or MNP) may be enabled for either dial or leased-line operation. However, error correction can function only if all of the following conditions are present:

- The modem that the modem is communicating with must be equipped with the same type of error correction (V.42/V.42 bis or MNP).
- The same type of error correction (V.42/V.42 bis or MNP) must be enabled at both ends of the communication link.
- Both communicating modems must be configured for asynchronous data format.

- The connected systems must support data flow control (have buffering capabilities).

Note—

- The V.42 and MNP error-correction options (listed and described below) are effective only when all of the conditions listed above are present.
- Error-correction options cannot be changed when the modem is on-line.
- For valid test results, disable error correction before running diagnostic tests.

User-selectable options let you configure the modem for V.42 (LAPM) error correction only, MNP error correction only, or V.42 error correction with MNP as the fallback (alternate) error correction protocol. Data compression may also be enabled by selecting either V.42 bis or MNP class 5 error correction. Other error-correction options are also available.

The available error-correction options are V.42 Mode, MNP Class (class limit), Break Handling, V.42 Selection, Buffer Mode/Speed Conversion, DTE Speed, DTE-DCE and DCE-DTE Flow Control options, and Pass-through Flow Control. All of these options affect the type of error correction selected via the V42 SELECTION screen (discussed below), except that the MNP Class option is

applicable only to MNP operation.

The error correction options can be selected in any order, but the following sequence is suggested: First select the type of error correction desired from the V.42 SELECTION screen. Next make a selection from the V.42 MODE screen. Then select other error correction options as appropriate for your application.

Two additional error-correction options are described near the end of this chapter, in **Section 3.16, Options Accessible Only via Summary Setup**. These additional options are Selective Retransmission and DCE Pass-through Flow Control.

V.42 Mode

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

The V.42 Mode settings described below apply to the type of error correction selected via the V42 SELECTION screen. For example, if LAPM ONLY has been selected as the error correction protocol, and MANDATORY is selected from the V42 MODE screen, V.42 or V.42 bis error correction will be activated—or if it cannot be, the modem will hang up.

OFF. Error correction will be disabled.

MANDATORY. Error correction will be activated. If the modem cannot establish a connection using the type of error correction selected via the V.42 Selection option, it will hang up.

TIGHT FIT = AUTO. The modem will fall back to buffer or non-buffer mode if conditions do not allow it to establish a connection using the type of error correction selected via the V42 SELECTION screen.

MNP Class (Limit)

Hayes, V.25bis, Dumb, Leased Line modes (except V.33)

This option is effective only when MNP error correction is active. It limits MNP operation to the selected MNP class or lower. (MNP classes 1-5 are available.) In general, the higher MNP classes provide greater throughput. Class 5, the default, can provide as much as 2-to-1 data compression over the transmission link.

V.42 Selection Options

The following two options are available through the V.42 SELECTION screen:

Protocol

Hayes, V.25 bis, Dumb, Leased line modes (except V.33)

LAPM/MNP. The modem will attempt to establish a connection using the V.42 link access protocol for modems (LAPM). This is the primary error correction protocol under the CCITT V.42 standard. If such a connection cannot be established (because the other modem does not support LAPM or is not configured for LAPM), the modem attempts to establish a connection using MNP class 5 as the fallback (alternate) error-correction protocol.

NOTE

When operating in LAPM mode, the modem uses V.42 error correction unless V.42 bis is enabled via the V.42 bis option. (V.42 and V.42bis error correction both use LAPM.)

LAPM ONLY. The modem will only attempt to establish an LAPM connection (will use only V.42 or V.42 bis error correction).

MNP ONLY. The modem will only attempt to establish an MNP connection.

NOTE

If a connection cannot be established using the selected protocol LAPM/MNP, LAPM ONLY or MNP ONLY), the action the modem will take depends on the V.42 mode setting. See V.42 MODE.

V.42 bis Operation

Hayes, V.25 bis, Dumb, Leased line modes (except V.33)

V.42 bis operation provides error correction with data compression. Like V.42 error correction, V.42 bis uses the link access protocol for modems (LAPM). V.42 bis operation may be enabled or disabled.

Break Handling

Hayes, V.25 bis (Async only), Dumb, Leased line modes (except V.33)

When error correction is active, a break signal is relayed with an “attention” packet. The break handling option determines how the attention packet is sent.

NONE. No attention packet is sent.

DESTRUCTIVE/EXPEDITED (DESTR/EXP). All data in the buffer is deleted; the attention packet is then passed through the channel.

NON-DESTRUCTIVE/EXPEDITED (NDT/EXP). The attention packet is passed through immediately, but data in the buffer is not deleted.

NON-DESTRUCTIVE/NON-EXPEDITED (NDT/NEXP). The attention packet is passed through the channel in sequence, and any data is buffered; this preserves the sequence of data and breaks received.

Buffer Mode/Speed Conversion

Hayes, V.25 bis, Dumb, Leased line modes (except V.33)

This option enables or disables speed conversion (for asynchronous operation only) between the DTE and modem when error correction is not used.

ENABLE. When error correction is not active, the V.42 circuit will function as a buffer between the DTE and the modem and will provide transmission-speed conversion.

DISABLE. Speed conversion is not allowed.

DTE Speed

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

This option controls the DTE speed; however, it is effective only when the modem is operating in V.42 mode, MNP mode or buffer mode. (If the modem is not in one of these modes, the DTE speed will be the same as the connect rate.)

The DTE speed can be set for 38.4, 19.2, or 115.2 Kbps or 9600, 4800, 2400, 1800, 1200, 600, 300, or 110 bps (except that 1800 bps is not available if the modem is in Hayes mode). The default DTE speed is 38.4 Kbps.

DTE speed refers to the speed of data transfer between the DTE and the local modem—it is not necessarily the same as the data transmission speed between the connected modems. If flow control is disabled, the DTE speed must be equal to or less than the modem speed, and the local and remote DTE speeds must be equal.

For Hayes mode operation, this option sets the default DTE speed that will be effective after powerup or after a full modem reset. However, the default DTE speed is automatically overridden when the modem is autobauded (when an “AT” attention code is sent to the modem).

Flow Control

The flow control options control the data flow according to the availability of memory in the buffer. Flow control can be set independently for the terminal to the modem (DTE-DCE) and for the modem to the terminal (DCE-DTE). The flow control options include DTE-DCE, DCE-DTE and Pass-through Flow Control.

Note the following:

- Flow control only applies to asynchronous connections with V.42 error correction or buffer mode enabled.
- When flow control is disabled, the DTE data rate must be equal to or less than the modem data rate, and the local and remote DTE data rates must be equal. (This precludes the need for flow control—which some DTE devices cannot handle—and avoids buffer overflow.)
- For DTE-DCE and DCE-DTE Flow Control options: When RTS on/off or CTS on/off flow control is used and a buffer connection has been established, conditions that will stop the data flow (e.g., dropped RTS) should not be permitted for long periods, if possible, to reduce the possibility of buffer overflow.

Fig. 3-4 illustrates the available flow-control options.

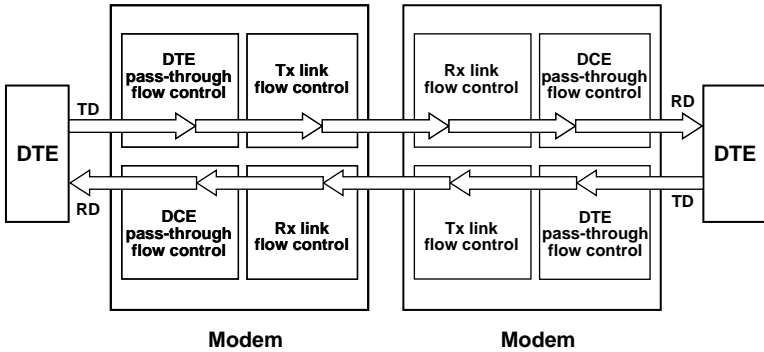


Fig. 3-4. Flow-Control Options.

DTE-DCE Flow Control

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

NONE. This setting disables flow control. All flow-control characters are passed through the communication channel.

RTS on/off. The Request to Send signal controls data flow from the modem to the DTE. (RTS on/off is also called hardware, physical or out-band flow control.) This selection enables flow control for the local modem only.

DC1/DC2. This option inserts the control characters ^R and ^Q into the data stream to stop and start/restart the flow of data from a device. (DC1/DC2 is also called software, logical, or in-band flow control.)

DC1/DC3 (X-ON/X-OFF). This is the most common method of flow control. It inserts the control characters ^S and ^Q into the data stream to stop (^S) and start/restart (^Q) the flow of data. (DC1/DC3 is also called software, logical, or in-band flow control.)

NOTE

When using the modem for binary file transfer, in-band flow control (flow control using control characters) must be disabled. In this case, use hardware flow control or, as an alternative, lower the DTE speed to reduce the possibility of overflow.

DCE-DTE Flow Control

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

All information given above under DTE-DCE Flow Control also applies to the DCE-DTE (modem to terminal) flow control option, except that the CTS, Clear to Send signal, is used to control DTE-DCE data flow.

DTE Pass-through Flow Control

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

Pass-through Flow Control affects DTE-DCE flow control only. This option determines whether flow-control characters received from the local DTE will be passed to the remote modem (if control characters are used for flow control).

