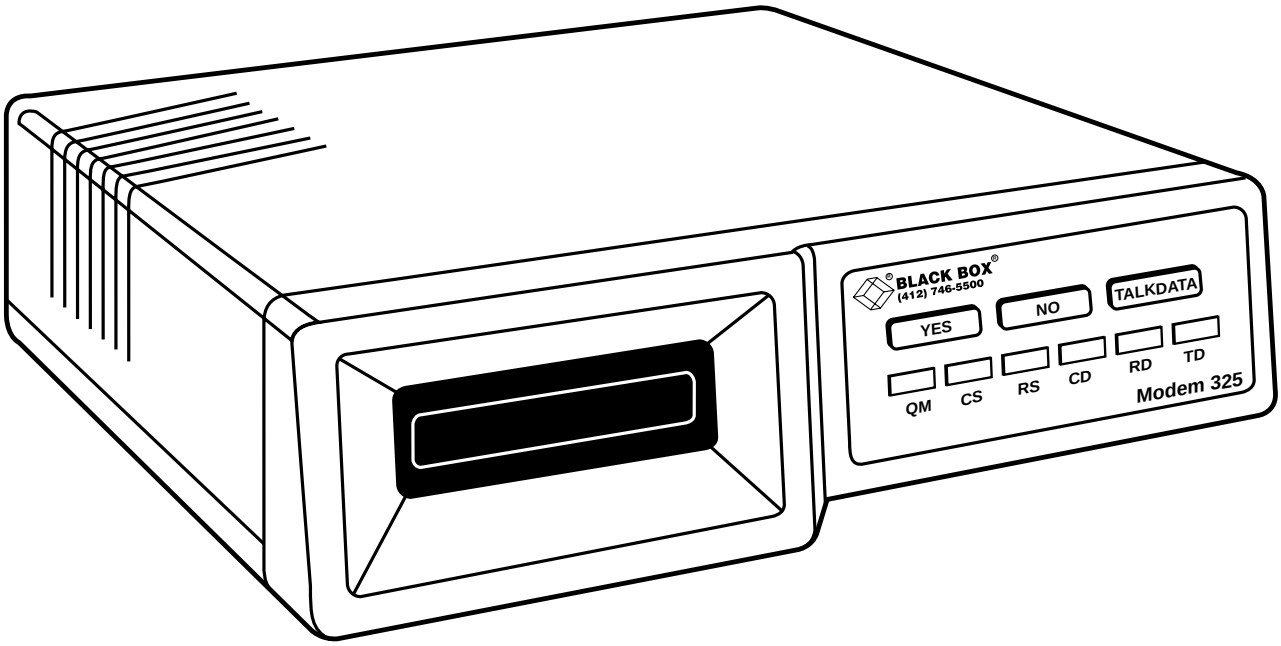
BLACK BOX
NETWORK SERVICES

FEBRUARY 1998
MD278A
MD278A-R2
MD278C

Modem 325
Modem 325 Card



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FEDERAL COMMUNICATIONS COMMISSION
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CANADIAN DEPARTMENT OF COMMUNICATIONS
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 the Canadian Department of Communications.

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 le ministère des Communications du Canada.

INSTRUCCIONES DE SEGURIDAD (Normas Oficiales Mexicanas Electrical Safety Statement)

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 connectado 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 fisica 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 lineas de energia.
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 objectos liquidos 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: Objectos 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.

TRADEMARKS

Other product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

CONTENTS

1. Specifications

Modem Data Rates—9600 trellis coded, 9600 and 4800 uncoded as stated in CCITT recommendation V.32, 2400 and 1200 compatible with CCITT recommendation V.22 bis, 300 as stated in Bell specification 103

Modulation—9600, 4800, 2400 QAM with suppressed carrier (V.32, V.22 bis compliant), 1200 PSK, 300 FSK

Transmit Carrier Frequencies—V.32 bis 1800 Hz

	Originate	Answer
1200 and 2400	1200 Hz ± 0.01%	2400 Hx ± 0.01%
300 bps		
Mark:	1270 Hz ± 0.5%	2225 Hz ± 0.5%
Space:	1070 Hz ± 0.5%	2025 Hz ± 0.5%

Internal Transmit Clock Frequency—Selected bit rate ±0.01%

External Transmit Clock Frequency—Selected bit rate ±0.01%

Transmit Output Level—0 to -15 dBm, selectable; PSTN operation is programmable or permissive

Operation—4-wire, full-duplex, leased (private) line; 2-wire, full-duplex, leased (private) line or PSTN

Carrier Detect Level—Dynamic to -43 dBm

Telco Connection—Two 8-pin modular jacks, dial and private lines

Testing—511 PN pattern (per V.52), V.54 remote loopback control

Telephone Line—Balanced 600-ohm type 3002 or equivalent, 16 dB nominal loss, frequency translation up to ±10 Hz

Digital Interface—Conforms to EIA-232D and CCITT V.24

Line Equalization—Automatic adaptive

RTS/CTS Delay—From 0 ±2 ms to 90 ±2 ms, user-selectable in 10-ms increments (the default is 0 ms)

Temperature—*Operating:* 32 to 122 °F (0 to 50 °C); *Storage:* -40 to 158 °F (-40 to 70 °C)

Humidity—0 to 95% relative humidity, noncondensing

Power—115 VAC ±10%, 60 Hz, 230 VAC ±10%, 50 Hz, or 12 to 60 VDC

Power Consumption—9 watts

Fuse—1/4 Amp slow-blow (115-VAC model)

Size—2.25"H x 7"W x 10.5"D (5.72 x 17.78 x 26.67 cm)

Weight—2 lb. 13 oz. (1.28 kg)

2. Introduction

2.1 General

The Modem 325 and Modem 325 Card are versatile, secure, and reliable modems that can operate full duplex on both dial-up and leased lines. The modems are compatible with all required standards and recommendations and offer a wide variety of automatic, remote, and backup capabilities. The most notable characteristics are MNP® error-control protocols through Level 5 data compression. Other special features include a V.25 bis autodialer, secure operation, and trellis coding for improved signal-to-noise performance.

The modem operates at data rates of

- 9600 bits per second trellis-coded, as stated in CCITT recommendation V.32
- 9600 and 4800 bps uncoded, as stated in CCITT recommendation V.32
- 2400 and 1200 bps compatible with CCITT recommendation V.22 bis
- 300 bps as stated in Bell specification 103*

Note: 4-wire leased-line mode supports 4800 and 9600 bps only.

2.2 Description

2.2.1 Functional

The Modem 325 processes asynchronous serial data at 19200, 9600, 4800, 2400, 1200, or 300 bps, or synchronous data at 9600, 4800, 2400, or 1200 bps, for transmission over the dial-up telephone network and 2- or 4-wire dedicated leased lines. In 9600-bps trellis mode, near- and far-end echo canceling combine with 8-state, 2-dimensional trellis coded modulation to maximize modem performance, even on lines of reduced quality.

Integral test features allow the operator to determine system performance and isolate faults in the communications link.

You can configure the modem from the front panel, or with AT or V.25 commands. Changes between different modes of operation can be made easily and rapidly.

A security scheme prevents unauthorized access by a remote modem.

The V.25 bis autodialer broadens compatibility with host equipment.

2.2.2 Physical

The modem is a standalone desktop unit. Operating options are stored in nonvolatile memory. A menu-driven, 32-character LCD provides the operator with command feedback as well as real-time displays of unit operation. Modem and DTE operation can be monitored by six LEDs and the display status screen on the front panel. **Figure 2-1** shows the LCD front panel.

The rear panel (**Figure 2-2**) has an EIA-232 connector for DTE interface, an 8-pin TELSET/LEASED LINE connector, an 8-pin DIAL connector, and the power switch. The fuse and power cord are also on the rear panel.

Inside the modem are two printed circuit boards and the AC line transformer. Hardware straps on the main board offer additional options.

Note: If you ordered the MD278A-R2, you should have received cables with it.

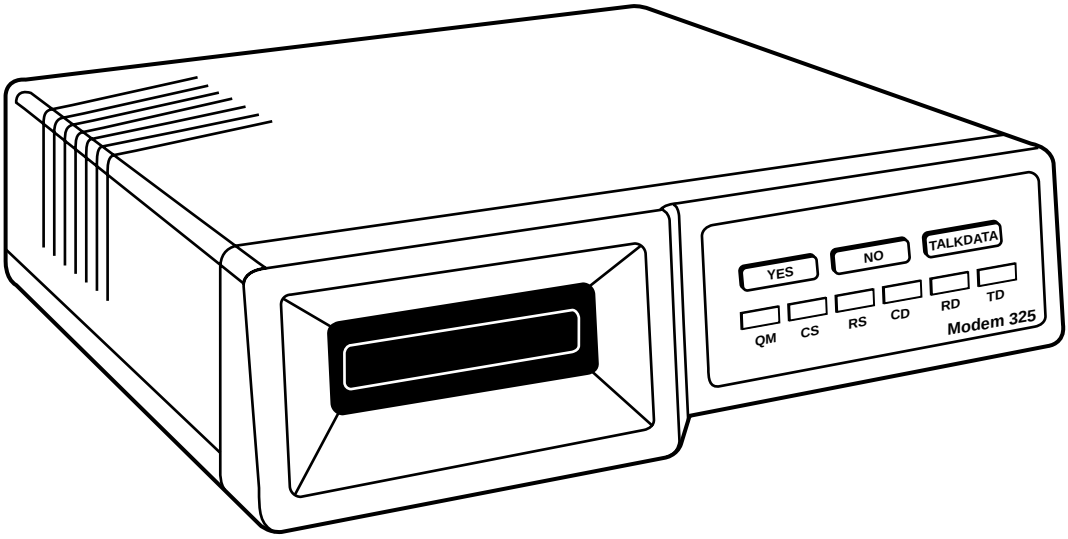

Figure 2-1. Front Panel.

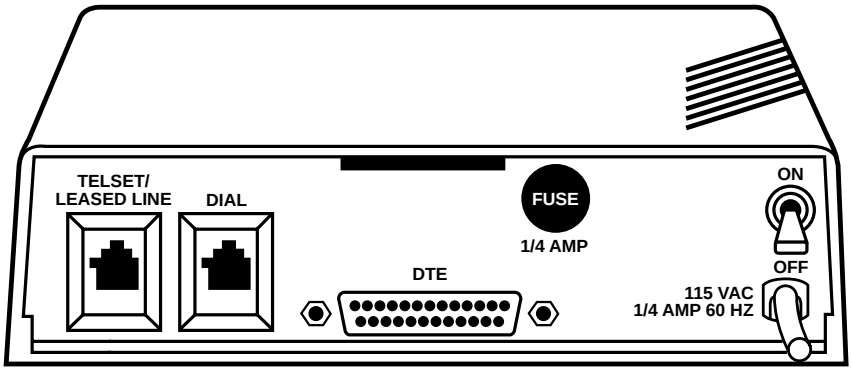

Figure 2-2. Rear Panel.

2.3 How to Use This Manual

2.3.1 Specifications

Modem specifications are listed in **Chapter 1**.

2.3.2 Option Selection

Four methods of selecting or changing modem options are available. You need to read only the part of the manual that deals with the method you've chosen.

- LCD—Using the front-panel LCD and pushbuttons for changing modem options is simple and straightforward, and requires the least amount of technical background. See **Chapter 4**.
- Software program—A wide variety of communication software programs is available, or advanced computer users can write their own software programs that will interact with the modem memory to select options. If you're using software to configure your modem, follow the software's instructions.
- AT Commands—The AT compatible command set can be used to select modem options. See **Chapters 6** and **7**.
- V.25 bis Commands—A set of V.25 bis commands allows selection of modem options during synchronous operation. See **Chapter 8**.

NOTE

You can select options from the LCD without the DTE or phone line connected.

2.3.3 Quick Startup

A quick startup procedure at the beginning of **Chapter 5** provides information for quickly getting online.

3. Installation

3.1 General

This chapter provides information for the mechanical and electrical installation of the modem.

3.2 Site Selection

Install the modem within 6 feet of a 115- or 230-VAC grounded outlet as required for the specific model and no farther than 50 feet from the terminal equipment.

The installation area should be clean and free from extremes of temperature, humidity, appreciable shock, and vibration. Refer to **Chapter 1** for details. Allow clearance for operation and maintenance access and at least 4 inches at the rear for cables and air flow.

3.2.1 Tools Required

Normal installation requires a screwdriver to secure the DTE cable to the modem and to attach the telco cable to the phone jack for leased-line operation.

3.2.2 Receipt Inspection

After unpacking the equipment, check the contents against the packing list. Inspect the equipment for any damage that may have occurred in shipment. If you note any damage or are missing equipment, call your supplier. Keep the shipping container and material for future shipment.

3.3 Electrical Installation

The rear panel (**Figure 3-1**) houses the power cord and connectors for the DTE and telephone lines.

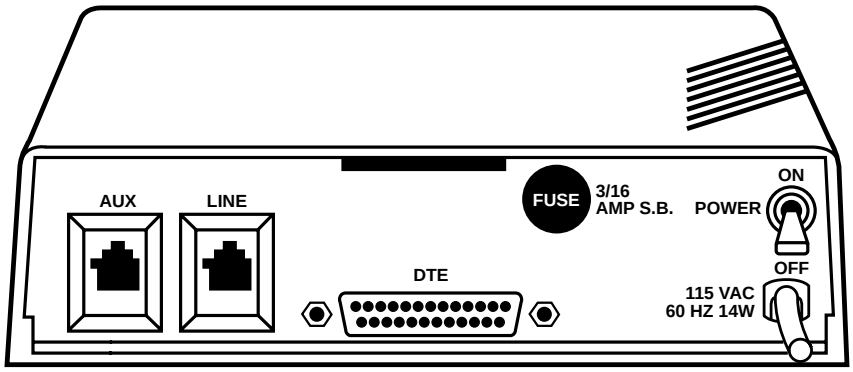

Figure 3-1. Rear Panel I/O.

AC Power Connection

Power is supplied through a 6-foot line cord with a grounded 3-wire plug. If chassis ground is available through the third prong of the plug, a separate ground wire is not required.

CAUTION

To protect the DC-to-DC converter from reverse-polarity damage, make sure that the positive and negative leads are properly connected.

The modem can be ordered for DC power input. Connect 12 to 60 VDC power to the terminal block attached to the modem back panel. A chassis ground connection is also supplied on the terminal block.

3.4 DTE Connection

The DTE connector is a 25-pin D-series type conforming to EIA-232 specifications. The digital interface signals are illustrated in **Figure 3-2** and described in **Table 3-1**.

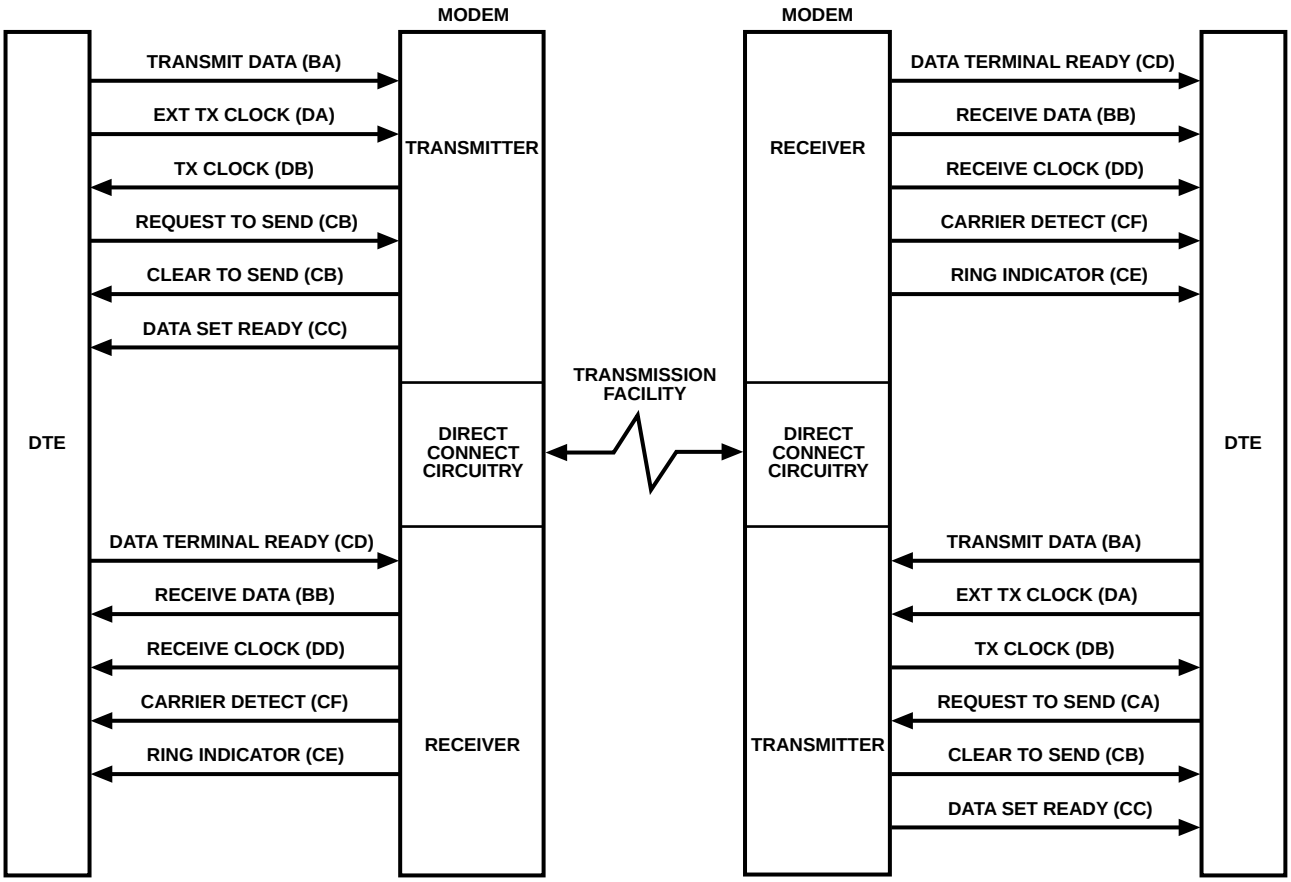

Figure 3-2. Digital Interface Signals.

Table 3-1. Digital Interface Signal Descriptions.

Pin No.	EIA-232D	CCITT V.24	Signal Name	Description
1		101	Shield	No connection
2	BA	103	Transmitted Data	Serial digital data (to be modulated) from a data terminal or other digital data source: Synchronous data must be accompanied by the modem transmit clock (pin 15) or by an external data rate clock (pin 24). Data transitions should occur on positive-going clock transitions; asynchronous data does not require a transmit clock.
3	BB	104	Received Data	Serial digital data output to the DTE interface: Sync data is accompanied by an internal data rate (receive) clock (pin 17) that has positive-going transitions on the data transition. Async data does not require a receive clock.
4	CA	105	Request to Send	A positive level to the modem when data transmission is desired.
5	CB	106	Clear to Send	A positive level from the modem in response to request to send and when the modem is ready to transmit.*
6	CC	107	Data Set Ready	A positive level from the modem when power is on and ready to operate: In dialup operation, the modem must be off hook to give a high DSR signal.*
7	AB	102	Signal Ground or Common Return	Common signal and DC power ground.
8	CF	109	Received Line Signal Detector	A positive level from the modem indicating the presence of a received signal (carrier detect).*
9			+12 Volts	+12 voltage reference
10			-12 Volts	-12 voltage reference
*Modem options may force these signals on or cause them to be ignored.				

Table 3-1 (continued). Digital Interface Signal Descriptions.

Pin No.	EIA-232D	CCITT V.24	Signal Name	Description
11			Signal Quality Indicator	This circuit indicates probability of errors in the received data. A positive level indicates poor signal quality; a negative level indicates good signal quality.‡
15	DB	114	Transmit Clock (DCE)	A transmit-data-rate clock output for use by an external data source: Positive clock transitions correspond to data transitions.
17	DD	115	Receive Clock	A receive-data-rate clock output for use by an external data sink: Positive clock transitions correspond to data transitions.
18		141	Local Loopback (Loop 3) Control	A positive level causes the modem to enter the local analog loopback test mode.
20	CD	108.2	Data Terminal Ready	This circuit is positive when the DTE is ready to originate or answer a call in dialup operation. DTE must always be active (high) in 2-wire private line operation. Cycling DTR causes retraining.*
21		140	Remote Digital Loopback	A positive level causes a digital loopback test mode at the remote modem.
22	CE	125	Ring Indicator	In direct-dial operation, this circuit is positive in response to an incoming ring signal.
23	CH	111	Data Rate Select	Supplies a data rate control input to select primary or fallback data rate: Negative voltage selects primary data rate and positive voltage selects fallback data rate.
24	DA	113	External Transmit Clock	A serial data rate clock input from the data source. Positive clock transitions correspond to data transitions.
25		142	Test Mode	Indicates the modem is in a test mode.

*Modem options may force these signals on or cause them to be ignored.
‡This function can be disabled or its logic sense reversed by hardware straps. Refer to Strap Options.

3.5 Telephone Cables

The cables used for connection between the modem and the various telco jacks are shown in **Figure 3-3**. The part number is printed on the cable.

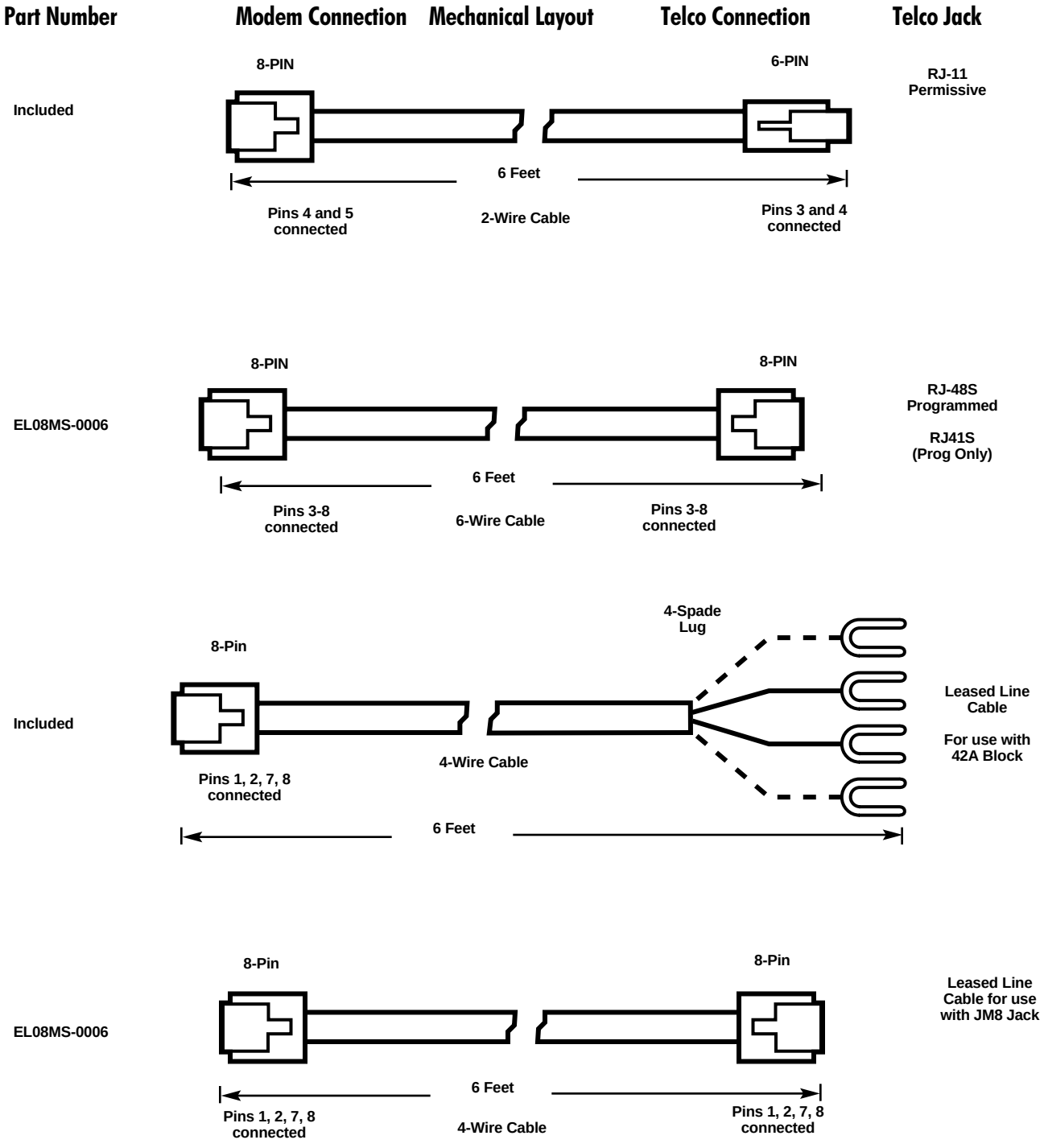

Figure 3-3. Telephone Cables.

3.6 Telephone Line Connection

The modem operates in one of three modes:

- Permissive (PSTN)
- Programmable (PSTN)
- Private line

Permissive and programmable modes are used on the dial-up Public Switched Telephone Network (PSTN). Private-line mode is used on 4-wire or 2-wire dedicated leased lines. The user must decide which mode to use and then select the telephone jacks accordingly.

3.6.1 PSTN Connection

This modem is registered by the Federal Communications Commission (FCC) for direct connection to the PSTN. The label on the chassis bottom gives the FCC registration number and other information.

Direct connection to the PSTN provides two modes of operation (**Figure 3-4**).

- Permissive
- Programmable

3.6.2 Permissive

In permissive mode, the modem transmits a maximum signal level of -9 dBm. Signal loss between the modem and telephone company central office is not controlled. Jack arrangements for this mode are the RJ-11C for standard telephones and the RJ-16X for exclusion key telephones. This cable (included) is used to connect the DIAL jack on the back of the modem to the RJ-11C or RJ-16X wall jack.

3.6.3 Programmable

Programmable mode corrects for the signal-level loss between the modem and the telephone company's central office. This is done by setting the modem's transmit-output signal level with a fixed-value programming resistor selected and installed in the jack by the telephone company. This allows the output signal to reach the central office at the optimum level of -12 dBm. Jack arrangements for this RJ-45S and RJ-41S jacks are used for this mode. RJ-41S has a switch option that must be selected to Programmed (P). Cable EL08MS-0006 is used to connect the DIAL jack on the back of the modem to the RJ-41S or RJ-45S wall jack.

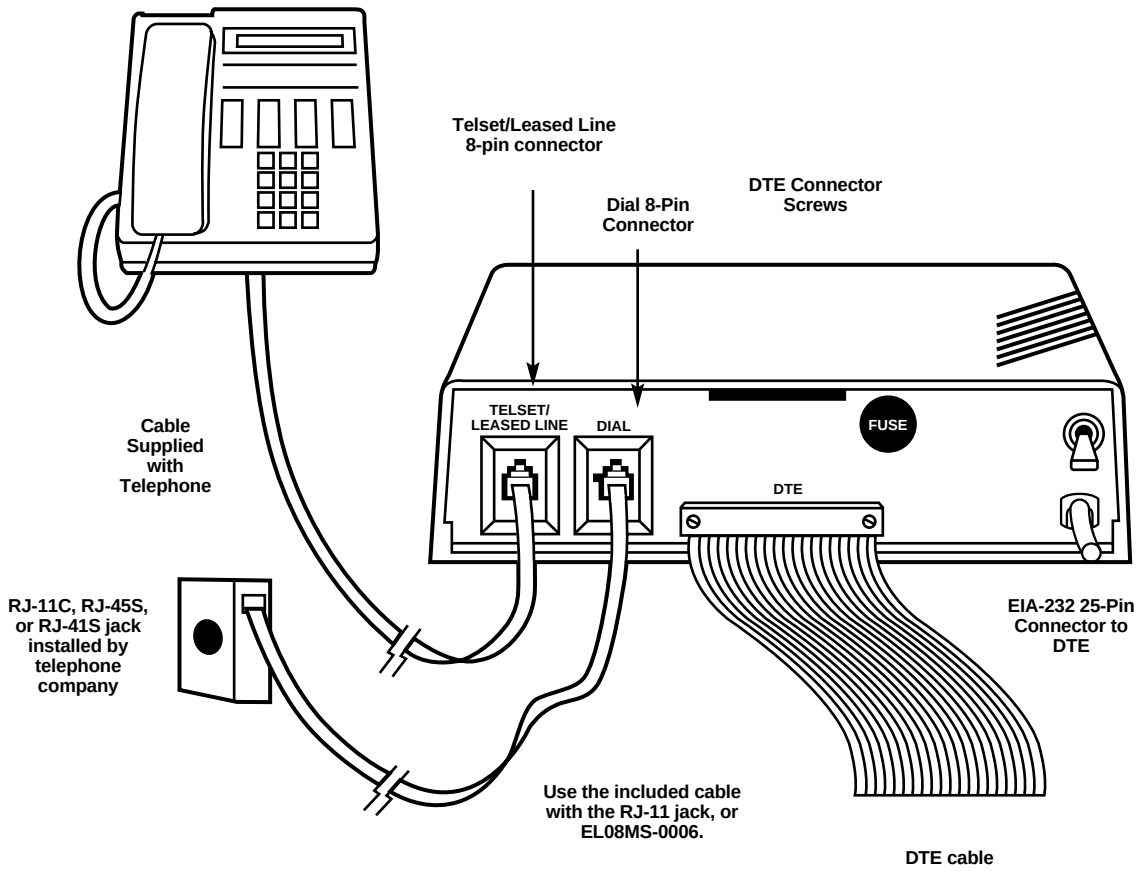

Figure 3-4. Permissive or Programmable Connection.