ENABLE. Flow control characters are passed to the remote end of the communication connection after the modem acts upon them.

DISABLE. Flow control characters are not passed.

3.7 Address

All modes

The address screen allows you to set the address of the modem at your location. An address may be useful if the modem will be used in a rack enclosure or in a network environment.

The available address numbers are 000,000 through 999,999. On the ADDRESS screen, the three digits to the right of the comma are the unit address number. The three digits to the left are the group address number. To change the address, use the right and left arrow pushbuttons to go to the

digit you want to change. Then use pushbutton 1 to decrease (DEC) a number and pushbutton 3 to increase (INC) it. The default address is 999,999.

3.8 Dialer Mode

Several dialer mode options can be selected from the DIALER and DIAL V25bis screens.

Dialer

All modes

See also V.25 bis Dialer Modes below.

OFF. The autodialer is off, meaning the modem will operate in Dumb mode only. Calls must be made using the front panel AUTO-DIAL function or they must be manually originated.

HAYES. The autodialer will automatically dial previously stored phone numbers, and the modem will respond to Hayes commands.

DTR. This selection enables DTR dialing, an option that allows you to set up the modem to automatically dial a stored number even when the autodialer has not been enabled.

NOTE

DTR dialing for V.25 bis mode or Penril autodialer mode cannot be enabled through the DIALER screen. To select DTR dialing for V.25bis or Penril mode, you must use the Penril/V.25bis DTR Dialing option.

V.25 bis Dialer Modes

V.25 bis mode

Any of the selections from the DIAL V25 bis screen will enable the V.25 bis autodialer.

The three selections on the DIAL V25bis screen allow you to select a data protocol that is appropriate for the DTE the modem is connected to. The choices are—ASYNCHRONOUS (Asyn) SYNCHRONOUS, CHARACTER ORIENTED (Syn_c), and SYNCHRONOUS, BIT ORIENTED (Syn_b)

3.9 Auto-Answer Option

Auto-Answer

Hayes, V.25 bis, Dumb, 208, V.32/208 modes

This option determines whether or not a call is automatically answered when the phone rings.

Setting the Auto-Answer option to ENABLE resets Hayes mode register S0 to 1 (meaning that calls will be answered on the first ring).

3.10 Data Format Options

Data Format (Sync or Async)

V.25 bis, Dumb, Leased line modes
The data-format setting for the local modem and for the remote modem must be the same.

ASYNCHRONOUS. Data is transmitted and received in the character asynchronous format. The character length (next option) must be the same for both communicating modems.

SYNCHRONOUS. If this setting is selected, data must be transmitted and received in the synchronous format. The appropriate transmitter clocking setting must be selected—see TRANSMITTER CLOCKING later in this chapter. The synchronous data format is not available for data rates of 300, 19.2, or 38.4 Kbps.

Character Length

All modes (asynchronous operation only)

This option selects a character length of 9, 10, or 11 bits for character asynchronous operation. The same character length must be

selected for both the local and the remote modems. Use pushbuttons 1 and 3 to select the desired character length. The most widely used character-length setting is 10 bits.

9 BITS: 1 start bit, 7 data bits, and 1 or more stop bits.

10 BITS: 1 start bit, 8 data bits, including parity, and 1 or more stop bits.

11 BITS: 1 start bit, 9 data bits, including parity, and 1 or more stop bits.

Parity

All modes

Parity selections will be effective only if error correction or buffer mode has been enabled or if the modem is in 2-wire dial Hayes mode. For most applications, parity should be set to NONE.

The following parity options are available: NONE (no parity), ODD, EVEN, MARK (parity is always 1) and SPACE (parity is always 0). All parity settings except NONE automatically enable parity conversion (except in Hayes mode), meaning that the parity of received data will be converted to match the selected parity option.

In Hayes mode, autobaud overrides the front panel parity setting; this occurs when the modem receives the AT attention code.

3.11 Disconnect Options

When the modem is operating in V.25 bis or Dumb mode, it is necessary to disconnect the modem from the telephone circuit once communications is completed. The most common form of disconnection is by dropping the Data Terminal Ready (DTR) signal from the DTE. However, some applications may require one of the five available automatic disconnect methods listed below.

For all five disconnect options, “disabled” means the modem will not disconnect in the presence of the conditions specified below

RX (Receive) Space Disconnect

Hayes, V.25 bis, Dumb modes

If this option is enabled, a 1.6-second continuous space will cause the modem to disconnect.

NOTE

For Hayes mode operation, the RX Space Disconnect and TX Space Disconnect options must both be enabled or must both be disabled.

TX (Transmit) Space Disconnect

Hayes, V.25 bis, Dumb modes

When TX Space Disconnect is enabled, the modem will transmit 4 seconds of space prior to disconnecting from the line. This ensures a clean disconnect if RX space disconnect is enabled on the remote modem.

NOTE

For Hayes mode operation, the TX Space Disconnect and RX Space Disconnect options must both be enabled or must both be disabled.

Carrier Disconnect

V.25 bis, Dumb modes

If enabled, a 400-ms loss of carrier signal will cause the line to be disconnected.

(To set this option for Hayes mode, use S register S10.)

Line Current Disconnect

V.25 bis, Dumb modes

If enabled, a 400-ms loss of current will cause the line to be disconnected.

(To set this option for Hayes mode, use S register S10.)

RTS Disconnect

Hayes, V.25 bis, Dumb modes

When RTS Disconnect is enabled, if RTS is off for a selected period of time (20 to 140 seconds, user-selectable), the line will be disconnected. Use pushbuttons 1 and 3 to set the RTS-OFF period required for a disconnect.

3.12 Test Options

The test options affect certain tests (as explained below) but do not activate tests.

DSR During Analog Loopback

All modes

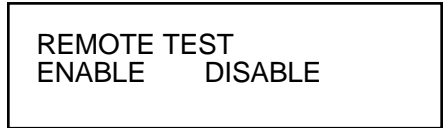
When ON is selected, the Data Set Ready signal is forced on when the modem is in the analog loopback test mode. In general, this option should be left ON (the default selection).

Remote Test

All modes

The Remote Test option allows you to prevent remote digital loopback or remote digital loopback self tests from being initiated on the local modem from a remote modem. If DISABLE is selected from the REMOTE TEST screen, the local will ignore test-initiation signals from a remote modem. If ENABLE is selected, tests can be initiated from a remote modem.

Note that there are two REMOTE TEST screens. One is for the option just described; the other is used for selecting remote digital loopback tests. The Remote Test option screen (for preventing or allowing remote testing) looks like this:

**3.13 EIA Options**

The seven options described next allow control over specific EIA interface signals.

CTS to EIA

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

Regardless of the setting selected for this option, Clear to Send (CTS) goes low. When DCD goes high during a V.42 error correction handshake or when DCE-DTE flow control is set to CTS on/off and a connection has been established with error correction or buffer mode enabled.

NORMAL. The Clear to Send signal is on while the modem is on-line.

RTS. The CTS signal immediately follows the RTS signal with no delay.

TRUE. The CTS signal follows DTR.

CTS can also be set to be ON at all times regardless of DTR by using the Summary Setup feature. (However, if CTS on/off has been selected from DCE-DTE screen 1, V.42 flow control, while active, will override the CTS ON selection.)

To set CTS ON, refer to **Appendix B, Fig. B-4**, EIA INTERFACE OPTIONS diagram. Note that if you set CTS to ON using Summary Setup and then make a selection from the CTS to EIA screen, the selection from the CTS to EIA screen will cancel the Summary Setup (CTS ON) selection.

NOTE

The modem also supports a CTS option intended only for V.33 and Bell 208A/B operation, which is described later in this chapter under V.33 and Bell 208A/B Options.

CD to EIA

All modes

NORMAL. Carrier Detect (CD) is on while the modem is on-line.

TRUE. CD follows DTR supplied from the DTE.

TOGGLE. CD turns on whenever DTR is present and then toggles off for 500 ms upon DTR disconnect, allowing the attached DTE to recognize that the call has ended and the connection has been dropped.

DSR to EIA

All modes

NORMAL. Data Set Ready (DSR) is on while the modem is on-line.

TRUE. DSR follows DTR supplied from the DTE.

CROSSOVER (XOVER). DSR is ON without DTR and toggles for 500 ms upon local or remote disconnect.

DTR from EIA

All modes

This option allows the user to force the Data Terminal Ready (DTR) signal on (TRUE), which may be needed if your computer or communication software does not supply a DTR signal.

NORMAL. DTR is supplied by the DTE. When DTR goes low, the modem sends a space disconnect (if TX Space Disconnect is enabled) and goes on-hook.

TRUE. The DTR signal is internally forced ON regardless of the DTR status at the interface.

DTE Control of ALB (ALB-DTE Ctrl'ed)

All modes

Analog loopback (ALB) testing can be initiated from the DTE via pin 18. Positive voltage activates the test, whereas negative voltage results in normal operation. Disabling this option keeps the modem from responding to pin 18.

DTE Control of RDL (RDL-DTE Ctrl'ed)

All modes

Remote digital loopback (RDL) testing can be initiated from the DTE via pin 21. Positive voltage activates the test, whereas negative

voltage results in normal operation. Disabling this option keeps the modem from responding to pin 21.