NOTE

The modem is compatible with exclusion key phone arrangements.

3.6.4 Leased-Line Connection

Leased lines use either a 2-wire or 4-wire connection. The telephone company will install the leased line and wall jack at your site. The line connects to the modem at the 8-position TELSET/LEASED LINE jack.

The 42A block is most common for leased-line use. It requires the use of the 8-pin-modular-to-spade-lug cable (included). **Figure 3-5** illustrates the typical hook-up of the modem for operation over private leased lines with dial backup.

NOTE

Some Bell operating companies have discontinued the 42A block for leased-line terminations. Instead, the modular jack JM8 is used. If this is the case in your area, you need a special cable (EL08MS-0006). Contact technical support for further information.

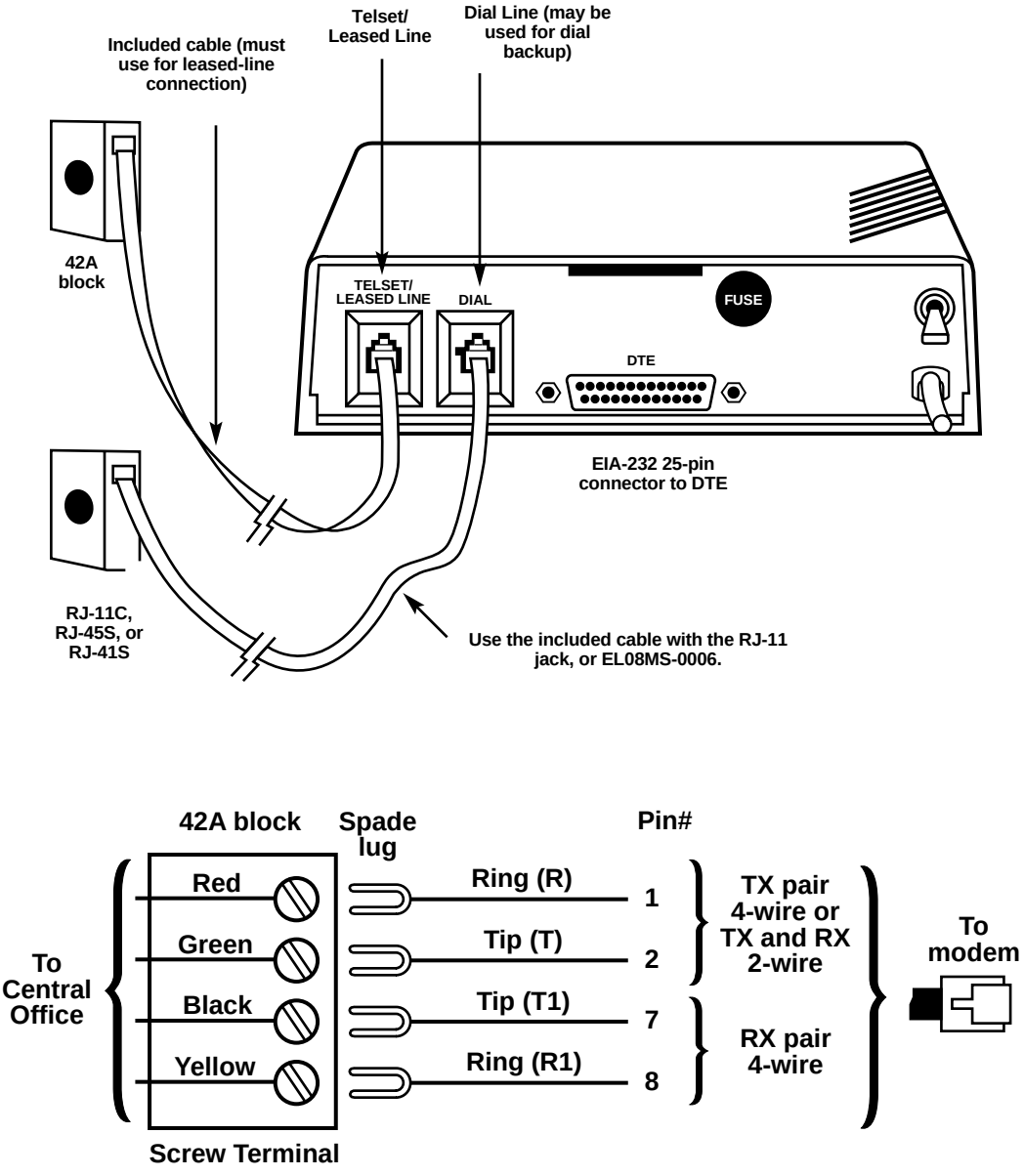

Figure 3-5. Leased-Line Connection.

4. Option Selection

4.1 General

NOTE

This chapter contains the options available by pushbutton in response to the LCD.

There are four factory option sets to choose from. The modem is shipped configured to factory option set #1 (see Appendix D). Because of the number of possible applications, most modems require some option changes to fit into the network.

A user programmed option set is available for storing a custom configuration.

4.2 Strap Option Selection

Modem configuration is determined by front panel controls, AT commands,and hardware option straps located on the pc board. Remove the modem cover for access to the option straps.

NOTE

Normally, PC board straps will not have to be changed.

Removing Cover

WARNING

Disconnect AC power before removing the cover. Although dangerous voltage levels are not exposed, disconnecting power eliminates the hazard of electrical shock.

Place the unit on its side on a flat surface. Insert a medium-size flat screwdriver blade in one of the bottom rear latch slots. DO NOT PUSH the screwdriver but lightly pry the handle away from the unit as illustrated in **Figure 4-1**. This will disengage the lock prong from the lock clip. Assist removal by pushing the cover from the chassis with your fingers on the rear edges of the unit. Repeat this procedure with the remaining three latch slots.

To replace the cover, align the lock clips, rear guide grooves, and front lock tabs. Press the cover in place until the lock clips engage the lock prongs.

Figure 4-2 shows typical strap configurations and **Figure 4-3** shows strap locations.

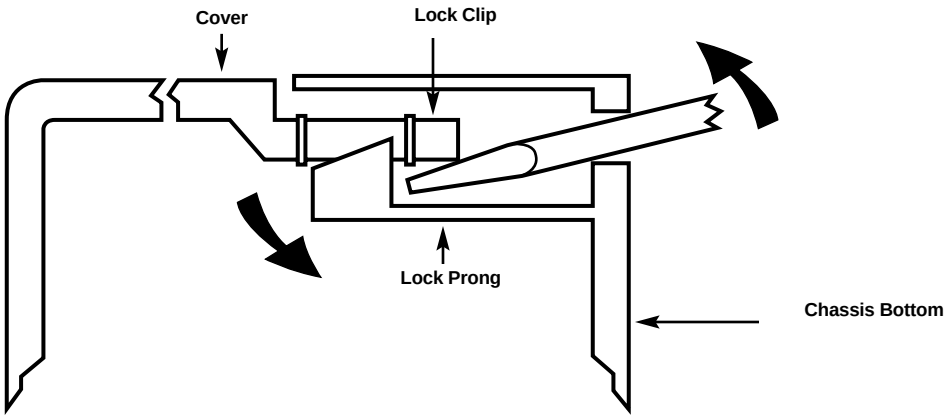

Figure 4-1. Removing the Cover.

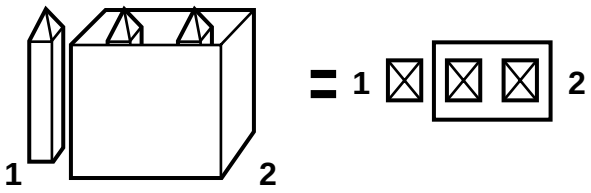

Figure 4-2. Option Strap Configuration.

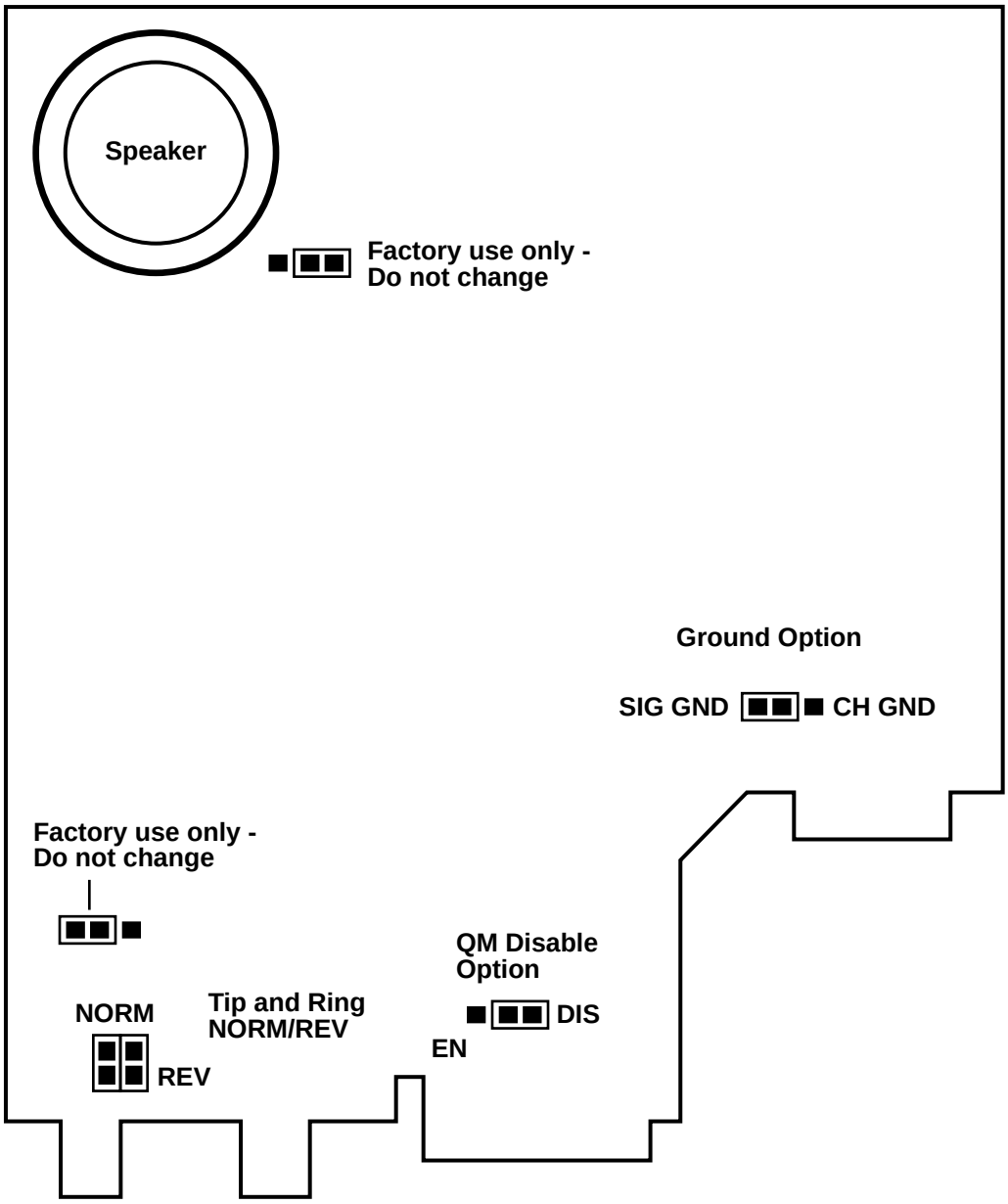

Figure 4-3. Strap Locations.

4.3 Hardware Straps

4.3.1 Tip and Ring Polarity

Some telephones are sensitive to tip and ring polarity. If a dial tone is detected after dialing, reverse these two straps.

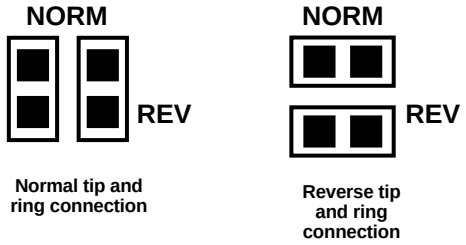

Figure 4-4. Tip and Ring Polarity Jumper.

4.3.2 Ground Option Strap

Signal ground is normally connected to chassis ground. If interference exists, isolate signal ground from chassis ground.

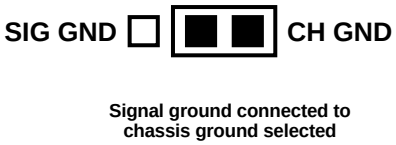

Figure 4-5. Ground Option Strap.

4.3.3 QM Disable Option

When enabled, the Quality Monitor (QM) output is connected to the EIA-232 (pin 11) interface. Disabled disconnects the QM output. Refer to **Chapter 5** and **Table 3-1** for more QM information.

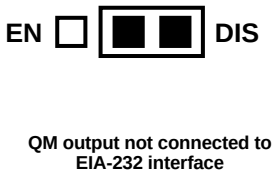

Figure 4-6. QM Disable Option Jumper.

4.4 LCD Option Selection

The modem options can be observed or changed through the front-panel LCD. The LCD also gives modem status.

4.5 Main Menu

There are six main menus that support modem operations:

- MODEM STATE
- DIAL STORED NUMBER
- DISPLAY STATUS
- SELECT TEST
- MODIFY CONFIGURATION
- CHANGE PHONE NUMBERS

Each main menu is supported by various submenus, items, and options (**Table 4-1**). The two right columns in the table show the associated AT commands and S-registers as a cross reference.

Menu Sequence

Main menus consist of six displays which allow access to submenus. Each submenu has a submenu item column; if an option setting is selected or if all options have been scrolled through, the menu will return to the submenu header.

If the NO pushbutton is pressed and held, the modem automatically scrolls through the menu.

NOTE

Main Menu 1 does not scroll. The displays in Main Menu 1 show the current operating mode or status. These displays are the results of other selected options and are not themselves option selections.

While operating in the option menu, pressing NO scrolls vertically down the columns in Table 4-1 and pressing YES advances horizontally across the columns.

Table 4-1. Menu Options.

	Main Menu	LCD Messages				
MAIN 1		V.32 9600 IDLE V.32 9600 TALK V.32 9600 TRAINING V.32 9600 ONLINE V.32 9600 RINGING V.32 9600 IN TEST		(Press NO to advance to MAIN 2)		
	MAIN MENU	**SUBMENU**	**SUBMENU ITEM**	**ITEM OPTION**	**AT COM.**	**S-REG**
MAIN 2	DIAL STORED NUMBER ?		DIAL #1-9	YES, NO	DSn (n=1-9)	—
MAIN 3	DISPLAY STATUS ? (status only)	DTE SIGNALS	DTR ON/OFF DSR ON/OFF OH ON/OFF RI ON/OFF	DISPLAYS STATUS	—	—
		MNP LEVEL	NEGOTIATING MNP LEVEL MNP LEVEL 2, 3, 4, OR 5 CONNECTION	DISPLAYS STATUS	—	—

Table 4-1 (continued). Menu Options.

	MAIN MENU	SUBMENU	SUBMENU ITEM	ITEM OPTION	AT COM.	S-REG
		CARRIER DESCRIPTIONS	RECEIVE LEVEL NEAR END ECHO LEVEL FAR END ECHO LEVEL ESTIMATED DELAY FREQUENCY TRANSLATION	DISPLAYS STATUS	—	—
MAIN 4	SELECT TEST ?		LOCAL ANALOG LOOP	INITIATE, EXIT	&T1	S16
			LAL WITH TP	INITIATE, EXIT	&T8	S16
		(4-wire only)	REMOTE ANALOG LOOP	INITIATE, EXIT	&T2	S16
			RAL WITH TP	INITIATE, EXIT	&T9	S16
			LOCAL DIGITAL LOOP	INITIATE, EXIT	&T3	S16
			REMOTE DIGITAL LOOP	INITIATE, EXIT	&T6	S16
			RDL WITH TP	INITIATE, EXIT	&T7	S16
			TEST PATTERN	INITIATE,	%T	—
MAIN 5	MODIFY CONFIGUR-ATION	CHANGE MODEM OPTIONS?	CHANGE DCE RATE	DTE SPEED 9600 TRELLIS 9600 UNCODED 4800 UNCODED 2400 V.22 bis 1200 V.22 bis 300 BELL 103	%B %B6 %B5 %B4 %B3 %B2 %B1	S69

Table 4-1 (continued). Menu Options.

	MAIN MENU	SUBMENU	SUBMENU ITEM	ITEM OPTION	AT COM.	S-REG
MAIN 5	MODIFY CONFIGUR-ATION (CONT)	CHANGE MODEM OPTIONS?	FORCED ANSWER OR NORMAL ORIGINATE	NORM ORIGIN FORCED ANSWER	*OR *OR1	S14
			V.32 FAST TRAIN	ENABLE, DIS	*FT1, *FT	S29
			AUTO RETRAIN	ENABLE, DIS	%E1, %E	S60
			TRANSMIT CLOCK	INTERNAL EXTERNAL RECEIVE	&X &X1 &X2	S27
			LINE TYPE	LEASED, DIAL	&L1, &L2, &L	S27
			JACK TYPE	PER—RJ-11 PROG—RJ-15	%Z %Z1	—
			LINE CURRENT DISCONNECT	OFF, 8 MS 90 MS	*LC, *LC1 *LC2	S32
			LONG SPACE DISCONNECT	ENABLE DISABLE	Y1 Y	S21
			V.32 CLEARDOWN	ENABLE DISABLE	H2 H3	S14
			V.22 GUARD TONE	DIS, 550 1800 Hz	&G, &G1 G2	S23
		(Leased Only)	2-WIRE/4-WIRE	2-WIRE/4-WIRE	&L1, &L2	S32
			DIAL BACKUP	MANUAL, AUTO	*DB, *DB1	S32
			LOOPBACK TIMER	OFF, 15, 30, 45 60 MIN	—	S28
			TRANSMIT LEVEL	0 TO -15 dB	*TLn	S52

Table 4-1 (continued). Menu Options.

MAIN MENU	SUBMENU	SUBMENU ITEM	ITEM OPTION	AT COM.	S-REG
	CHANGE MNP OPTIONS? (Async Only)	MNP PROTOCOL	ENABLE DISABLE	\N2, \N3 \N, \N1	S70
		AUTO FALLBACK/ DISCONNECT (If MNP Proto En)	DISCONNECT FALLBACK TO NON EC MODE	\N2 \N3	S70
		DTE SPEED	DTE=DCE CONSTANT DTE	\J1 \J	S72
		MNP FLOW CONTROL	DISABLE XON/XOFF CTS only RTS/CTS	\Q \Q1 \Q2 \Q3	S54
		XON/XOFF PASS THROUGH	ENABLE DISABLE	\X1 \X	—
		DATA COMPRESSION	ENABLE DISABLE	%C1 %C	S60
		MNP INACTIVITY TIMER	OFF, 15, 30, 45 60, 75, 90 MIN	—	S58
		MNP BREAK CONTROL	0, 1, 2, 3, 4, 5	\K, \K1, \K2, \K3, \K4, \K5	S59
MAIN 5	CHANGE DTE OPTIONS?	OPERATION	SYNC ASYNC	&M1, &M2, &M3, &M4, &M5 &M	S27 S30
		DTE RATE (Async)	19200, 9600, 4800, 2400, 1200, 300	—	S61
		CHAR SIZE (Async)	7 BIT 8 BIT	—	S61

Table 4-1 (continued). Menu Options.

MAIN MENU	SUBMENU	SUBMENU ITEM	ITEM OPTION	AT COM.	S-REG
		PARITY (Async)	NO, EVEN, ODD	—	S61
		AT COMMAND SET	ENABLE DISABLE	*NT1 *NT	S29
		DIAL METHOD (Sync) (Async allows DTR control)	ASYNC DTR, MANUAL, V.25 BISYNC, V.25 SDLC	&M1, &M2 &M3 &M4 &M5	S27 S30
		CHARACTER TYPE (V.25 only)	ASCII, EBCDIC	—	—
		DTR RESPONSE	IGNORE RECALL CMD DISCONNECT RESET	&D D1 D2 D3	S21
		DSR STATE	NORMAL FORCED HIGH OFF 5 SEC ON DISCONNECT FOLLOWS OH	&S1 &S &S2 &S3	S21
		DCD STATE	NORMAL FORCED HIGH OFF 5 SEC ON DISCONNECT FOLLOWS REMOTE RTS	&C1 &C &C2 &C3	S21
		CTS STATE	NORMAL FORCED HIGH CTS FOLLOWS DCD CTS=RTS	&R &R1 &R2 &R9	S21 S72 S72

Table 4-1 (continued). Menu Options.

MAIN MENU	SUBMENU	SUBMENU ITEM	ITEM OPTION	AT COM.	S-REG
		RTS/CTS DELAY	0 to 90 ms (10 ms)	—	S26
		DTE COMMANDED FALLBACK	ENABLE DISABLE	*FB1 *FB	S53
		OPTIONS RES/ RETND AT DISC	RESTORED RETAINED	*RO1 *RO	S29
	CHANGE TEST OPTIONS?	BILATERAL ANALOG LOOP	ENABLE DISABLE	*AN1 *AN	S34
		BILATERAL DIGITAL LOOP	ENABLE DISABLE	*DG1 DG	S34
		DTE LOCAL TEST	ENABLE DISABLE	*LA1 *LA	S34
		DTE REMOTE TEST	ENABLE DISABLE	*RD1, *RD	S34
		REMOTE COMMANDED	ENABLE DISABLE	&T4 &T5	S23
		TEST TIMEOUT	OFF, 60, 120, 180, 240 SEC	—	S18
	CHANGE DIAL OPTIONS?	DIAL TYPE	PULSE, TONE	P, T	S14
		AUTODIAL #	OFF, 1-9	*AUn (n=1-9)	—
		DIAL TONE	BLIND DIAL WAIT FOR DIAL TONE	X, X1, X3 X2, X4	S22
		WAIT DELAY (Blind Dial)	1, 2, 3, 4, 8, 16 32 SEC	—	S6
		PAUSE DELAY	1, 2, 3, 4, 8, 16 32 SEC	—	S8

Table 4-1 (continued). Menu Options.

MAIN MENU	SUBMENU	SUBMENU ITEM	ITEM OPTION	AT COM.	S-REG
		CALL TIMEOUT	15, 30, 45, 60, 75, 90, 105, 120 SEC	—	—
		ANSWER RING #X	MANUAL, 1, 2, 4, 8, 16	—	S0
		801 V.32 TIMEOUT	LONG, SHORT	—	S53
		AUTOCALLBACK	ENABLE, DISABLE	—	S72
	CHANGE SPEAKER OPERATION?	VOLUME CONTROL	LOW MEDIUM HIGH	L1 L2 L3	S22
		SPEAKER CONTROL	ON UNTIL CARR DETECT ALWAYS ON OFF WHILE DIALING ALWAYS OFF	M1 M2 M3 M	S22
	LOAD/STORE OPTION SET?	LOAD FACTORY OPTION	NO, 1, 2, 3, 4, RESET SECURITY?	&Fn (n=1-9)	—
		STORE PRESENT OPTIONS	YES, NO	&W	—
MAIN 6 CHANGE PHONE NUMBERS?		PHONE NUMBER	NO/ NINE 31-CHAR NUMBERS	&Zn (n=phone # and dial modifiers) *CNn,x	—

4.6 Option Selection

Options are selected by pressing the YES/NO buttons. When powered up, the modem will go to the selected display under the Main Menu 1 header in **Table 4-1**. Any time a Main Menu is displayed, pressing NO scrolls through the Main Menus. When the end is reached, the display returns to main #2.

NOTE

Certain options depend on or are restricted by the mode of operation. For example, dial backup is not available in V.22 mode.

NO	DIAL STORED NUMBER	NO	DISPLAY STATUS?	NO	CHANGE PHONE #?		

4.6.1 Main Menu

When any Main Menu is on display, pressing YES advances to the first Submenu in that Main Menu group.

MODIFY CONFIGURATION?	YES	CHANGE MODEM OPTIONS?

4.6.2 Submenu

When in a Submenu column, pressing NO will scroll down the Submenu and when the end is reached will return to the Main Menu header for that Submenu group.

CHANGE MODEM OPTIONS?	NO	LOAD/STORE OPTION SET?	NO	MODIFY CONFIGURATION?			

When in a Submenu column, pressing YES advances to the Submenu Item column.

CHANGE MODEM OPTIONS?	YES	DCE RATE

4.6.3 Submenu Item

When in a Submenu Item column, pressing NO will scroll through the items and when the end is reached will return to the Submenu header for that item group.

DCE RATE	NO	ORIG/FORCE ANSWER?	NO	V.22 GUARD TONE DISABLED*	NO	CHANGE MODEM OPTIONS?	

**This is the last submenu item for modem options.*

When in a Submenu Items column, pressing YES advances to the Option Setting for that Submenu Item. The first option that appears is the currently selected option.

NORMAL ORIG. FORCED ANSWER?	YES	FORCED ANSWER NORMAL ORIG.?

4.6.4 Item Option

When in the Item Option column, respond to the prompt question on the LCD to either keep or change the current display.

USE RECEIVE TRANSMIT CLOCK?	NO	USE EXTERNAL TRANSMIT CLOCK?	NO	USE INTERNAL TRANSMIT CLOCK?	YES	INTERNAL CLOCK CHANGE?

4.6.5 Selecting the Option

Select the submenu containing the option (submenu item) to be changed and press YES. The LCD displays the first submenu item.

If the first submenu item (option) setting displayed is the desired option, press NO to scroll through Submenu Items. If the first setting displayed is not the desired setting, respond to the prompts until the desired setting is displayed, then advance to the next submenu item. In any case, responding to the prompt will guide you to the desired option.

NOTE

Because of menu structure and options available, not all Main Menus have Submenus and not all Submenus have Item Options. However, the option selection sequence is the same.

5. Operation

5.1 General

This chapter contains a functional description of the modem.

5.2 Controls and Indicators

The front panel houses the LCD panel and LED indicators. The power switch is located on the rear panel.

5.3 LED Descriptions

The LEDs display modem status during various operations.

5.3.1 Request to Send

RS—lights when the data terminal is ready to send data to the modem. This signal is input on EIA-232 pin 4.

5.3.2 Clear to Send

CS—lights when the modem is ready to accept data from the terminal. This signal is output on EIA-232 pin 5.

5.3.3 Quality Monitor

QM—lights when poor signal quality produces a bit error rate of 1 x 104 or greater. This signal is output on EIA-232 pin 11.

5.3.4 Carrier Detect

CD—lights when the received audio carrier signal is detected or, if enabled, when V.42 negotiation is complete. This signal is output on EIA-232 pin 8.

5.3.5 Received Data

RD—lights for a space at the receive data output, indicating receive output data activity. This signal is output on EIA-232 pin 3.

5.3.6 Transmit Data

TD—lights for a space at the transmit data input, indicating transmit input data activity. This signal is input on EIA-232 pin 2.

5.4 Getting on Line Quickly

Turn the power switch on the rear panel ON.

This procedure can help with first time operation of the modem. The procedure assumes that phone numbers have been inserted in memory, that an asynchronous dial-up option set is in effect, that power, DTE, and telephone line connections are made, and that a similar, remote station is available for communication.

- Ensure the modem is installed according to the instructions in **Chapter 3**.
- Turn on the computer and the modem.

5.4.1 Manual Dialing

After turning the modem on the LCD shows the software version and advances to main menu 1.

- Press TALK/DATA. The display will show V.32 9600 TALK.
- Pick up the handset and dial the phone number of the remote modem.
- If the remote modem is set for autoanswer, a high-pitched tone (a 2100-Hz answer-back tone) is heard.
- Press TALK/DATA. This puts your modem in the DATA mode and data transfer can begin.

The display shows TRAINING as the modems negotiate a connection and then ONLINE when the connection is made.

5.4.2 Manual Answering

The modem will autoanswer in both TALK or IDLE mode. To manually answer the phone for conversation, set the front panel to TALK and the autoanswer register (S0) to a ring count value high enough to allow answering the call before autoanswer does.

When conversation is completed, both parties press TALK/DATA and a data connection is established.

5.4.3 Autodial (Front Panel)

- Starting at the V.32 9600 IDLE display, press NO. The display advances to DIAL STORED NUMBER?
- Respond to the prompts until you reach the desired number to dial.
- Press YES. The modem will go through the dial sequence and establish a connection.
- You can follow this sequence of events by observing the LCD and listening to the speaker.

5.4.4 AT Command Dialing

Starting from V.32 IDLE or TALK and using a computer in terminal mode, enter ATD and the telephone number to dial or ATDS and the memory location to dial. When the enter key is pressed the dial sequence starts. You can follow the status of the dial sequence by observing the monitor screen and listening to the speaker.

5.4.5 Software Communication Packages

A large variety of software packages compatible with the modem is available. Most of them provide a means for the operator to select options, insert phone numbers, and establish communications with a remote station. See the instructions for your software.

5.5 Error Control

The modem provides error detection and automatic retransmission of data upon detection of an error. The retransmission buffer is 2048 bytes long and can accommodate up to eight frames. MNP levels 2, 3, 4, and 5 are supported. Level 2 is the asynchronous link version, level 3 is the synchronous link version, level 4 is synchronous with optimized headers for increased efficiency, and level 5 implements data compression for increased data throughput. When making a call in dial mode, the modem negotiates the highest protocol common to both modems. If the connection cannot be established, the modem continues through successive protocols until all are tried or a connection is made.