Test Mode (TM to EIA)

All modes

This option controls pin 25, the test mode (TM) indicator, on the RS-232 interface connector. **NORMAL.** TM output is high (active) only during test modes. **TRUE.** TM output is high all of the time.

3.14 Modem Setups

The options listed below, through RTS-CTS Delay, are available via the MODEM SETUPS screens.

Carrier Detect

All modes

This option selects the carrier detect level. To make a selection, first select either LEASED or DIAL from the CARRIER DET. LVL screen, depending on your application. The appropriate carrier detect level screen will then be displayed.

Leased-Line Applications

For leased-line use, the carrier detect level can be set for -43, -33 or -26 dBm. The default setting is -26 dBm.

Dialup Applications

For dial line use, the carrier detect level can be set for -51, -41 or -34 dBm. The default setting is -51 dBm.

Transmit Level

All modes

This option controls the modem's transmission level. To make a selection, first select either LEASED or DIAL from the TRANSMIT LEVEL screen.

Leased Line Applications

For leased lines, the transmission level can be set between 0 and -15 dBm, in 1-dBm steps. The standard setting is 0 dBm. (Use pushbuttons 1 and 3 to select the desired transmission level.)

Dialup Applications

The transmission level for dial lines can be set as either programmable, if you are using RJ-45S connectors, or permissive, fixed at -10 dBm +/-1 dBm, which is the most common setting.

Signal Quality

All modes

This option sets the threshold for the ER (error) indication during normal operation. You can choose either 10^3 , one error in 1000 bits, or 10^5 , one error in 100,000 bits. The settings of the Signal Quality and Carrier Detect Level options determine the threshold values the modem uses as criteria for entering Leased Line Auto-Recovery mode.

Compromise Equalizers

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

NOTE

The compromise equalizers only affect V.32 operation (4800 bps to 14.4 Kbps, asynchronous/synchronous, full duplex).

For most applications, the automatic adaptive equalizer setting will provide all the equalization necessary to compensate for line impairments, meaning that equalizer adjustments generally will not be necessary. However, in the event that equalizer adjustment is needed, any of four types of compromise equalization can be selected: Type I (T-I on the LCD), Type II (T-II), Type III (T-III) and Type IV (T-IV). The equalizer can also be turned OFF.

Where line conditions are atypical, it may be necessary to adjust the equalizers to optimize the signal quality. If adjustment is necessary, refer to the quality screen for guidance; this screen shows a relative indication of the signal quality, in both numeric and graphic form.

Trellis Code

Hayes, V.25 bis, Dumb, Leased line modes (except V.33)

Trellis coding provides performance advantages for all modulation patterns. The modem's CCITT compliant trellis coder is normally enabled at speeds of 7200 bps and above, but may be negotiated off by a modem that is not equipped with a trellis coder at 9600 bps. The trellis code option allows the user to enable or disable the trellis coder.

Transmitter Clocking

All modes

This option selects one of three possible sources for the transmitter timing signal:

INTERNAL. The timing of the modem and data terminal transmitting circuits is provided by an internal clock within the modem.

RECEIVED (RX-CLK). The timing of the data received from the remote modem is used to control the timing of the transmitted data. This timing mode is used if the modem's transmit timing must be controlled by a remote source.

EXTERNAL. The timing of the modem and data-terminal transmitting circuits is synchronized to an external clock from within the data terminal and is provided to the modem via the DTE connector pin 24. This mode of clocking is used if the DTE must be in control of the modem's transmit timing. The modem's minimum and maximum speed must be set to approximately the same speed as the DTE clock. (To set the maximum speed, use the Speed Limit option.)

T1 Timer

Hayes, V.25 bis, Dumb modes

The T1 Timer option is only effective if the Summary Setup Multimode Handshake option is set to 0 (T1 timer).

The T1 Timer option determines how long the ALX modem will attempt to handshake with a calling V.32 modem before falling back to a lower speed. The available T1 Timer settings are 0, 0.3, 0.8, 1.6 and 3.0 seconds.

Normally, as part of the V.32 handshake, the calling modem begins sending a sequence to the answer modem while the answer modem is still sending answer tone—in this case, there is no T1 timer. However, the V.32 Recommendation allows for a T1 time of up to 3 seconds, meaning that the answer modem may be set to wait (before falling back) for up to 3 seconds.

Auto-Retrain

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

If the modem makes a connection at one of the V.32 rates (4800 bps to 14.4 Kbps) or V.22 bis rate (2400 bps), it can request that the remote modem send a retrain sequence.

ENABLE. The modem will request a retrain sequence.

DISABLE. The modem will not request a retrain sequence.

Answer/Originate Default

Leased line modes (and manual originate/answer dial operation)

This option sets the modem to default to either answer or originate status when it makes a connection at one of the V.32 rates (4800 to 14.4 Kbps). It also applies to the V.22 bis rate (2400 bps), for dial operation only.

ANSWER. The modem is set to answer mode.

ORIGINATE. The modem is set to originate mode.

Answer Tone

Hayes, V.25 bis, Dumb modes

The answer tone frequency is selectable only if the maximum data rate has been set to 1200 bps (via the SPEED LIMIT menu), in which case the answer tone can be set to either 2225 or 2100 Hz. Otherwise, the answer tone frequency will be 2100 Hz (the standard for V.32 operation). In general, this setting should not be changed (even for fallback with Bell standard modems, which use a 2225 Hz answer tone).

Front-Panel Control

All modes

For security purposes, this option may be used to make it difficult for unauthorized users to modify the modem's configuration. If Front-Panel Control is disabled, the modem will not respond to Quick Setup selections or to changes made through option screens accessed via the SETUP menus. In addition, Hayes configuration commands (and the &W and &Z Hayes commands) will have no effect, and stored user profiles (for Hayes mode) cannot be altered. Note that even if Front-Panel

Control is disabled, front-panel screens that do not affect the modem configuration (such as AUTO-DIAL and test modes) will function.

Speaker

Two speaker options are available: Speaker Control and Speaker Volume.

Speaker Control

All modes

ON. Speaker is on during the full modem handshake process and while the unit remains on-line.

OFF. The speaker is off; the call cannot be audibly monitored.

ON TILL CD. Speaker remains on until a carrier signal (CD) is detected.

Speaker Volume

All modes

The speaker volume can be set to LOW, MEDIUM, or HIGH.

Guard Tones

Hayes, V.25 bis, Dumb modes Guard tones are used—in V.22 and V.22 bis modes only—to assure proper band separation on systems that use international telephone circuits. Unless you will be using international circuits in one of

these modes, you should turn the guard-tone option OFF. If guard tones are required, their frequency can be set to 550 Hz or 1800 Hz (the most commonly used guard-tone frequency).

V.13 Operation

V.25 bis, Dumb, Leased-line modes (synchronous operation only)

OFF. V.13 operation is off. This setting allows normal full-duplex operation. (All other selections are for enabling V.13 operation.)

TX ONLY. Status of RTS will be sent to remote modem.

RX ONLY. Carrier Detect (CD) will be controlled by V.13 signals from the remote modem.

TX AND RX. Status of RTS will be sent to remote modem, and CD will be controlled by V.13 signals from the remote modem. To select one of the four V.13 options, press pushbutton 1 or 3—with the V13 screen displayed—until the selection you want is displayed. For half-duplex point-to-point applications, select TX AND RX. For multidrop-type applications, select RX ONLY for all modems at the host site and TX ONLY for all modems at the remote site.

NOTE

If V.13 operation is enabled (TX ONLY, RX ONLY or TX AND RX), the data format is automatically changed to synchronous. However, if you enable V.13 operation and later disable it, the data format does not automatically revert to asynchronous. To restore the asynchronous data format, you must use the Data Format option.

3.15 V.33 and Bell 208A/B Options

The following three options are available on the modem and are intended only for V.33 or Bell 208A/B operation. (For Bell 208 operation, see also Satellite Delay, Turnaround Delay, 208 Phase Detection, Answer Tone Detection and V.32/208 Auto-Detect Mode later in this chapter.)

Carrier Type

V.33, 208, V.32/208 modes

SWITCHED (SWITCH). For 2-wire applications, the carrier type option must be set for switched carrier operation.

CONSTANT. Constant, or continuous carrier can be used only for 4-wire leased line applications (although such applications may also use switched carrier).

CTS

V.33 mode

This option applies only to V.33 leased-line applications that use constant carrier.

RTS. The CTS signal follows RTS.

ON. CTS is always ON.

NOTE

The modem also supports a CTS to EIA option, which is described in Section 3.11.

RTS-CTS Delay (CTS Delay)

V.33, 208, V.32/208 modes

The available RTS-to-CTS delay settings are 0, 15, 50, or 150 ms. However, the only available choices for 208A/B operation are 50 and 150 ms. If you select 0 or 15 ms, the actual delay in 208A/B mode will be 50 ms.

NOTE

RTS-to-CTS delay is not effective if the CTS option is set to ON (always ON). For V.33 operation, RTS-to-CTS delay is only effective for 4-wire leased line applications that use constant carrier.

RTS-CTS Delay with V.13 Operation

If the V.13 Operation option is set to TX ONLY or TX AND RX, the actual RTS/CTS delay time may differ from the selected RTS/CTS Delay setting. The actual RTS/CTS delay depends on the data rate, as shown in **Table 3-2**.

Table 3-2. RTS/CTS Delay with V.13 Operation.