5.6 Flow Control

Flow control adjusts for differences in speed between the modem and DTE. The DTE can operate at a constant speed independent of the bit rate of the modem.

Flow control works in both directions. The modem can start and stop the DTE transmitter and the DTE can start and stop the modem transmitter. Both inband and out-of-band flow control are implemented. Inband methods employ the characters DC1/DC3 (11 hex / 13 hex). Out-of-band flow control is accomplished with the CTS and RTS interface leads.

5.7 Autobaud

With autobaud, the modem will automatically detect DTE speed and adjust to communicate with the DTE at that rate as soon as it receives the first "AT." The protocol processor will default to 9600 bps. Autobaud also detects the character size and parity used by the DTE.

NOTE

Autobaud overrides the LCD selection for DTE speed, character length, and parity.

5.8 4-Wire Operation

When configured for 4-wire operation, the modem is a full-duplex leased-line modem requiring a dedicated 4-wire leased line. Only point-to-point dedicated leased lines are supported. The 4-wire leased line is connected to the TELSET/LEASED LINE jack on the rear panel. Dialing is not necessary. When connected via leased line, the modems will train and begin communicating with each other. The DIAL jack can be used to connect a 2-wire PSTN line for dial backup.

NOTE

One modem must be configured for forced answer and MNP options must be the same on both ends of a 4-wire leased line for the connection to be successful.

NOTE

4-wire leased-line mode supports 4800 and 9600 rates only and incorporates a CCITT V.33-like training sequence. The modem will not connect with a 4-wire leased-line modem using a CCITT V.32-type training sequence.

5.9 2-Wire Operation

When configured for 2-wire operation, the modem is a full-duplex modem able to operate over 2-wire leased or PSTN lines.

5.9.1 2-Wire Leased-Line Operation

The 2-wire leased line is connected to the TELSET/LEASED LINE jack; the DIAL jack is used to connect a 2-wire PSTN line for dial backup. The leased line connects the local and remote modems directly, so dialing is not necessary. One of the modems must be configured for FORCED ANSWER. When connected via leased line, the modems will train and begin communicating with each other.

NOTE

DTR must be held high in 2-wire leased line operation. This is accomplished by DTE control, wiring pin 20 of the digital interface cable high, or by selecting the option, IGNORES DTR. If DTR is terminal controlled, loss of synchronization can be corrected by cycling DTR. This causes the modem to initiate the 2-wire training sequence. DSR goes off during the training procedure.

5.9.2 2-Wire Dial-Up Operation

Connection to the telephone network is through the DIAL jack. A standard telephone connects to the TELSET/LEASED LINE jack.

5.10 Remote Configuration

You can also configure the modem remotely from another modem.

To start configuring the modem remotely, enter AT%T=. The remote modem is now in remote configuration mode, and you can configure it just as you would a local modem.

If you need to put your local modem back in DTE mode, use the escape sequence (+++).

To put the remote modem back in DTE mode, use the command ATO. You can switch DTE service between the local and remote modems as needed.

To exit remote configuration, use the command AT&T.

A **security code** will prevent unauthorized users from reconfiguring your modem remotely. To set up a security code, use the command AT%P=<code>. The code can be any number from 0 to 99999999. For example, to set up 12345 as the security code, enter AT%P=12345. By default the code is blank, which means there is no security code.

Once you have set up a security code, you will have to enter remote configuration with the command AT%T=<code>. For example, if you have set up 12345 as the security code, then use the command AT%T=12345 to enter remote configuration.

To find the security code of your *local* modem, enter AT%P?.

To disable remote configuration entirely, enter AT%P=D. No one—including you—will be able to configure your modem remotely until you enter a different security code, or eliminate security altogether with the command AT%P=.

You can dial the modem and go directly into remote configuration by placing the AT*T command—without the "=" but followed by the security code (if there is one)—at the end of the dial string.

5.11 Secure Operation

Secure operation provides password protection against unauthorized dial-up access. The security feature can be enabled with AT commands when operating on a dial-up system and requires the secure modem to be set for MNP or buffered mode.

Security may be enabled or disabled. TXD and RXD are suppressed to the host DTE before and during security validation; all other signals (CTS, DSR, RI, etc.) operate as configured. After the password has been validated, the modem operates like a standard V.32 unit. Security has no front-panel operation except for the RESET SECURITY? prompt in the FACTORY OPTIONS submenu. Resetting security clears both passwords and turns security off.

5.11.1 Operating Without Security

The modem operates like a standard V.32 modem, except that several additional AT commands are available to access security. With these commands, any user can set the passwords and turn security on when the modem is not already secure.

5.11.2 Operating With Security

A secure modem will not allow data transfer between its host and a remote host until a correct password is received from the calling party. If an incorrect password is received, the secure modem disconnects. The front panel is not locked out, since the primary reason for security is to prevent unauthorized dial-up access.

5.11.3 Remote Operation

The remote modem must pass security validation before the secure modem will allow data transfer. Once communication has been established, the secure modem prompts the originator with

PLEASE ENTER YOUR PASSWORD ===>>

To respond to the password prompt, enter $ as a lead-in character followed by the password.

After receiving the $, the modem collects up to ten characters until the user presses the carriage return. Entering more than ten characters causes the secure modem to disconnect. After receiving a valid password the secure modem sends PW ACCEPTED to the originating modem.

5.11.4 Local Operation

When accessing the local modem, the password is not required except when the user wants to change a security option. To change a password or to turn security on or off, the user must enter a password when entering the appropriate AT commands. The EIA-232 signals to the DTE are not affected by security.

5.11.5 Passwords

Two passwords of up to ten characters each are stored in the modem's nonvolatile memory. AT commands change the passwords. Backspace and escape keys are not supported for password entry. The passwords can consist of any printable characters except a dollar sign, a comma, and a space. Passwords are case-sensitive.

The passwords have the same priority level and may be substituted for each other. This can be helpful in some situations, such as when the user forgets one of the passwords.

5.11.6 LCD Indication of Security

The front-panel LCD indicates whether security is enabled or not. If security is disabled, screens referring to security do not appear on the LCD. If security is enabled, main #1 consists of the following display:

```
SECURE 9600
XXXX
```

5.11.7 Security Reset

The only security operation available through the front-panel menu is RESET SECURITY. If you forget both passwords, this option will reset security to its initial state (off and with no passwords stored). This option is located under the LOAD FACTORY OPTIONS menu:

RESET SECURITY?

PUSHBUTTON ACTION

YES -	Advances to ERASE ALL SECURITY INFO?
NO, TALK/DATA -	Returns to submenu LOAD OR STORE OPTION SET?

5.11.8 Security Commands

The following AT commands operate security:

AT$S=x	Sets an empty password location to x. This command only applies when no password or only one is stored in memory. It can not be used to change a password.
AT$C=x, y	Changes either password, where x is the old password and y is the new one.
AT$C=x,-	This deletes password x from memory. Security is automatically disabled if the last password is deleted.
AT$E=x	Enables security, where x is either password.
AT$E?	Displays the current status of security (on or off).
AT$D=x	Disables security, where x is either password.
AT$D?	Displays the current status of security (on or off). Same as AT$E?.
AT$DR	Resets security to its initial state (off with no passwords stored).

x and y indicate passwords

5.11.9 Restrictions in Security Operation

The following conditions will cause the modem to disconnect.

- Caller is 300 bps
- Caller is synchronous
- Secure modem has protocol or buffers disabled
- Caller gives wrong password

These restrictions apply only when security is enabled.

5.12 Dial Backup

Dial backup allows the modem to switch to a dial-backup mode if the data connection on the leased line becomes unacceptable for communications. This can be accomplished in two ways:

- Automatic—the modem can be set to switch to the backup line automatically after an extended loss of carrier or 4 unsuccessful retrains in 3 minutes
- Manual—you can switch to dial backup from the front panel or with the *LB or *LD command.

* *Not supported in V.22 mode.*

CAUTION

In 4-wire leased-line operation, if both units have autodial backup enabled, one must be configured for forced answer. This prevents both units from dialing if the leased line fails.

Both methods will cause the modem to dial the prestored autodial number. The originate modem will go to idle mode for 5 seconds and then initiate the call. The answer modem will remain idle while looking for a ring. The modems then connect and begin communicating over the dial-up line. If the dial connection is unsuccessful after three attempts, a retrain on the leased line will be initiated.

In manual mode, the return to leased line is only done when commanded from the front panel or AT command. In automatic mode the return to leased line is initiated after the lookback time in register S28 has elapsed. To prevent unnecessary termination of the dial-line connection, a leased-line lookback test is performed. If the leased line is not acceptable, the dial connection is resumed with a retrain. If the leased line is acceptable, the dial connection is dropped and normal leased-line mode is resumed.

When the unit attempts to return to leased line, the LCD displays LEASE LOOKBACK. If the leased line has been restored to service, data can be passed approximately 10 seconds after LEASE LOOKBACK was initiated. The LCD will continue to display LEASE LOOKBACK for slightly more than a minute. During this time the dial-line connection is maintained in case a return to dial-line operation is required. When the LCD displays ON LINE again the dial line is disconnected.

NOTE

A diagnostic test initiated during dial-backup mode will end when the modem performs a leased-line lookback.

5.13 Placing a Call

5.13.1 Direct Connect with a Standard Telephone

- Lift the telephone receiver. Set the LCD to with a TALK. Wait for the dial tone.
- Dial the number of the remote site.
- When the answer tone is heard, immediately press the TALK/DATA button. The originating modem goes off hook and normal operation will begin within 30 seconds. If not, hang up and return to the first step.
- After the link is established, hang up the telephone.

5.13.2 Direct Connect with an Exclusion-Key Telephone

- Place the LCD in IDLE mode and the telephone in voice mode (pull the exclusion key button up). Wait for a dial tone.
- Dial the number of the remote site.
- The remote modem answers with a 2100-Hz answer tone. If the remote modem does not answer, hang up and return to the first step.
- When the answer back tone is heard, place the telephone in data mode (push the exclusion key button down).
- The originating modem goes off hook and normal operation begins within 30 seconds. If a successful connection is not established, return to the first step.

5.13.3 Autodial From Front Panel

- Advance the LCD to #6 on the main menu, DIAL STORED NUMBER.
- Select the number to dial and press YES to dial. Operation begins in 30 seconds. If not, press the TALK/DATA button and return to the first step.

5.13.4 Autodial with the AT Command Set

- To dial a number—for example, 555-1212—type AT D 555-1212 and a carriage return.
- To dial a stored number type ATD Sn (n=1-9) and a carriage return.
- The modem dials the number—either pulse or tone, whichever is currently in effect—and takes the role of the originate modem.

Refer to **Section 6.7** for additional dialing commands.

5.14 Answering a Call

5.14.1 Autoanswer

Autoanswer by the modem is the normal configuration. Pressing TALK/DATA switches between IDLE and TALK. The modem will answer an incoming call in either mode. If TALK is selected, a telephone plugged into the telset jack will also ring.

V.32 9600 IDLE	or	V.32 9600 TALK

5.14.2 Manual Answer

On ring detection the modem front panel displays:

V.32 9600 RINGING

Press TALK/DATA to answer the call or enter the ATA command at the DTE.

5.15 Call Termination

5.15.1 Conditions That Terminate A Call

The following conditions cause call termination:

• Abort Disconnect (No answer, busy signal, no modem, etc.)	Default 30 sec. Selectable 1 to 30 sec.
• ATH	Disconnect command.
• Loss of Carrier Disconnect	Selectable 100 ms to 25.5 sec.
• Receive Long Space Disconnect	Selectable for disable or 2 sec.
• DTR Disconnect	Selectable for disabled or 10 ms to 2.55 sec.
• LCD Display	When TALK/DATA is pressed LCD displays DO YOU WANT TO GO TO TALK? When YES is pressed, the modem hangs up if no phone is connected or if the connected phone is not off hook. Pressing NO displays DO YOU WANT TO DISCONNECT? Pressing YES then disconnects.
• Protocol Link Establishment Failure	Reliable mode only. Failure to establish reliable link.
• Protocol Inactivity Timeout	Default (0) disabled. Software selectable for disabled or 1 to 255 minutes.
• Protocol Retry Limit Exceeded	12 retransmissions of the frame.
• Signal Quality	Leased line operation with dial backup enabled. Extended loss of carrier or 4 unsuccessful retrains in 3 minutes.

- Modem power is turned off.

5.15.2 V.32 Cleardown

V.32 cleardown is a method of call termination specified in the CCITT recommendation. The cleardown method incorporates a training sequence which ends with a command to disconnect. If long-space disconnect is disabled, the cleardown sequence is activated by the ATH2 command.

6. Asynchronous Operating Commands

6.1 General

Most of the time, you will probably use your modem with communications software, Your software will configure the modem for you, or will offer you simple menu choices for configuring the modem. The software will also establish and maintain the communications link for you.

If you use communications software to configure and operate your modem, you can skip this chapter. However, if you intend to do your own programming, or if you want to set the modem's configurations directly, you can use this chapter as a reference.

This chapter describes the asynchronous operating commands used to select options, test, and operate the modem. These commands are based on the AT command set and extensions. Certain options are dependent on or are restricted by the mode of operation. For example, remote DCD is not available in the V.22 bis or Bell 103 mode of operation. Refer to **Chapter 8** for V.25 bis synchronous operating commands.

NOTE

If AT commands are accidentally disabled, refer to the section called AT Command Set Recover later in this chapter.

6.2 Command Categories

The modem offers eight major categories of command statements:

- Response
- Dial
- Terminal Interface
- Test
- General
- Remote Configuration
- Protocol
- S-registers (**Chapter 7**)

6.3 Operation Modes

During asynchronous operation the modem functions in one of three modes:

- Offline Command Mode
- Online Command Mode
- Data Mode

6.3.1 Offline Command Mode

In offline command mode (generally referred to as command mode), the modem accepts commands from the computer or terminal. Commands can be entered separately or in strings to change modem options, rebuild profiles, store or change telephone numbers, and initiate or receive phone calls. There is no data communication link established in this mode.

6.3.2 Online Command Mode

This mode is entered from the data mode by issuing the escape command. The data communication link remains established but data transmission is suspended. The modem will now accept commands as it does in the offline command mode.

6.3.3 Data Mode

The modem goes to data mode (online) after it successfully connects with a compatible modem. In data mode, the modem sends and receives data, but will not accept or execute command instructions.

Example: The modem is in the command state. The D command and phone number are used to dial a remote modem. The local modem waits to receive a signal from the remote modem. The remote modem acknowledges the call by sending a carrier signal. When the local modem receives this carrier, it leaves the command state and goes online in the data mode. At this time, both modems are using the telephone line and a communication link is established.