Data Rate bps	Delay Setting, ms			
	0	15	50	150
	Actual Delay, ms			
14,400	9	15	50	106
12,000	9	15	50	106
9600	8	15	50	106
7200	6	15	50	106
4800	10	15	50	106
2400	16	16	50	150
1200	29	29	50	150
600	65	65	65	150

LCD Intensity

All modes

This option allows you to use pushbutton 3 (for INC or increase) to darken characters on the LCD or pushbutton 1 (for DEC or decrease) to lighten them.

3.16 Options Accessible Only via Summary Setup

The options described in this section can only be changed through the modem's Summary Setup feature, which is explained in **Appendix B**. For most applications, it is not necessary to change these options—they are intended primarily for specialized applications. For an explanation of how to change these options, available option settings and the default setting for each option, see **Appendix B**.

Three additional options accessible only via Summary Setup include Operating Mode Fallback, Rate Renegotiation Procedure, and Speed Fallback.

3.16.1 DIAL LINE OPTIONS

(The numbers used to select different settings for each option on the Summary Setup LCD screen are arranged according to option groups—dial line options, V.42 error-correction options, etc. For details, see **Appendix B**.)

Wait for Carrier

V.25 bis, Dumb modes

The time the modem will wait for a carrier signal when originating a call can be set for 30, 45, 60, or 75 seconds. (Note: In Hayes mode, the wait-for-carrier time is determined by the value in register S7.)

3.16.2 V.42 ERROR-CORRECTION OPTIONS*Selective Retransmission*

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

This option allows the modem to communicate with certain modems that are not able to respond to the MNP selective retransmission command.

ENABLE. This setting allows the modem to request retransmission of a single information frame (in the event of a transmission error).

DISABLE. Data can be retransmitted only in a series of information frames.

DCE Pass-through Flow Control

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

This option affects DCE-DTE flow control only. It is effective only if error correction or buffer-mode/speed conversion is enabled.

ENABLE. The modem will pass flow-control characters received from the remote modem to the local DTE.

DISABLE. The modem will not pass flow control characters from the remote modem to the local DTE.

Link Flow Control

Hayes, V.25 bis, Dumb, Leased line modes (except V.33)

This option is effective only if buffer-mode/speed conversion is enabled and a buffer link without error correction is established. Do not enable Link Flow Control if binary data will be transmitted or received.

ENABLE. The modem will check for X-ON/X-OFF (DC1/DC3) flow-control characters received from the remote modem to determine whether to stop or start/restart data transmission to the remote modem. A DC3 control character will cause the modem to stop data transmission and hold data in its buffer until it receives a DC1

control character (which instructs the modem to resume transmission).

If Link Flow Control is enabled with DTE-DCE flow control set to RTS on/off and DCE-DTE flow control set to CTS on/off on both the originating and answering modems, and both modems establish a buffer-mode connection, the modems will exchange flow control signals across the link in the form of DC1 and DC3 characters. If the data being exchanged contains a DC3 character (e.g., binary or executable files), this will signal the remote modem to halt and buffer all data from the remote DTE until the local DTE sends a DC1 character.

DISABLE. The modem will ignore XON/XOFF (DC1/DC3) flow-control characters received from the remote modem.

SLAVED. Link flow control is controlled by the DCE-DTE Flow Control option. If DCE-DTE Flow Control is set to NONE or CTS, Link Flow Control is disabled. Otherwise it is enabled.

3.16.3 DATA PUMP OPTIONS

Phase Reversal in Answer Tone

All modes

When enabled, the Phase Reversal in Answer Tone option signals the telephone network to turn off its echo cancelers. For virtually all applications, phase reversal should be enabled (the default setting).

Satellite Delay

208, V.32/208 modes

This option facilitates transmission over satellite links (but does not permit fast-turn-around operation). When the Satellite Delay option is on, RTS is inhibited for 275 ms after the answer tone stops and after the DSR signal comes on. This delay occurs at both the originating and answering modems, allowing the echo suppressors on the telephone link to be enabled.

Turnaround Delay

208, V.32/208 modes

This option is intended for circuits where echo is a problem. It prevents the modem from receiving an echo of its own transmitted data. When the Turnaround Delay option is on, CD (pin 8) is held low for 150 ms after RTS is turned off. If the modem detects an energy loss during the delay, it turns CD on 52 ms after detecting the loss. If

the modem does not detect an energy loss, it turns CD on 52 ms after the end of the delay. The modem ignores any energy loss during the first 8.5 ms.

V.32 Mode

Hayes, V.25 bis, Dumb, Leased-line modes (except V.33)

This option is used to select CCITT V.32 bis operation or V.32 extended operation.

V.32bis. When V.32bis mode is selected (factory-default setting), the following are available: Rate Renegotiation Procedure (RRP), a data rate of 7200 bps, and a RATE screen that allows the user to manually initiate RRP.

RRP enables the modem to automatically fall back or fall forward to a lower or higher data rate during data transmission in response to changes in signal quality. Selecting V.32 bis mode makes RRP available as an option; however, RRP will not function unless it is enabled. (Enabled is the factory-default setting.) RRP is described fully in **Section 4.3.2**.

When V.32 bis mode is selected, a RATE screen is available from MAIN MENU screen 3. The RATE screen can be used to manually initiate RRP for diagnostic purposes. For additional information, see RATE CHANGE SCREEN in **Section 8.7**.

When V.32bis mode is selected, 7200 bps can be selected as the maximum or minimum data rate (using the Speed Limit option). When V.32bis is not selected, 7200-bps operation is not available.

NOTE

By definition, V.32 bis operation includes the ability to operate at 12,000 and 14,400 bps. However, RRP, the 7200-bps data rate, and the RATE screen are available on the modem when V.32 bis is selected.

V.32 EXTENDED. V.32 extended mode disables the V.32 bis features. In V.32 extended mode, the modem's functionality is identical to that of modems prior to incorporation of the CCITT V.32 bis recommendation.

208 Phase Detection

208, v.32/208 modes

NORMAL. Conditions the modem's 208 receiver for compensated modulation detection for improved performance with older 208 modems.

V.22 bis S1 Duration

Hayes, V.25 bis, Dumb modes

This option affects the duration of the S1 signal during a V.22 bis handshake. To allow the modem to connect properly with certain

manufacturers' V.22 bis modems that do not conform fully with the V.22 bis standard, the modem's S1 signal duration may have to be changed from the default setting, 100 ms, to 150 ms. The CCITT V.22 bis specification specifies an S1 duration of 100 ms.

V.32/208 Auto-Detect Mode

208, V.32/208 modes

To enable V.32/208 auto-detect mode, the V.32/208 auto-detect Summary Setup option must be set to 1 for enable and the front panel Speed Type option must be set to AUTO. (If you select the V.32/208 auto-detect Quick Setup, the modem automatically sets both of these options to enable V.32/208 auto-detect mode.)

When V.32/208 auto-detect mode is enabled, the modem automatically selects V.32 or Bell 208 mode, depending on the mode of the originating modem.

3.16.4 MISCELLANEOUS OPTIONS

V.25bis DTR Dialing

V.25 bis mode

This option enables or disables DTR dialing for V.25 bis mode only. If this option is enabled, DTR dialing will function in V.25 bis mode—depending on which of these modes (i.e., which autodialer) is enabled.

ENABLE. Enables DTR dialing for V.25 bis mode.

DISABLE. Disables DTR dialing for V.25 bis mode.

Analog Loopback Make Busy

All modes

If the Analog Loopback Make Busy option is enabled, the modem will provide a busy indication to the dial-line interface when the modem is in analog loopback test mode.

Answer Tone Detection

208, V.32/208 modes

ENABLE. Conditions the originating modem's receiver to wait for answer tone detection before going on-line.

DISABLE. Conditions the originating modem to go on-line without requiring answer tone detection. This setting accommodates operation with automatic calling units that connect the modem to the line at the end of answer tone.

Multimode Handshake

Hayes, V.25 bis, Dumb modes

This option determines how long the modem will attempt to handshake with a V.32 modem before falling back to a lower speed.

T1 TIMER. If the T1 timer setting is selected, the modem will attempt to handshake with a calling V.32 modem for the time specified by the T1 Timer option.

V.32 bis ANNEX A. If the V.32 bis Annex A setting is selected, the modem will handshake according to the conventions established in Annex A of the CCITT V.32 bis recommendation. Handshaking using the Annex A selection will generally be faster than handshaking based on the T1 timer.

Remote RTS Signaling

Leased line modes (except V.33)

This option provides remote RTS signaling in asynchronous mode. When the Remote RTS Signaling option is on, the state of the Ready to Send (RTS) signal is transferred across the modem link (for diagnostic purposes) without affecting normal operation. The Remote RTS Signaling option allows control over the remote Carrier Detect (CD) signal as described below.

Note the following restrictions for Remote RTS Signaling: The two modems must be connected at a data rate of 7200 bps or higher. The V.13 Operation option must be off. The DTE-DCE and DCE-DTE Flow Control options should not be set to RTS on/off.

ON. The state of RTS input (EIA pin 4) will be signaled to the remote modem's CD output, and CD (pin 8) on the local modem will follow the state of the remote modem's RTS input. (The typical propagation delay is less than 800 ms.)

OFF. This setting allows for normal operation: The state of RTS at the local modem will not be signaled to the remote modem.

Leased Line Interrupt

Leased-line modes (except V.33)

The Leased Line Interrupt option controls a modem designated as the answer modem and configured for Leased Line Auto-Recovery (**Section 4.9**) as stated below.

ON. The answer modem will answer incoming calls, regardless of the state of the leased line (CD ON or OFF).

OFF. This setting allows for normal operation: If Carrier Detect (CD) is ON, this means the leased line is trained and working, and the answer modem will ignore any incoming calls on the dial line.

Wait for MNP Link Request

Hayes, V.25 bis (Async only),
Dumb, Leased-line modes
(except V.33)

When a remote originating modem attempts to establish an MNP connection with a modem, the answer modem will wait up to 3 seconds, by default, to receive the MNP link request. This option allows the user to configure the modem to wait longer (7 seconds) for an MNP link request. The longer wait time allows the modem to establish MNP connections under conditions that require multiple link requests.

CFI AB Response on Disconnect

V.25 bis

In V.25bis mode, the originate modem sends a CFI AB result code when a call is aborted because the user has selected HANGUP from the front panel or because of DTR loss. If the CFI AB Response on Disconnect option is enabled, the originate modem will also send a CFI AB result code upon call disconnect.

Low-Profile DIAG LED Function

All modes

This option may be used to change the function of the DIAG LED on low-profile modems (**Appendix D**), as explained below.

CONNECT STATUS. DIAG LED on indicates the modem's diagnostic port is actively connected. DIAG LED off indicates the diagnostic port is not connected.

DTR STATUS. DIAG LED on indicates DTR is high. DIAG LED off indicates DTR is low.

2.1.2 CONNECTIONS

Fig. 2-1 shows how the modem is connected to the computer or terminal, power, phone lines, and handset (optional). **Do not install the modem more than 50 feet (15.2 m) from the DTE.** This is the EIA recommended maximum length for interface cable.

For all applications—

- Connect the modem connector marked “DTE” to the computer or other DTE. Use an EIA RS-232 interface cable (not supplied with the modem) to make this connection.
- Attach the power transformer cable (supplied with the modem) to the modem receptacle marked “POWER,” and plug the other end into a 115-VAC power outlet.

For dialup applications—

- Connect the modem to the telephone line modular wall jack, as follows: Use the cable (supplied) that has an eight-pin modular connector on one end and a six-pin modular connector on the other. Plug the eight-pin connector end of the cable into the modem jack labeled “TX DIAL.” Then plug the six-pin connector end into the telephone line modular wall jack. Do not bundle the telephone and EIA interface cables together.

- Optional: If you want to use the telephone line for voice transmissions (when the modem is not operating in data mode) or for manual dial operation, plug a standard telephone set into the jack in the rear of the modem labeled “PHONE.”

For leased line applications—

- Attach the six-pin modular connector end of the four-conductor cable (supplied) to the modem connector labeled “LEASED LINE.” Attach the spade-lug end of the cable into the line terminal block.

The same cable is used whether the leased line is a 4-wire or 2-wire line. In a 4-wire application, the green and red wires are the TRANSMIT pair of wires, and the yellow and black wires are the RECEIVE pair. When the cable is connected to a 2-wire line, only its green and red wires are used (and the yellow and black wires should be cut off).

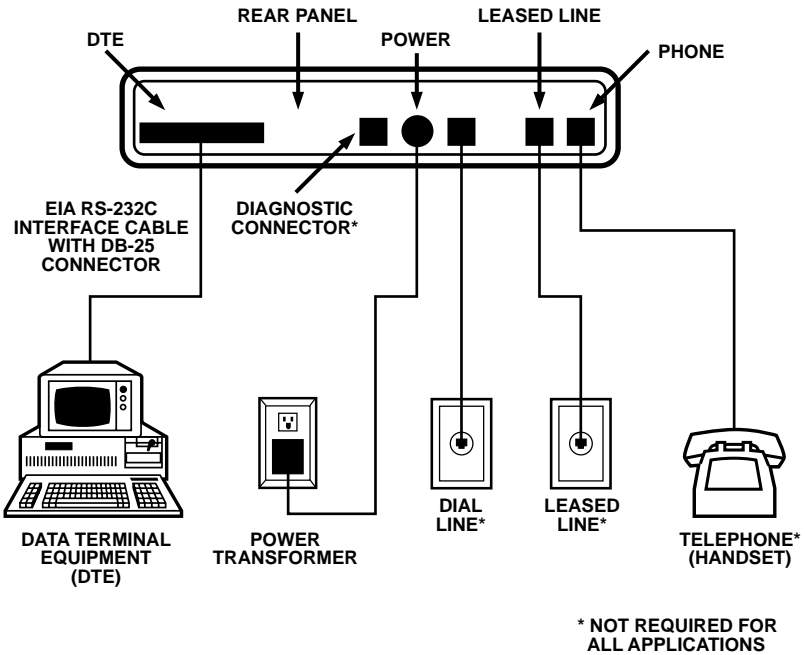


Fig. 2-1. Installation of the Modem.

2.1.3 JUMPERS

For most applications, you don't need to reset internal jumper switches. However, jumper switches must be reset if you need to connect frame ground to signal ground, switch from A/A1 control to MI/MIC control, or use the modem in a DC rack enclosure. For detailed jumper information, see **Appendix C**.

2.2 Front-Panel LCD and Controls

To select a Quick Setup configuration (as explained in the next section), you will need to use the pushbuttons and liquid crystal display (LCD) on the modem's front panel. These features are shown in **Fig. 2-2**.

V.32 bis/19.2M
Version 3.02

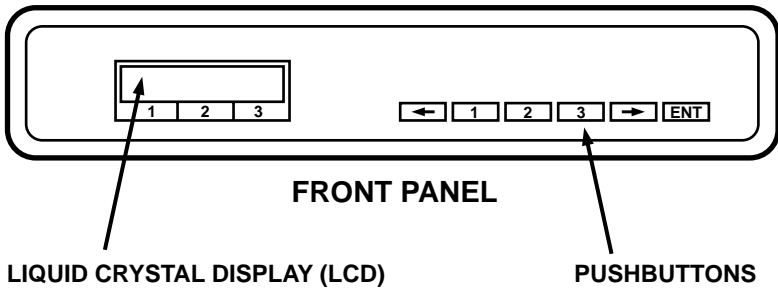


Fig. 2-2. Pushbuttons and LCD on the Modem's Front Panel.

For a detailed explanation of the front-panel controls, see **Chapter 3**.

2.2.1 POWER-ON SCREEN

When the modem is powered on, the unit momentarily displays the power-on screen, which typically looks like this:

```
V.32 bis/19.2M
Version 3.02
```

The numbers displayed in the lower right corner are the revision levels of the software used in the modem. The software revision levels displayed by your unit may be different than those shown above. If you need to call Technical Support, please be prepared to give the support group the software revision levels of your unit.

The modem spends about two seconds checking the ROM checksum and doing self-tests and then displays the EIA status screen.

2.2.2 EIA STATUS SCREEN

The EIA status screen indicates the operational status of the modem as well as the condition of certain EIA RS-232 leads. The abbreviations that may appear are identified below; however, typically only a few of these abbreviations will be displayed during actual operation.

```
D   TR  MR  RS  CD  TD
9600   TM  ER  CD  RD
```

D=Dial line occupied

R=Ringing (R appears in same position as D.)

S=Connection secured by security handshake (S appears in the same position as D. S and D may flash alternately.)

TR=Data Terminal Ready

MR=Data Set Ready

RS=Request to Send

CS=Clear to Send

TD=Transmit Data

14,400, 9600, 4800, etc.=Data speed in bits per second (“idle” or H-01, H-14, etc. may also be displayed in the data speed position; see below.)

TM=Test mode

ER=Error (poor signal quality)

CD=Carrier Detect

RD=Receive Data

Codes beginning with “H” (such as H-01) in the lower left corner of the status screen indicate that the modem is handshaking with another modem (attempting to establish a connection). When the modem is off-line, the word “idle” is displayed in the same position.

2.3 Quick Setup

To quickly set up the modem for immediate use (or to quickly change the modem’s configuration for an alternate mode of operation), select one of the factory-preset Quick Setup configurations. Select the Quick Setup (**Table 1-1**) that corresponds to the application you will use.

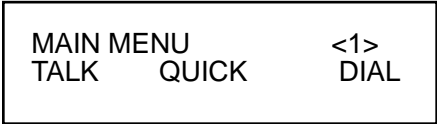
When you select a Quick Setup, the modem automatically sets all of its options to the settings that are typically most suitable for your application. Selecting a Quick Setup overwrites previously stored option settings but does not affect telephone numbers which may be stored in the modem’s memory.

Whether you use a Quick Setup configuration “as is” or customize it by changing specific option settings (**Chapter 3**), you should begin by selecting the Quick Setup that corresponds to your application.

2.3.1 HOW TO SELECT A QUICK SETUP

To select (activate) a Quick Setup configuration, follow the steps below. As you do, you may find it helpful to refer to the LCD flow chart that is shipped with the modem.