In online command mode, the modem can have its own command set altered or use remote configuration to change a remote modem's command set.

6.4 Sending Commands to the Modem

When the computer, modem, and monitor are on, an instruction can be sent to the modem telling it what function or activity to perform. The instruction, called a command statement, command string, or just command, is typed using the computer keyboard. The command statement temporarily resides in a section of memory called the command buffer.

Each command statement is made up of characters, numbers, and such keyboard symbols as the & and % signs. Commands must be written in a specific form so that the modem recognizes and follows the instruction.

6.4.1 Creating a Command Statement

Create a command statement using the following steps:

- Type AT. This is the Attention Code telling the unit a command statement follows.
- Type the command.
- Press the return key to "Enter" or send the command statement to the modem.

Here is an example of a command statement using the dial command (D).

ATD555-1212

This command statement can be read as: "Attention: Dial 555-1212."

Another example is ATZ. This means "Attention: Execute the Z command."

After you enter a command line, the modem returns a response indicating whether the command was accepted or giving the data requested by the command statement.

6.4.2 Autobaud

The attention code (AT) is analyzed by the modem to determine the transmission speed, parity, and bits per character used by the DTE. This autobaud process is repeated each time the AT command prefix is sent.

6.4.3 Guidelines for Creating Command Statements

When typing command statements, note the following:

- The attention code (AT) may be upper or lower case, but not a combination like aT.
- Return or Enter must be pressed to execute (enter) a command.
- Command statements are limited to 40 characters.
- Use the backspace or delete key to erase the last character.

Even though the initial AT code must be all upper or lower case, characters that follow can be any mix of upper and lower case.

6.4.4 Monitor Display

As commands are typed they appear on the monitor so the operator can verify the input. This is called local character echo. The echo may be turned on or off using AT commands. Refer to Local Character Echo in the GENERAL COMMANDS section of this chapter for details.

6.4.5 Command-Statement Buffer

The modem temporarily stores up to 40 characters in a buffer memory, so that you can repeat it with the A/ command (see **Section 6.4.7**). If this limit is exceeded, the modem does not accept the command and sends an ERROR message. To correct this condition, retype the command using 40 characters or less. The AT characters and punctuation used in phone numbers do not take up space in the buffer. Also, blank characters used as spaces to help increase readability are not counted. For example, the modem reads the commands

ATD (212) 555-1212

ATD2125551212

ATD 212 555 1212

as having 11 characters each. Type the command in any of these forms.

Three things will clear the buffer: Turning the modem off, entering AT, or using the DTR reset feature.

NOTE

Phone numbers stored using AT commands are limited to 34 characters.

6.4.6 Backspace Key

Use the backspace key to change the command statement or correct errors. The backspace key allows the cursor to be moved back to the character(s) in error. The command can then be retyped from that point.

Example: ATD5551211 has been typed. To change the last 1 to 2, press the backspace key once, type 2, and press Return to execute the command.

6.4.7 Repeating a Command (A/)

This command tells the modem to repeat the last command stored in its buffer. It automatically reexecutes the command without retyping. The return key does not need to be pressed.

Example: The ATD5551212 command has been executed, and the phone is busy. To repeat the instruction type A/, but do not use AT before this command, since AT would empty the buffer and there would be no command to repeat.

6.4.8 Numbered Commands

Series of commands that start with the same letter are distinguished by a number called a command parameter following the letter.

For example, the M0 command selects speaker always off, M1 speaker on until carrier detected, and M2 selects speaker always on.

In all cases, the zero (0) may be omitted. So the commands M and M0 are identical.

This manual uses the commands without the zero. The modem treats both the same but zeros count against the buffer total.

6.4.9 Group Commands

A group of commands can be typed in a single command statement. Pressing the return key sends the entire command string to the modem, which executes each command individually in the order in which it appears in the command statement.

For example, the command statement ATQ0V0L3DT5551212 means

AT Attention.

Q0 Allow response messages to be sent.

V0 Select digit code responses.

L3 Select high volume.

DT Tone-dial 555-1212.

The modem executes the AT command followed by the Q, V, L, D, and T commands. Command statement ATQ0V0L3DT5551212 can be read: ATQVL3DT5551212. Eliminating zeros reduces the number of characters in a command statement, thereby simplifying typing and allowing more room in the buffer.

The dial D command initiates the dial process, so no other commands, only dial modifiers, can follow the D command.

6.5 Command Table

Table 6-1 is a listing of the AT commands used by the modem.

Table 6-1. AT Commands.

Control Command	General Description	Page Number
A/	Repeat last command	54
+++	Escape code	72
A	Go off hook in answer mode (answer immediately)	66
D	Dial	63
E	Local terminal echo	72
H	Hang up	73
I	EPROM check, product revision and model	73
L	Speaker volume	74
M	Speaker ON/OFF control	74
O	Return online	74
Q	Response control	59
V	Form of response messages	59
X	Call-progress control	60
Y	Long-space disconnect	75
Z	Reset	83
&C	DCD control	67
&D	DTR response	68
&F	Load active profile with factory settings	84

Table 6-1 (continued). AT Commands

Control Command	General Description	Page Number
&G	Guard tones	75
&L	Line type (telephone)	76
&M	Async/sync data and sync dial method	76
&P	Pulse-dial make/break ratio	77
&R	RTS to CTS delay	69
&S	DSR control	67
&T	Diagnostic tests	70
&V	View configuration profiles/receive signal parameters	84
&W	Store active profile	82
&X	Synchronous transmit clock source	77
&Z	Store phone number	84
%An	Auto-reliable fallback character	89
%B	Modem speed	77
%C	Data compression	89
%D	Disconnect buffer delay	78
%E	Automatic retrain	79
%P=	Remote configuration security code	85
%T	Transmit test pattern	70
%T=	Initiate remote configuration	86
%V	Display the modem firmware version	79
%Z	Select permissive or programmable mode	79
\A	MNP block size	92

Table 6-1 (continued). AT Commands

Control Command	General Description	Page Number
\B	Transmit a break/set break length	93
\C	Auto-reliable buffer	93
\G	Modem port flow control	87
\J	Constant speed interface on/off	87
\Kn	Break control	90
\N	Operating mode	86
\O	Originate MNP link	94
\Q	Serial-port flow control	88
\R	Serial-port ring indicate	68
\T	Inactivity timer	92
\U	Accept an MNP link	94
\V	Protocol result codes	93
\X	XON/XOFF flow-through mode	88
\Y	Switch to MNP from normal mode	94
\Z	Switch to normal from MNP mode	95
*AN	Controls bilateral test functions	71
*DA	Selects talk or data mode	80
*DB	Selects manual or automatic dial backup	80
*DG	Controls bilateral test functions	71
*FB	DTE fallback control	69

Table 6-1 (continued). AT Commands

Control Command	General Description	Page Number
*FT	Enables or disables fast train	80
*LA	DTE controlled local analog loopback	71
*LB	Wait for dial-backup call (leased line)	81
*LC	Controls line-current disconnect	81
*LD	Dial autodial number (leased line)	81
*NT	Enables/disables AT command set	81
*OR	Forces modem into answer or originate mode	82
*RC	Number code application	61
*RD	DTE controlled remote digital loopback	71
*RO	Retain/restore options at disconnect	85
*TLn	Leased line TX level	82
$S=x	Sets an empty password location to x	47
$C=x, y	Changes either password x=old, y=new	47
$C=x, -	Deletes password x from memory	47
$E=x	Enables security where x is either password	47
$E?	Displays the current status of security (on or off)	47
$D=x	Disables security where x is either password	47
$DR	Reset security	47
$D?	Displays the current status of security	47
$V	Displays product serial number	79

6.6 Response Commands

The modem communicates with the operator through response messages. These appear on the monitor or a computer printout to show the result of the command or action executed. Response messages can appear as words or as numbers.

6.6.1 How Response Messages Work

When an instruction is executed, the modem sends a message to the monitor showing the results of the instruction.

6.6.2 Selecting Response Form (V)

V tells the modem which type of response message to show on the monitor. These messages indicate the present state of the modem and can appear as either digit or word messages. Some programming situations require digit response messages. Otherwise, word response messages are better, because their meanings are easier to remember than digits.

Table 6-2. Selecting Response Form (V).

Command	Description
V	Enables digit response messages
V1	Enables word response messages†
†*default*	

6.6.3 Electing to Use Response Messages

The modem comes ready to send response messages which are recommended to monitor modem operation. You can change this by:

- Using the Q command
- Using the X command
- Using the \V command (refer to **Section 6.14.11**.)

6.6.4 Enabled/Disabled Response Displays (Q)

The Q command is used to enable or disable response messages. The modem still responds to commands when the response display is inhibited.

6.6.5 Dial Parameter and Connect Speed Displays (X)

Command	Description
X	Dial-tone and busy-signal detection not selected. CONNECT (code 1) response messages displayed for all speeds.
X1	Dial-tone and busy-signal detection not selected. Appropriate CONNECT response messages or codes displayed for data rate.
X2	Dial-tone detection only selected. NO DIAL TONE message or code appears if dial tone is not detected within 5 seconds.
X3	Busy-signal detection only selected. BUSY message or code appears if dialed number is busy.
X4	Dial-tone and busy-signal detection selected. The appropriate CONNECT message or code is displayed.†
†default	

Table 6-3. Dial Parameter and Connect Speed Displays (X).

X followed by a dial command causes the modem to go off hook, wait the amount of time set in register S6, and dial the number. If connection is made, the modem returns a CONNECT (code 1) message to the screen regardless of the speed of connection. With a basic response, the modem will not detect a busy or no dial tone condition.

X1 followed by a dial command causes the modem to go off hook, wait the amount of time set in register S6, and dial the number. If connection is made the modem returns an appropriate CONNECT message or code to the screen. The modem will not detect a busy or no-dial-tone situation.

X2 followed by a dial command causes the modem to go off hook and wait for a dial tone before dialing. If a dial tone is not detected within 5 seconds, the modem sends a NO DIALTONE message and hangs up. The modem will not detect a busy situation in this mode.

X3 followed by a dial command causes the modem to go off hook, wait the amount of time set in register S6 and dial the number. If a busy signal is detected, the modem sends a BUSY message and hangs up. If the call is completed, the appropriate CONNECT message similar to X1 will be displayed. The modem will not detect a no-dial-tone situation.

X4 followed by a dial command causes the modem to go off hook and wait for a dial tone before dialing. If a dial tone is not detected within 5 seconds, the modem returns a NO DIALTONE message and hangs up. If a busy signal is detected, the modem returns a BUSY message and hangs up. If the call is completed, the appropriate CONNECT message similar to X1 will be displayed.

The X4 command combines all the features of X2 and X3. The factory setting is X4.

NOTE

When an X2, X3, or X4 command is in effect, an appropriate CONNECT data-rate message or code is displayed as for X1.

When a blind-dial command (X, X1, X3) is in effect, the modem waits 2 seconds or the time set by S6 and then dials.

6.6.6 Number Code Application (*RC)

Some communications software packages use different number codes to indicate the data rate of the serial port. This option selects either of two commonly used number code sets.

Table 6-4. Number Code Application (*RC).

Command	Code Set	Number	Operation
*RC	Standard	15	4800 bps†
		18	9600 bps
*RC1	Alt	11	4800 bps
		12	9600 bps
*†default is *RC*			

NOTE

Asterisks in AT commands are part of the command and do not indicate footnotes.

6.6.7 Response Number Codes/Messages

Response number codes, messages, and their corresponding meanings are listed in **Table 6-5**. The connect speeds indicated are the serial-port rate (DTE), not the DCE speed.

Table 6-5. Response Codes/Messages.

Code	Message	Meaning
0	OK	Command received.
1	CONNECT	300 bps while X1, X2, X3, or X4 command in effect. All DTE rates while X command in effect.
2	RING	Ring detected.
3	NO CARRIER	Valid carrier is not detected after call attempt within period specified by register S7, or carrier lost for value of S10 or more.
4	ERROR	Command not recognized or too long.
5	CONNECT 1200	Connection made at 1200 bps.
6	NO DIAL TONE	No dial tone detected for 5 seconds (X2 or X4 command in effect).
7	BUSY	Dialed number busy (X3 or X4 command in effect).
10	CONNECT 2400	Connection made at 2400 bps.
11, 15	CONNECT 4800	Connection made at 4800 bps.
12, 18	CONNECT 9600	Connection made at 9600 bps.
14	CONNECT 19200	Connection made at 19200 bps.
20	CONNECT 300/REL	MNP 300 bps connection.
22	CONNECT 1200/REL	MNP 1200 bps connection.
23	CONNECT 2400/REL	MNP 2400 bps connection.
24	CONNECT 4800/REL	MNP 4800 bps connection.
25	CONNECT 9600/REL	MNP 9600 bps connection.
26	CONNECT 19200/REL	MNP 19200 bps connection.
NOTE: Indicated speed is DTE speed.		

6.7 Dial Commands

Dial commands let the modem originate a call to another modem. These commands can be used with either tone- or pulse-dial telephone systems.

6.7.1 Dialing (D)

To dial a number—for example, 555-1212,

Enter AT D 555-1212

The modem dials the number, either pulse or tone, whichever is currently in effect, and takes the role of the originate modem.

You can use spaces, hyphens, parentheses, or other punctuation except dial modifiers to make the command line easier to read and enter. For example, these are all treated the same:

AT D 1-800-555-1212

AT D 1 (800) 555-1212

ATD18005551212

The dial modifiers are shown in Table 6-6.

Table 6-6. Dial Modifiers.

Modifier	Operation
T	Tone dialing†
P	Pulse dialing
,	Insert a long pause (2 seconds or value in S8)
W	Wait for 2nd dial tone
!	Flash (½ second)
R	Switch to answer mode after dialing
@	Wait for silence
;	Return to command mode after dialing
S	Dial stored command line or number
†*default*	

6.7.2 Tone Dialing (T)

To tone-dial a number sequence, insert a T in the dial command.

Enter AT D T 323-1111

In this example, the modem tone-dials the telephone number. The dialing method selected remains in effect until changed.

6.7.3 Pulse Dialing (P)

To pulse-dial a number sequence, insert a P in the dial command.

Enter AT D P 555-9902

6.7.4 Insert Pause (,)

To insert a pause in the dialing sequence, use a comma. This inserts a 2-second delay (or the value in register S8).

Enter AT D P 9, 1-800-555-1000

Here the modem pulse dials a 9, pauses for the telephone system to switch to an outside line, then dials the phone number. Comma pauses may be inserted consecutively if you need a longer pause.

6.7.5 Wait for Second Dial Tone (W)

To wait for second dial tone

Enter AT D 9 W 323-8000

Instead of using a comma pause for an outside line, you can wait up to 30 seconds (time specified by S7) for a second dial tone.

6.7.6 Switch Hook (!)

To flash the switchboard, enter an exclamation mark. This inserts a ½-second on-hook condition, usually for transferring a call or similar use.