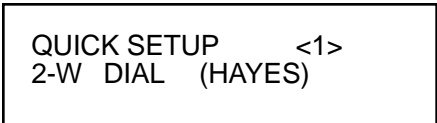
1. Press the ENT (enter) pushbutton on the modem’s front panel. Screen 1 of the MAIN MENU will be displayed:



You will only need to press the ENT button once if the modem has just been powered up. Otherwise, you may have to press the ENT button two or more times until screen 1 of the MAIN MENU is displayed.

[There are two ways to access the QUICK SETUP menu: QUICK may be selected from the MAIN MENU, as described above, or from screen 1 of the SETUP menu. See MAIN MENU screen 1 and SETUP menu screen 1 on the LCD flow chart.]

2. Press pushbutton 2. Screen 1 of the QUICK SETUP menu will be displayed:



3. Move to the QUICK SETUP screen that shows the configuration you want. Use the right arrow button to move from QUICK SETUP screen 1 to the QUICK SETUP screen for the configuration you want. You may also use the left arrow button to move “backward” through the QUICK SETUP menu.

There are 15 QUICK SETUP screens, one for each Quick Setup configuration. For a brief description of each Quick Setup configuration, see **Table 2-1**.

4. When the LCD shows the Quick Setup configuration you want, press pushbutton 2. This will cause the bottom line of the display to flash on and off.

5. Press the ENT button twice. As you do this, you will see SETUP screen 1; then—after you press the ENT button a second time—the modem will reset. (It is at this point that the selected Quick Setup actually takes effect.)

The modem is now set up for the Quick Setup configuration you have selected. All options will be set as shown in **Appendix A**. If you want to customize the Quick Setup configuration by changing individual options, see **Chapter 3**. For Hayes mode options, see also **Chapter 5**.

Table 2-1. Available Quick Setup Configurations.

Quick Setup as Identified on LCD	Description
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> QUICK SETUP <1> 2-W DIAL (HAYES) </div>	<p>2-Wire Dial Hayes Emulation Mode— This Quick Setup (for communication over ordinary phone lines) allows the modem to automatically dial (autodial) a previously stored phone number and respond to Hayes commands. This mode is compatible with communication software packages that use Hayes™ style “AT” commands. The Hayes mode Quick Setup is the factory-default configuration for the modem.</p>
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> QUICK SETUP <2> V25 DIAL (Async) </div>	<p>2-Wire Dial V.25 bis Mode, Asynchronous—In V.25 bis mode, the modem operates in conformance with CCITT recommendation V.25 bis, allowing you to store and direct dial or autodial phone numbers from the DTE. Use Quick Setup 2 if the DTE connected to the modem is asynchronous.</p>
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> QUICK SETUP <3> V25 DIAL (Syn_c) </div>	<p>2-Wire Dial V.25 bis Mode, Synchronous, Character-Oriented—Same as Quick Setup 2 except for data protocol. Use Quick Setup 3 if the DTE is synchronous, character-oriented.</p>

Table 2-1. Available Quick Setup Configurations (continued).

Quick Setup as Identified on LCD	Description
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> QUICK SETUP <4> V25 DIAL (Syn-b) </div>	2-Wire Dial V.25 bis Mode, Synchronous, Bit-Oriented—Same as Quick Setup 2 except for data protocol. Use Quick Setup 4 if the DTE is synchronous, bit-oriented.
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> QUICK SETUP <5> 2-W DIAL (DUMB) </div>	2-Wire Dial Dumb Mode—When the modem is in Dumb mode, you can use the modem for dial answer-only applications, dial a previously stored telephone number from the front panel, or dial phone numbers via an external source (telephone).
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> QUICK SETUP <6> 2-W LEASED (ORG) </div>	2-Wire Leased Line Originate Mode—In Leased Line mode, the modem connects to the leased line and stands ready to send and receive data. Use Quick Setup 6 if the leased line is a 2-wire line and you want to configure the modem as the originate modem.
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> QUICK SETUP <7> 2-W LEASED (ANS) </div>	2-Wire Leased Line Answer Mode—Same as Quick Setup 6 except for modem answer/originate status. Use Quick Setup 7 if the leased line is a 2-wire line and you want to configure the modem as the answer modem.

Table 2-1. Available Quick Setup Configurations (continued).

Quick Setup as Identified on LCD	Description
<p>QUICK SETUP <8> 4-W LEASED (ORG)</p>	<p>4-Wire Leased Line Originate Mode— Same as Quick Setup 6 except for line type. Use Quick Setup 8 if the leased line is a 4-wire line and you want to configure the modem as the originate modem.</p>
<p>QUICK SETUP <9> 4-W LEASED (ANS)</p>	<p>4-Wire Leased Line Answer Mode— Same as Quick Setup 6 except for line type and modem answer/originate status. Use Quick Setup 9 if the leased line is a 4-wire line and you want to configure the modem as the answer modem.</p>
<p>QUICK SETUP <10> 4-WLL V.33</p>	<p>V.33 Leased Line Operation—This Quick Setup configures the modem for V.33 operation.</p>
<p>QUICK SETUP <11> 2-W DIAL (208)</p>	<p>2-Wire Dial Bell 208 Operation— This Quick Setup configures the modem for 2-wire dial operation compatible with Bell standard 208B.</p>
<p>QUICK SETUP <12> 2-W DIAL V32/208</p>	<p>2-Wire Dial V.32/208 Auto-Detect Mode—This Quick Setup configures the modem to automatically select V.32 or Bell 208 operation, depending on the mode of the originating modem.</p>

Table 2-1. Available Quick Setup Configurations (continued).

Quick Setup as Identified on LCD	Description
<p>QUICK SETUP <13> 4-WLL V.29</p>	<p>4-Wire Leased Line V.29 Mode— This Quick Setup configures the modem for V.29 operation, for compatibility with V.29 modems.</p>
<p>QUICK SETUP <14> V.29 FAST MASTER</p>	<p>V.29 Fast Master Mode— This Quick Setup configures the modem for V.29 fast train <i>master</i> operation, for use in a multidrop network where multiple remote (slave) modems share the master modem as the host modem.</p>
<p>QUICK SETUP <15> V.29 FAST SLAVE</p>	<p>V.29 Fast Slave Mode— This Quick Setup configures the modem for V.29 fast train <i>slave</i> operation, for use in a multidrop network where multiple remote (slave) modems share the same host (master) modem.</p>

Table 2-2. Quick Setup Modes Supported.

Quick Setup	V.32/19.2M	
Hayes (01) V.25bis (02-04) Dumb (05) Leased (06-09)	Y	Y
V.33 (10)	N	Y
Bell 208 (11-12)	N	Y
V.29 (13-15)	N	Opt.
Y Yes; supported. N No; not supported. Opt. Optional;		

2.4 Basic Operation

To assist you in getting the modem up and running, the following sections provide basic information for each of the modem's primary operating modes. For additional operating information, refer to the remaining chapters in this manual.

If you encounter difficulty, refer to **Section 2.4** at the end of this chapter.

2.4.1 2-WIRE DIAL HAYES MODE (QUICK SETUP 1)

Two-wire dial Hayes emulation mode is the factory default configuration for the modem. Hayes mode operation is explained in detail in **Chapter 5**.

To dial a telephone number in Hayes mode, type the Hayes command **AT D** on your computer or terminal keyboard followed by the number you want to call. For example:

AT D 5551212 [CR]

Dashes or spaces may be included for clarity, but they are not necessary. (The modem will ignore them.) A carriage return [CR] or period is required at the end of each command line. (On most keyboards, the carriage-return [CR] key is labeled "Enter" or "Return.") In response to the command line shown above, the modem will dial the number 555-1212.

If you have to dial an access code such as 9 to dial out of your building, insert the access code and a comma in the dial string.

AT D 9,5551212 [CR]

The comma causes the modem to pause for 2 seconds. This allows the modem to detect a second dial tone (after the access code) before dialing the number.

The default dialing mode is pulse dialing. To change to tone dialing, insert a T after AT D: AT DT. To change from tone dialing to pulse dialing, insert a P: AT DP. The specified dialing mode will remain active until the alternate mode is specified or the modem is reset.

When a phone number is successfully dialed, a "CONNECT" message will appear on the computer screen, and the LCD on the modem will display a status screen that typically look like this:

D	TR	MR	RS	CS	TD
9600				CD	RD
TD and RD will be flashing (to					

indicate that the modem is transmitting and receiving data). (The speed may be other than 9600 bps; the modem will automatically adjust to the speed of the remote modem, provided the remote unit is a compatible modem.)

To terminate a call, first enter the escape sequence `+++`. When the OK response appears on the DTE screen, enter the command `AT H`. An alternate method is to drop the DTR signal from the DTE. If you are using a computer with a communication software program, follow the program's instructions for initiating and terminating calls.

2.4.2 2-WIRE DIAL V.25 BIS MODE (QUICK SETUP 2-4)

The modem supports three types of V.25 bis operation—asynchronous; synchronous, character-oriented; or synchronous, bit oriented. There is a Quick Setup for each V.25 bis type, as shown in **Table 2-1**. For V.25 bis operation, the modem must be configured to use the same data protocol (asynchronous; synchronous, character-oriented; or synchronous, bit-oriented) as the attached DTE. If you have selected the correct V.25 bis Quick Setup, the data protocol will be set automatically to the correct setting. V.25 bis mode operation and commands are explained in detail in **Chapter 6**.