AT D T 9W 323-8000 ,!,, #7 377

In this example, the modem tone dials a 9, waits for the second dial tone, dials the phone number, pauses, flashes to start the transfer, pauses twice, then uses #7 to transfer the call to extension 377.

6.7.7 Switching to Answer Mode After Dialing (R)

To switch to answer mode after dialing, use an R at the end of the dial sequence.

AT D 555-2345 R

Use this command suffix to call an originate-only modem.

6.7.8 Wait for 5 Seconds of Silence (@)

To wait for 5 seconds of silence (no answer tone) after accessing an electronic service, use the @ command.

AT D 399-4700 @ 2251 ;

In this example the modem dials the number and, after the connection, waits for 5 consecutive seconds of silence. The modem then sends service code 2251 and returns to command mode (see the next section) for further input.

For example, you might enter a dollar amount for a banking transaction by entering

AT D 1400 ;

This sends the sequence 1400 and then returns to the command mode for further entries, according to the requirements of the banking service.

6.7.9 Remaining in Command Mode (;)

To remain in command mode after dialing, place a semicolon at the end of the dial string.

AT D 234-5678 ;

The modem will dial the telephone number entered but will not attempt to train when the remote service answers the call.

This is used to retain control so that further tones may be entered with

AT DTn ;

The semicolon should be placed at the end of each sequence of digits in order to remain in command mode (n=additional tones to be sent).

6.7.10 Dialing a Stored Telephone Command Line (S)

Use the S command to dial a previously stored command line.

ATDS—Dials number stored at location 1. ATDS and ATDS1 are the same.

To dial one of the multiple stored numbers, enter ATDSn, where n is between 1 and 9.

AT D S9

In this example the number stored in location 9 is dialed.

AT*AUn—Selects stored number n (n=1 to 9) to be autodialed. This is the autodial number, which is used for dial backup or if DTR-controlled dialer is enabled.

6.7.11 Voice Calls

To make a voice call, place modem in TALK mode by pressing the TALK / DATA button and dial the number with the telephone. If you wish to use the dial command for the call

Enter AT D (number) ;

Then place the modem in TALK mode to give the telephone control of the phone line. The semicolon character (;) recalls the command mode and prevents the modems from training. The remote site must be answered by the phone with the modem in talk mode.

6.7.12 Switch from Voice to Data

After dialing in TALK mode, place the modems in DATA mode by pressing the TALK/DATA button.

6.8 Answering a Call

There are three ways to answer a call for data connection:

- Manual
- AT command
- Autoanswer

The most common is autoanswer.

6.8.1 Manual Answer

When the phone rings, answer by changing the front-panel switch from TALK to DATA after the first ring.

6.8.2 AT Command Answer (A)

The modem can be made to go off hook in the answer mode by entering ATA when the phone rings. This commands the modem to go to the answer mode and connect.

6.8.3 Autoanswer (S0)

Autoanswer is controlled by register S0. S0 determines which ring the modem answers on. S0 can be loaded with a value between 1 and 255 for autoanswer.

Entering ATS0=0 disables the autoanswer feature. Decide which ring the modem is to answer on and set S0 to that decimal value.

NOTE

If the &D2 option is active, the DTR signal must be on for autoanswer to work.

When these steps have been taken, the modem automatically answers on the selected ring and connects with the calling modem. This allows two computer systems to exchange data via unattended modems. Actual data transfers may be controlled by the software used by both computers.

6.9 Terminal-Interface Commands

The terminal interface is the connection between the modem and its associated data terminal (for example, your computer). Terminal-interface commands control the action of the modem and the terminal in response to the signals being exchanged on the interface.

6.9.1 Data Carrier Detect (&C)

When using DCD to indicate a valid carrier, enter AT&C1. Some terminals and other devices require DCD on to communicate with the modem; if so, select &C.

Table 6-7. Data Carrier Detect (&C).

Command	Operation
&C	DCD always on†
&C1	DCD is on when the modem recognizes remote modem carrier or, if enabled, when MNP negotiation is complete
&C2	DCD on except for 5 seconds after disconnect
&C3	DCD follows RTS on remote modem (simulated switched carrier)
†*default*	

AT&C3 simulates switched-carrier operation.

NOTE

For simulated switched carrier-operation, &C3 must be selected on both modems. (Only available in V.32 direct or synchronous mode.)

6.9.2 Data Set Ready (&S)

These commands control the DSR signal generated by the modem to indicate that the modem is ready for operation. DSR must be on for some terminals and devices to communicate with the modem.

Table 6-8. Data Set Ready (&S).

Command	Description
&S	DSR always on†
&S1	DSR on when off hook in data mode
&S2	DSR off for 5 seconds after disconnect then returns to on
&S3	DSR follows OH (off hook)
†*default*	

6.9.3 Data Terminal Ready (&D)

In data mode, DTR may be used for modem control.

Table 6-9. Data Terminal Ready (&D).

Command	Description
&D	Causes the modem to ignore DTR†
&D1	Causes the modem to go to command mode from data mode when DTR goes from on to off.
&D2	Commands the modem to disconnect when DTR goes from on to off and disables autoanswer while DTR is off.
&D3	Disconnects, recalls command mode, and resets the modem to a stored configuration when DTR goes from on to off. In dial-line mode, the modem will disconnect; in leased-line mode, the modem will retrain.
†*default*	

NOTE

If DTR Controls Dialer is selected, then &D1 and &D2 will cause an autodial after an off-to-on transition of DTR.

6.9.4 Serial-Port Ring Indicate (\R)

Determines indication mode of serial-port ring indicate line (pin 22) and LCD display.

Table 6-10. Serial Port Ring Indicate (\R).

Command	Operation
\R	Causes the LCD ring-indicate display and EIA-232 pin 22 to turn on (high) when the phone rings and remain on during the duration of the call.
\R2	Causes the LCD ring-indicate display and EIA-232 pin 22 to turn on (high) when the phone rings and turn off (low) when the call is answered.†
†*default*	

6.9.5 Request to Send/Clear to Send (&R)

When the modem is operating in nonbuffered mode (direct mode), AT&R enables the RTS-to-CTS delay, determined by the value in S26. AT&R1 forces CTS high, and the modem ignores RTS. With AT&R2 selected, CTS goes high when carrier is detected. AT&R9 forces CTS to follow the state of RTS without delay.

Table 6-11. Request to Send/Clear to Send (&R).

Command	Description
&R	Enables RTS to CTS delay
&R1	CTS forced on†
&R2	CTS follows DCD
&R3	CTS equals RTS
†*default*	

NOTE

RTS/CTS delay is not valid in buffered mode or with MNP enabled.

NOTE

With AT&R2 selected, XON/XOFF is the only valid method of flow control and &C and &C1 are the only valid carrier detect options.

6.9.6 DTE Fallback (Pin 23) (*FB)

If the DTE fallback (EIA-232, pin 23) input to the modem is not in use, set the option to ignore pin 23. To cause the modem to act on high/low levels of pin 23, enable this option. Negative level forces higher rate; positive forces lower rate.

Table 6-12. DTE Fallback (Pin 23) (*FB).

Command	Operation
*FB	Ignore pin 23†
*FB1	Transition on pin 23 changes speed
†*default*	

6.10 Test Commands (&T)

Diagnostic tests are used to isolate faults in the communications path. Diagnostic tests will terminate after the period of time specified by S18. If S18 is set to 0, the timer is disabled and tests will run continuously. Tests may also be terminated by the AT&T command. When in test modes without test pattern, issue the escape sequence (+ + +) to return to command mode before terminating the test with the AT&T command.

Table 6-13. Test Commands (&T).

Command	Operation
&T	Terminate any test
&T1	Initiate local analog loopback test
&T2	Initiate remote analog loopback test
&T3	Initiate local digital loopback test
&T4	Allows acceptance of remote requested digital loopback†
&T5	Disallows acceptance of remote requested digital loopback
&T6	Initiate remote digital loopback test
&T7	Initiate remote digital loopback with test pattern
&T8	Initiate local analog loopback test with test pattern
&T9	Initiate remote analog loopback with test pattern
%T	Transmit test pattern
†*default*	

NOTE

Local analog loopback with or without test pattern is the only test available in error-control mode.

6.10.1 Bilateral Test Enable/Disable (*AN, *DG)

Enables or disables bilateral test function.

Table 6-14. Bilateral Test Enable/Disable.

Command	Operation
*AN	Bilateral analog loop disabled†
*AN1	Bilateral analog loop enabled
*DG	Bilateral digital loop disabled†
*DG1	Bilateral digital loop enabled
†*default*	

6.10.2 DTE-Controlled Remote Digital Loopback (Pin 21) (*RD)

To enable DTE-controlled remote digital loopback, enter AT*RD1. When the test is enabled, the modem goes into remote digital loopback when it detects an off-to-on transition of pin 21 while in the online data mode. The test ends when it detects an on-to-off transition of pin 21 and then returns to online data mode. To disable this function, enter AT*RD.

Table 6-15. DTE Controlled Remote Digital Loopback (Pin 21) (*RD).

Command	Operation
*RD	Ignore pin 21†
*RD1	RDL enabled (pin 21)
†*default*	

NOTE

If the test timeout option is enabled and pin 21 remains high, the modem returns to online mode at the end of the test timeout period and then immediately reenters the test mode.

6.10.3 DTE-Controlled Local Analog Loopback (Pin 18) (*LA)

To enable DTE-controlled local analog loopback, enter AT*LA1. When the test is enabled, the modem goes into local analog loopback when it detects an off-to-on transition of pin 18. The test ends when it detects an on-to-off transition of pin 18. To disable the test, enter AT*LA.

Table 6-16. DTE Controlled Local Analog Loopback (Pin 18) (*LA).

Command	Operation
*LA	Ignore pin 18†
*LA1	LAL enabled (pin 18)
†default	

NOTE

If the test timeout option is enabled and pin 18 remains high, the modem returns to idle mode at the end of the test timeout and then immediately reenters the test mode.

6.11 General Commands

These commands control various standard options that in most cases apply to any mode of operation.

6.11.1 Changing from Data Mode to Command Mode (+ + +)

To change from data mode to online command mode, press the escape character three times (+ is the default). Pause for the length of time set by register S12 (1 second is the default) before and after the +++ to ensure the modem recognizes the escape command.

This sequence temporarily suspends data mode transmissions and allows command mode operations without breaking the connection. The modem responds with OK when it detects the escape code. Return to data mode by entering ATO.

NOTE

The AT command set must be enabled.

6.11.2 Local Character Echo (E)

Type AT without a carriage return. If the screen shows AT, the character echo is set correctly. Proceed with other commands as desired.

If the screen shows AATT, enter the ATE command to correct the double characters, or disable the local echo on the terminal.

If the screen shows no characters, type ATE1 to turn the echo on, or enable local echo on the terminal.

Table 6-17. Bilateral Test Enable/Disable.

Command	Operation
E	Echo off
E1	Echo on†
†*default*	

6.11.3 Hanging Up (H)

To terminate a call, enter the command ATH. This tells the modem to disconnect and go on hook. The modem must be in command mode to use this command.

6.11.4 V.32 Cleardown (H2, H3)

This disconnect option allows a training sequence before the actual hang up.

Table 6-18. V.32 Cleardown (H2, H3).

Command	Operation
H2	V.32 cleardown enabled
H3	V.32 cleardown disabled†
†*default*	

6.11.5 EPROM Check (I)

PC software packages may issue the ATI command to verify the modem will support all commands needed by the software package. The modem returns ASCII characters representing the model and revision level. To request the CRC to be calculated on the EPROM, enter ATI1. The modem returns four ASCII characters representing the CRC in hexadecimal form. Enter ATI3 to request the product version.

Table 6-19. EPROM Check (I).

Command	Operation
I	Request product code
I1	Request EPROM CRC value
I3	Request product version

6.11.6 Speaker Volume (L)

ATL commands offer three volume levels.

Table 6-20. Speaker Volume (L).

Command	Operation
L, L1	Speaker volume low
L2	Speaker volume medium†
L3	Speaker volume high
†*default*	

6.11.7 Speaker Control (M)

ATM commands enable or disable the speaker for monitoring purposes.

Table 6-21. Speaker Control (M).

Command	Operation
M	Disables the speaker
M1	Disables the speaker while receiving a carrier signal†
M2	Speaker always on
M3	Disables the speaker while receiving a carrier signal and modem is dialing
†*default*	

6.11.8 Return Online (O)

Use the O command when you are in the online command mode and want to return to data mode. It returns the modem to the same mode (originate or answer) that it was in before escaping to the (online) command mode.

6.11.9 Long Space Disconnect (Y)

One method of disconnecting two modems is called long-space disconnect. When any disconnect condition is detected by the local modem, it will send 4 seconds of data space condition to the remote modem before disconnecting. This signals the remote modem to disconnect. The local modem will disconnect if it receives 1.6 or more seconds of data space condition from a remote modem. If break sequences of 1.6 or more seconds are to be sent, enter ATY to disable this feature and prevent unintentional disconnects.

NOTE

This option must be disabled if SDLC NRZI data is used.

Table 6-22. Long Space Disconnect (Y).

Command	Operation
Y	Long space disconnect off
Y1	Long space disconnect on†
†*default*	

6.11.10 Guard Tones (&G)

This option controls the generation of CCITT V.22 guard tones. These guard tones are not used in the United States.

Table 6-23. Guard Tones (&G).

Command	Operation
&G	No guard tone†
&G1	550 Hz guard tone
&G2	1800 Hz guard tone
†*default*	

6.11.11 Dial/Leased Line (&L)

If operating on dial-up lines, enter AT&L. If operating on leased lines, enter AT&L1 for 2-wire or AT&L2 for 4-wire.

Table 6-24. Dial/Leased Line (&L).

Command	Operation
&L	Dial (switched)†
&L1	Leased (private) 2-wire
&L2	Leased (private) 4-wire
†*default*	

6.11.12 Asynchronous/Synchronous Mode Selection (&M)

The AT&M commands select synchronous or asynchronous operation and V.25 bis autodialing protocols.

AT&M selects asynchronous mode.

AT&M1 selects synchronous mode 1. Calls are placed asynchronously. Operation switches to synchronous when connecting.

AT&M2 selects synchronous mode 2. The modem automatically dials a stored number when it detects an off-to-on transition of DTR. Use the AT&Dn command to select the action to be taken on a DTR transition.

AT&M3 selects synchronous mode 3. Calls are placed manually.

AT&M4 selects synchronous mode 4. V.25 bis autodialer set for Bisync protocol.

AT&M5 selects synchronous mode 5. V.25 bis autodialer set for SDLC protocol.

Use register S30 to select EBCDIC/ASCII and NRZ/NRZI for data format.

Table 6-25. Asynchronous/Synchronous Mode Selection (&M).