Asynchronous V.25 bis Operation

In asynchronous applications, V.25bis commands (listed in **Chapter 6**) may be entered from the DTE keyboard. As an example, the simplest command sequence is **CRN 3331234**. In response to this command, the modem sends a VAL result code (indicating that the command has been accepted), dials the telephone number, 333-1234, and then waits for an answer tone from a remote modem. If no carrier is detected within a given time (45 seconds by default), the modem automatically releases the line and sends a CFI NT result code.

Spaces entered in the command line for readability are ignored; therefore, **CRN 555 1212** will have the same effect as **CRN5551212**.

The data format of the DTE should be set to 7 data bits with even parity and one stop bit. (Note that the default DTE interface rate is 38,400 bps in asynchronous mode.)

When a phone number is successfully dialed, the EIA status screen on the modem will typically look like this:

D	TR	MR	RS	CS
9600				CD

Synchronous V.25 bis Operation

In synchronous applications, the V.25 bis commands can be used to facilitate computer-controlled operations. Synchronous bit-oriented operation uses High-Level Data Link Control (HDLC) formatting. In synchronous character-oriented operation, messages are framed by synchronous start-of-text and end-of-text characters, with the start-of-text character preceded by two synchronous (SY) characters.

2.4.3 2-WIRE DIAL DUMB MODE (QUICK SETUP 5)

Dumb mode is used primarily for manual call origination, and answer-only applications, and in conjunction with certain dial back security systems that use MI/MIC signals to place the modem on-line. (If you need to configure the modem for MI/MIC use, refer to **Appendix C**.) For additional information on Dumb mode, refer to **Chapter 4**.

Answering a Call Automatically

After the Quick Setup for 2-wire dial Dumb mode has been selected, the modem is configured to automatically answer incoming calls. The only other requirement is that the DTE must provide the DTR signal (TR on the EIA status screen) to the modem or DTR must be set to TRUE (using the modem's DTR from EIA option screen).

Originating a Call from the Front Panel

Before you can originate a call from the front panel, you must store the number to be dialed in the modem.

Storing a Number

From the EIA status screen, access the PHONE screen by pressing the following pushbuttons in sequence:

ENT
Right arrow
Pushbutton 1
Left arrow 2 times
Pushbutton 1

The abbreviations DEC, CTRL, and INC will be displayed on the bottom line of the LCD, indicating that you have located the PHONE screen.

Store the phone number as follows: Use the right and left arrow pushbuttons to go to the digit you want to change. The cursor will cause the character at that digit location to blink, indicating that the digit or character can be changed. Use pushbutton 1 to decrease numbers and pushbutton 3 to increase them. Use pushbutton 2 (CTRL) to sequence through the dialing control characters (which are explained in **Chapter 4**). Use the arrow pushbuttons to move on to the next digit or character to be changed. (The characters that can

be stored are listed in **Chapter 4.**) The phone number is saved when you return to the Main Menu. To return to the EIA status screen, press ENT three times.

Autodialing the Stored Number

To autodial the stored number from the EIA status screen, press the following pushbuttons in sequence:

- ENT
- Pushbutton 3 (to select DIAL from MAIN MENU screen 1)
- Pushbutton 1 (to select DIAL from the AUTO-DIAL screen)

When the local modem has successfully established a connection with the remote unit, the EIA status screen should be present. Typically this screen will look like this:

D	TR	MR	RS	CS	TD
9600				CD	RD

If the modem's LCD displays an AUTO-DIAL FAILURE message, refer to the explanations listed below.

Table 2-3. Failure Message and Explanations.

Failure Message	Explanation
LINE OCCUPIED	The data line is already in use.
DIAL NOT ALLOWED	Modem is not configured for dial backup.
NO DTR	DTR is not present.
NO LINE CURR	Line current has been lost.

Terminating a Data Call

Normal termination of a data call is processed through communication software. An alternate method is to switch to the HANGUP option on the AUTO-DIAL screen. Another method is to drop the DTR signal from the DTE (by software control or by turning the DTE off).

For manual originate/answer operation, see **Chapter 4**.

2.5 Leased Line (2- or 4-Wire) Mode (Quick Setup 6–9)

This section does not apply to V.33 leased-line operation. For V.33 leased-line operation, see the next section.

The following information applies to both 2-wire and 4-wire leased line operation:

- The modem must be configured for the correct line type—2-wire or 4-wire. If you have selected the correct Leased Line Quick Setup, the line type will be set automatically to the correct setting.
- One modem must be set to originate mode and the other to answer mode. If you have selected the correct Leased Line Quick Setup, the answer/originate status will be set automatically to the correct setting.

- Leased line operation is restricted to data rates of 4800 bps or higher.
- Lines can be conditioned or unconditioned.

Four different leased-line Quick Setups are available (not counting V.33 leased line operation), as shown in **Table 2-1**. After you select the appropriate leased-line Quick Setup, the answer unit immediately generates an answer tone that signals the originate modem to begin the training sequence, meaning it is ready to “handshake” with the originate modem.

When the local modem has established a connection with the remote unit, the EIA status screen should be present. Typically this screen will look like this:

TR	MR	RS	CS	TD
9600			CD	RD

2.6 V.33 Leased Line Operation (Quick Setup 10)

V.33 operation is available on the modem and is restricted to speeds of 12,000 and 14,400 bps.

V.33 leased line operation provides compatibility with V.33 modems (synchronous operation only).

A 4-wire line must be used (conditioned or unconditioned), and both connected modems must be set for V.33 operation.

After the V.33 Leased Line Quick Setup has been selected, the modem immediately begins the training sequence, meaning it is ready to communicate with the other modem. The second modem to come online will automatically establish the data link (regardless of whether it is the local or remote unit).

When the local modem has successfully established a connection with the remote unit, the EIA status screen should be present. Typically the screen will look like this:

TR	MR	RS	CS	TD
14.4			CD	RD

Three options are intended for V.33 (and Bell 208A/B) operation exclusively. These options are listed in **Chapter 3** under the heading V.33 and Bell 208A/B Options.

2.7 2-Wire Dial Bell 208 Operation (Quick Setup 11–12)

The modem supports Bell 208 operation. To confirm this, select **SETUP** from **MAIN MENU** screen 2. Then select **QUICK** from **SETUP** screen 1. Press the right arrow pushbutton repeatedly to cycle through the Quick Setup screens. If you can access the two Quick Setup screens shown below, the unit supports Bell 208 operation.

QUICK SETUP 2-W DIAL (208)	<10>
QUICK SETUP 2-W DIAL V32/208	<11>

Fig. 2-3. Quick Setup.

2.8 Two Types of Bell 208 Operation

Two Bell 208 Quick Setups are available, as shown in **Table 2-1**. One configures the modem for Bell 208 operation, exclusively; the other configures the modem for V.32/208 auto-detect mode.

2.8.1 BELL 208 OPERATION (EXCLUSIVE)

The Quick Setup identified on the LCD as 2-W DIAL (208) configures the modem for 2-wire dial synchronous operation compatible with Bell standard 208B. The data rate is fixed at 4800 bps, and the data format is set to synchronous. Both connected modems must be set for 208B operation.

Beginning with the section titled “Answering a Call Automatically,” all information in **Section 2.4.3** also applies to Bell 208 operation.

2.8.2 V.32/208 AUTO-SELECT MODE

The Quick Setup identified on the LCD as 2-W DIAL V32/208 (shown above) configures the modem for V.32/208 auto-detect mode. This means the modem will automatically select V.32 or Bell 208 mode, depending on the mode of the originating modem. Note that the modem will not handshake in V.22 bis, Bell 212/103, or V.21/V.22/V.23 mode when it is configured for V.32/208 auto-detect mode.

2.9 4-Wire Leased Line V.29 Mode (Quick Setup 13)

The following information applies to 4-wire leased line V.29 operation:

- The modem must be configured for use with a 4-wire line. If you have selected the 4-Wire Leased Line V.29 Quick Setup, the line type will be set automatically to the correct setting.
- Operation is restricted to data rates of 4800, 7200, and 9600 bps.
- Lines can be conditioned or unconditioned.

After you select the 4-Wire Leased Line V.29 Quick Setup, the modem will send a training sequence and wait for a training response from the remote modem.

The modem will repeat the training sequence every 1.2 seconds until the remote modem responds.

When the local modem has established a connection with the remote unit, the TIA/EIA status screen will be present. Typically, this screen will look like this:

TR	MR	RS	CS	TD
9600			CD	RD

NOTE

For point-to-point 4-wire leased line V.29 operation, the Auto-Retrain option should be enabled on both modems. (Auto-Retrain is enabled by default if you select the 4-Wire Leased Line V.29 Quick Setup.) If the Auto-Retrain option is disabled, the modem will not transmit a training sequence and will instead train on the data stream from the remote modem. Disabling Auto-Retrain in 4-wire leased line V.29 mode is recommended for test purposes only. If Auto-Retrain is disabled, it should be disabled on both modems.

2.9.1 V.32 DIAL BACKUP

NOTE

Dial backup can only be used in point-to-point applications.

To prevent service interruption in case of poor leased line conditions, the modem can be configured for V.29 leased line operation with V.32 dial backup. This means that the modem will use dial lines to automatically restore operation when conditions on the leased lines deteriorate. (The modem will use V.32 modulation for dial backup.) To set up the modem for V.29 leased line operation with dial backup, follow these steps:

1. Select the 4-wire leased line V.29 (4-WLL V.29) Quick Setup on both the local and remote modem.
2. One modem must be set to originate mode and the other to answer mode. To make this selection, use the ANS/ORG DEFAULT screen on the front panel LCD.
3. Configure the modems for leased line auto-recovery, as explained in **Chapter 4**.

2.10 V.29 Fast Master and Slave Modes (Quick Setups 14–15)

NOTE

Modems used in a V.29 Fast Master and Slave (multidrop) configuration must be modems that support V.29 operation.

In multidrop operation (**Figure 2-4**), the master modem transmits to all of the slave (remote) modems. When the DTE at a slave site recognizes its own address in the polling protocol, it raises RTS to the slave transmitter. The slave responds by transmitting a special training sequence, then raising CTS and transmitting the data from the DTE. When the DTE has completed transmission, it lowers RTS and the modem will drop carrier to let the next modem on the poll list use the channel.

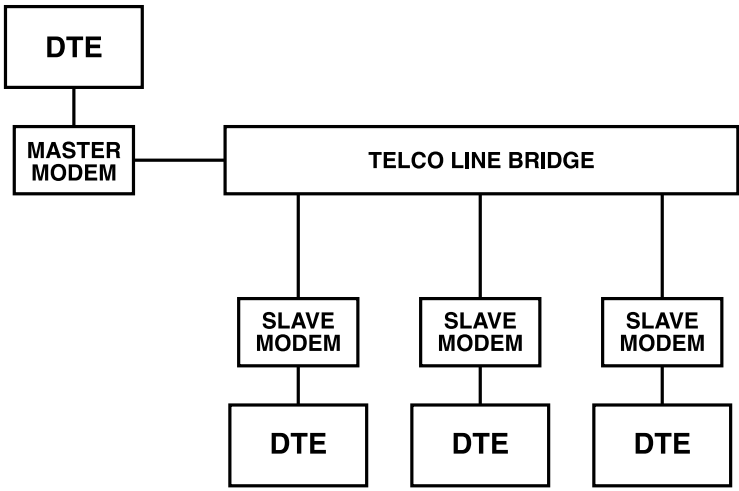


Fig. 2-4. A Typical Multidrop Configuration.

The V.29 Fast Master and Fast Slave modes support sync data rates of 4800, 7200, and 9600 bps and an async data rate of 9600 bps only. The leased lines can be conditioned or unconditioned. The master modem must be set to originate mode, and the slave modem must be set to answer mode. (The Answer/Originate option is automatically set to these settings when the V.29 Fast Master and Fast Slave Quick Setups are used.)

NOTE

If you're using V.29 master/slave async in an unmanned location, call Black Box Tech Support at 724-746-5500.

SLAVE-TO-MASTER (INBOUND) TRANSMISSION

When the remote modems come on-line, they automatically synchronize to the incoming carrier and train on the data stream from the master modem. Slave-to-master transmission is always switched carrier operation under control of the RTS signal from the DTE. An anti-streaming timer built into the modem will (if enabled) halt transmission if the DTE holds RTS on for more than 30 seconds. The assumption is that if RTS is held on for more than 30 seconds, there is a fault in the DTE.

NOTE

See page 176 (pump 3) to enable anti-streaming.

If you access the TIA/EIA status screen on the LCD display when a slave modem is transmitting to the master modem, the status screen will typically look like this:

TR	MR	RS	CS	TD
9600			CD	RD

Typically, TD, CD, and RD will flash on the master modem, and RS, CS, TD, and RD will flash on the slave modem.

2.11 If You Have Problems

If you encounter difficulties in setting up or using the modem, try the remedies described below. If you suspect a system malfunction, follow the diagnostic procedures described in **Chapter 7**. If you cannot resolve the problem, call Technical Support.

2.11.1 ALL MODES

Make sure all cables are properly connected to the back of the modem.

2.11.2 ALL DIAL MODES (HAYES, V.25 BIS, DUMB, BELL 208, AND V.32/208)

DTR (Data Terminal Ready) must be ON (received from DTE, or DTR from EIA option set to TRUE) if you want to use the modem's autodial or auto-answer features. (If DTR is ON, the TR indicator will be present on the EIA status screen.)

2.11.3 ALL ASYNCHRONOUS MODES

The modem's default DTE speed is 38,400 bps in asynchronous mode. If the local DTE does not support this speed, change the modem's DTE Speed option setting. In Hayes mode, the default DTE speed is automatically overridden when the modem is autobauded (when the Hayes mode "AT" attention code is sent to the modem).

2.11.4 HAYES MODE

In Hayes mode, with default settings in effect, the modem transmits result codes (messages) to the DTE. In some installations, this may cause undesirable interaction with the attached DTE. If such interaction occurs, result codes for incoming calls should be suppressed (using the command **AT Q2**).

2.11.5 ALL LEASED-LINE MODES (2-WIRE, 4-WIRE, V.33, AND V.29)

DTR (Data Terminal Ready) must be ON for the units to train on the leased line. (If DTR is ON, the TR indicator will be present on the EIA status screen.)

If the signal quality appears to be inadequate (see **Section 7.6.2**) or if the modems are frequently retraining, try changing the equalization option.

2.11.6 LEASED LINE (EXCLUDING V.33 AND V.29 OPERATION)

Make sure one modem has been set to originate mode and that the other has been set to answer mode. (If the correct Quick Setup has been selected, and not incorrectly modified, the answer/originate status should be correct.)

Table 1-1. Pin Assignments—EIA Interface Connector

Pin	Designation	Function	LCD Indicator	Source
1	AA	Frame ground—not connected		
2	BA	Transmit (send) data (TD)	TD	DTE
3	BB	Received data (RD)	RD	Modem
4	CA	Request to send (RTS)	RS	DTE
5	CB	Clear to send (CTS)	CS	Modem
6	CC	Data set (modem) ready (DSR)	MR	Modem
7	AB	Signal ground (SG)		Ground
8	CF	Carrier detect (CD)	CD	Modem
9	+P	Testing voltage, +10V		Modem
10	-P	Testing voltage, -10V		Modem
15	DB	Transmit clock (TC)		Modem
17	DD	Receive clock (RC)		Modem
18	CN	Analog loopback control (ALBT)		DTE
20	CD	Data terminal ready (DTR)	TR	DTE
21	CN	Remote digital loopback control		DTE

Table 1-1. Pin Assignments—EIA Interface Connector (continued)

Pin	Designation	Function	LCD Indicator	Source
22	CE	Ring indicator (RI)	R	Modem
23	CH	Speed select		DTE
24	DA	External transmit clock		DTE
25	CN	Test mode indicator (TM)	TM	Modem

NORMAS OFICIALES MEXICANAS (NOM) ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc.
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.

11. El aparato eléctrico deberá ser conectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.
12. Precaución debe ser tomada de tal manera que la tierra física y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las líneas de energía.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objetos líquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
 - A: El cable de poder o el contacto ha sido dañado; u
 - B: Objetos han caído o líquido ha sido derramado dentro del aparato; o
 - C: El aparato ha sido expuesto a la lluvia; o
 - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
 - E: El aparato ha sido tirado o su cubierta ha sido dañada.

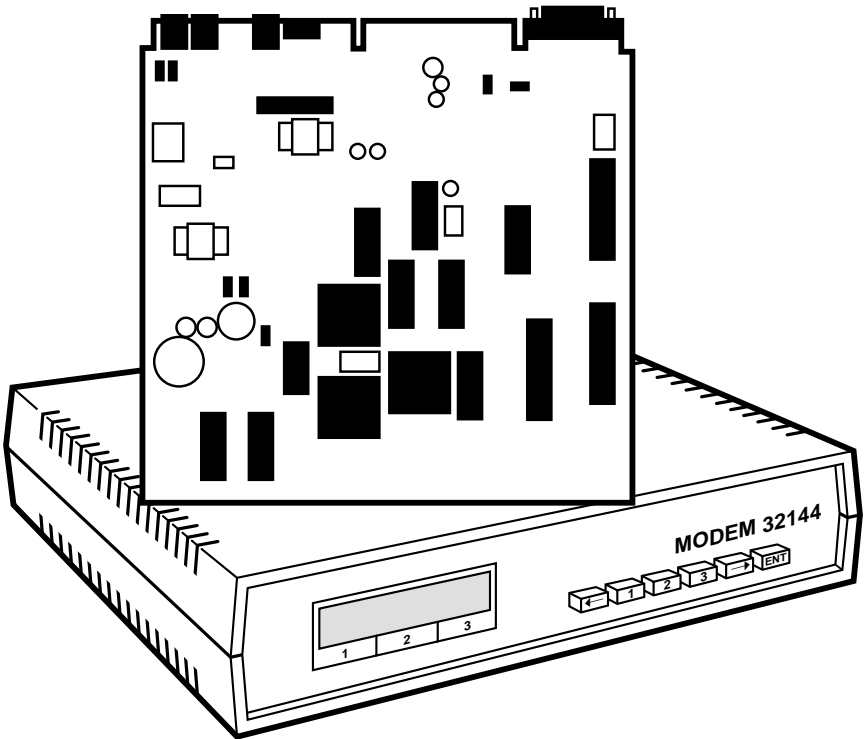
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