Command	Operation
&M	Asynchronous mode†
&M1	Synchronous mode 1
&M2	Synchronous mode 2
&M3	Synchronous mode 3 (V.25 bis disabled)
&M4	Synchronous mode 4 with V.25 bis Bisync
&M5	Synchronous mode 5 with V.25 bis SDLC
†*default*	

6.11.13 Make/Break Dial Pulse Ratio (&P)

Using AT&P, the dial pulse is on for 39% and off for 61% of one cycle. Using AT&P1, the dial pulse is on for 33% and off for 67% of one cycle.

Table 6-26. Make/Break Dial Pulse Ratio (&P).

Command	Operation
&P	39%: 60% (US and Canada)†
&P1	33%: 67%
†*default*	

6.11.14 Synchronous Transmit Clock Source (&X)

The AT&X commands select internal, external, or receive clock as the transmit clock source.

Table 6-27. Synchronous Transmit Clock Source (&X).

Command	Operation
&X	Internal clock†
&X1	External clock
&X2	Receive clock
†*default*	

6.11.15 DCE Speed (%B)

AT%B sets the originating DCE speed to follow the DTE speed. Two modems will not connect at a speed faster than the lower DCE speed setting of the two modems. To allow the modem to transmit data at a speed different from DTE speed, enter AT%Bn (n=1 to 6).

Table 6-28. DCE Speed (%B).

Command	Operation
%B	Use DTE speed
%B1	300 bps
%B2	1200 bps
%B3	2400 bps
%B4	4800 bps
%B5	9600 bps
%B6	9600 trellis†
†*default*	

6.11.16 Disconnect Buffer Delay (%D)

Sets a delay during which the modem will process data in its transmit and receive buffers before disconnecting. When a condition exists which will cause a disconnect, the modem will attempt for n seconds to empty its buffers. When the buffers are empty or if n=0, the modem disconnects immediately.

Table 6-29. Disconnect Buffer Delay (%D).

Command	Operation
%D	Disconnect buffer delay disabled†
%Dn	Disconnect buffer delay value (seconds)
†*default*	

6.11.17 Auto Retrain (%E)

This option allows the modem to automatically retrain in response to poor received signal quality without a reconnection. The modem will always respond to a retrain request from the remote modem.

Table 6-30. Auto Retrain (%E).

Command	Operation
%E	Disable auto retrain
%E1	Enable auto retrain†
†*default*	

6.11.18 Product Revision Level (%V)

The %V command displays the product revision level.

6.11.19 Product Serial Number ($V)

The $V command displays the product serial number.

6.11.20 Permissive/Programmable (%Z)

For dial-up operation the modem transmitter output can be set for two different modes of operation. In permissive (RJ11 jack), transmit output level is set to -9 dBm. To set the modem for permissive mode enter AT%Z. In programmable (RJ45 jack) operation, the transmit level can be set by an external program resistor. This mode is selected with AT%Z1.

Table 6-31. Permissive/Programmable (%Z).

Command	Operation
%Z	RJ-11 (permissive)†
%Z1	RJ-45 (programmable)
†*default*	

NOTE

Asterisks in AT commands are part of the command and do not indicate footnotes.

6.11.21 Talk/Data (*DA)

The AT*DA command selects talk or data mode.

Table 6-32. Talk/Data (*DA).

Command	Operation
*DA	Switches modem to talk
*DA1	Switches modem to data

6.11.22 Dial Backup (*DB)

Determines whether dial-backup mode will be manual or automatic.

Table 6-33. Dial Backup (*DB).

Command	Operation
*DB	Manual dial backup operation†
*DB1	Automatic dial backup operation
†*default*	

6.11.23 V.32 Fast Train (*FT)

The V.32 fast-train option is used to reduce training time when operating over high-quality, limited-distance dial or 2-wire leased lines.

Table 6-34. V.32 Fast Train (*FT).

Command	Operation
*FT	Disable fast train†
*FT1	Enable fast train
†*default*	

6.11.24 Return to Leased Line From Dial Backup (*LB)

On dial-up lines, *LB causes the modem to return to leased line operation from dial backup. On leased lines with forced answer enabled, *LB causes the modem to wait for a dial backup call.

6.11.25 Line Current Disconnect (*LC)

Dial line operation only. The modem can be configured to disconnect upon interruption of telephone line current.

Table 6-35. Line Current Disconnect (*LC).

Command	Operation
*LC	Line current disconnect off
*LC1	Line current disconnect short (8 ms)
*LC2	Line current disconnect long (90 ms)†
†*default*	

6.11.26 Manual Dial Backup (*LD)

Leased line operation only. *LD dials the autodial number if the modem is in originate mode with manual dial backup selected.

6.11.27 Disable AT Command Set (*NT)

AT*NT disables the AT command set.

AT*NT1 allows a remote modem to enable AT command operation of another modem via remote configuration.

Recover AT commands via LCD if needed.

Table 6-36. Disable AT Command Set (*NT).

Command	Operation
*NT	Disable AT command set
*NT1	Enable AT command set†
†*default*	

6.11.28 Answer/Originate (*OR)

Forces modem to answer or originate mode. This option is used with 2 or 4-wire leased line operation with error correction and/or dial backup.

Table 6-37. Answer/Originate (*OR).

Command	Operation
*OR	Force originate†
*OR1	Force answer
†*default*	

6.11.29 Leased-Line Transmit Level (*TLn)

Table 6-38. Leased-Line Transmit Level (*TLn).

Command	Operation
*TLn	Sets leased line TX level to n where n is a number between 0 and 15 corresponding to a TX level of 0 to -15 dBm
default is 0 dBm	

6.12 Configuration Commands

These commands recall various profiles and insert them into the active profile, store the active profile and telephone numbers in nonvolatile memory, and designate the powerup profile. Remote configuration is discussed at the end of this section.

6.12.1 Modem Power-On Configuration (&W)

The &W command stores the current modem configuration (or profile) options in nonvolatile memory. The stored configuration is retained in memory, even when power is off, until &W is issued with a new configuration or a factory configuration is restored with the &Fn command.

To store the current configuration, enter AT&W.

When the modem is reset with the Z command or power is turned on, the stored configuration becomes the current configuration. Once a proven configuration is established, this command saves time.

To reset the modem, enter ATZ.

Enter the ATZ command to reset the modem and reinstate the power-on configuration stored in the modem memory.

Figure 6-1 illustrates configuration storage and recall.

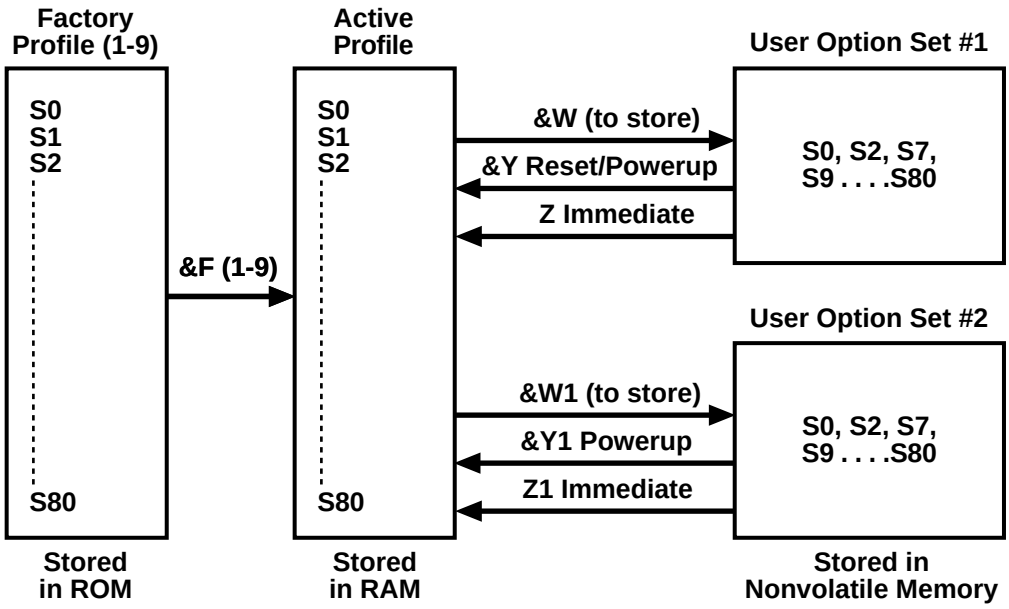

Figure 6-1. Configuration Storage and Recall.

To view the active configurations, enter AT&V

The terminal displays the active configuration in the form of S-register values.

To insert a factory configuration, enter AT&Fn (n=1-4)

The AT&Fn command loads one of four factory settings into the active profile.

6.12.2 Reset to Stored Configuration (Z)

To reset the modem to stored configuration profile, enter ATZ.

Table 6-39. Reset to Stored Configuration (Z).

Command	Operation
Z	Reset to last stored configuration

6.12.3 Load Factory Options (&F)

The AT&Fn command is used to load the factory option sets. Refer to **Appendix C** for a complete list of each set.

Table 6-40. Load Factory Options (&F).

Command	Operation
&F, &F1	Load factory option 1 (async dialup with MNP)†
&F2	Load factory option 2 (async dialup without MNP)
&F3	Load factory option 3 (sync dialup without MNP)
&F4	Load factory option 4 (sync 4-wire leased line without MNP)
†*default*	

6.12.4 View Configuration Profiles/Received Signal Parameters (&V)

Allows the user to view the current configuration profile in the form of S-register values. &V1 displays the received signal parameters.

Table 6-41. View Configuration Profiles/Received Signal Parameters (&V).

Command	Operation
&V	Displays configuration profiles
&V1	Displays received signal parameters

6.12.5 Storing a Telephone Command Line (&Z)

Nine stored phone number locations of up to 31 characters each are available in nonvolatile memory. Normally, one phone number per location is accommodated. However, a phone number longer than 31 characters will overflow into the next location. Any spaces remaining in the overflowed location cannot be used for another number. The stored phone number is retained until replaced by another number. Modem power can be turned off without affecting stored information.

Two commands can store phone numbers:

AT&Zn—Stores telephone number n, including dial modifiers, at location 1 (up to 31 digits).

AT*CNx,n—Stores telephone number n, including dial modifiers, at location x (x=1 to 9).

NOTE

Neither the AT prefix nor the D command should follow the &Z.

AT*ND—Displays the stored numbers (1-9).

NOTE

Phone numbers stored using AT commands are limited to 34 characters.

6.12.6 Retaining/Restoring Options (*RO)

This option is used when the modem is shared by two or more DTEs. When options are retained, the current configuration is not altered at disconnect. With options restored, the modem returns to the previously stored configuration on disconnect.

When the modem is configured for options to be restored, the following commands return OK but are not executed:

AT*CN Store telephone number

AT&Z Store telephone number

AT&F Recall factory configuration

AT&W Store current configuration

Table 6-42. Retaining/Restoring Options (*RO).

Command	Operation
*RO	Retain options at disconnect†
*RO1	Restore options at disconnect
†*default*	

6.13 Remote Configuration

6.13.1 Security Code (%P=)

A security code is used to prevent unauthorized access to remote configuration mode. The security code can be set to any value from 0 to 99999999 using the AT%P= <desired code> command.

Example: If the remote modem security code is 12345, then the local modem must include this code in the initialization string before the remote modem will respond. Default security code= <Blank>.

Table 6-43. Security Code (%P=).

Command	Operation
%P=	Sets security code to value entered after equals character. Example: %P=<0 to 99999999>
%P?	Request local security code to be displayed
%P=D	When the security code equals D, access for remote configuration by a remote modem is not possible

6.13.2 Remote Configuration (%T=)

This mode of operation allows the modem user to view or modify the option set of a remote modem. Entering AT%T= (security code of remote) will initiate remote configuration.

Refer to **Chapter 5** for description.

Table 6-44. Remote Configuration (%T).

Command	Operation
%T=	This command followed by the correct security code establishes remote configuration mode
&T	Exits remote configuration mode

6.14 Protocol Commands

These modes and conditions are selected by AT commands. **Table 6-45** illustrates mode and condition availabilities.

Table 6-45. Operating Modes and Conditions.

Operating Mode	Error Correction	Data Compression	Flow Control	Data	Constant Speed Interface
Normal	Disabled	Disabled	Allowed	Buffered	On or Off
Direct	Disabled	Disabled	Not allowed	Not buffered	DTE=DCE (slaved)
Reliable (MNP)	Enabled	On or off	Allowed	Buffered	On
Auto-reliable (MNP)	Enabled	On or off	Allowed	Buffered	On

6.14.1 Operating Mode (\N)

Sets the operating mode that the modem uses while in data mode. An AT\Nn command issued during command mode while a connection is in progress will not affect the current connection but will be acted on for subsequent connections. Refer to **Chapter 9** for descriptions.

Table 6-46. Operating Mode (\N).

Command	Operation
\N	Normal mode (no error control): data is buffered
\N1	Direct mode (no error control): data is not buffered
\N2	Reliable mode (MNP only)
\N3	Auto-reliable mode (try MNP then fall back to normal async)

6.14.2 Serial Port (DTE) bps Adjust (\J)

The AT\J command allows DCE and DTE to operate at different speeds. The AT\J1 command forces serial-port (DTE) speed to follow data link speed in any mode.

If the modem is in direct mode (\J1) and a DCE link is established at a speed other than that of the original DTE autobaud speed, the modem will issue the CONNECT message for the new DTE speed at the original rate. All subsequent data will be sent to the DTE at the new DCE speed.

Table 6-47. Serial Port (DTE) bps Adjust (\J).

Command	Operation
\J	Disable slaved DTE/DCE (constant speed DTE on)†
\J1	Enable slaved DTE/DCE (constant speed DTE off)

†*default*

6.14.3 Data-Link Flow Control (\G)

Enables or disables flow control used to pace data sent from the remote modem to the local modem during a normal connection. When AT\G1 is set, the modem uses XON/XOFF to start/stop data transmission from the remote modem. This command is ignored during a reliable connection.

Table 6-48. Data Link Flow Control (\G).

Command	Operation
\G	Disable modem-port flow control†
\G1	Enable modem-port XON/XOFF flow control
†*default*	

6.14.4 Serial-Port Flow Control (\Q)

Sets the type of flow control used by the serial port. If the serial-port speed exceeds that of the modem connection, characters may be sent by the DTE to the modem faster than it can send them to the remote modem. The modem holds characters in an internal buffer until they can be transmitted. When this buffer is full, the modem uses flow control to cause the DTE to stop sending characters. As the modem continues to transmit data and the buffer empties, flow control is again used to cause the DTE to resume sending data.

AT\Q disables flow control.

When AT\Q1 is set, the modem generates and accepts XON/XOFF characters to start and stop the data flow. These characters have the same parity as the DTE setup taken from the last AT command.

AT\Q2 allows use of CTS off to stop the data from the DTE and CTS on to restart it.

AT\Q3 forces the modem to act on CTS like \Q2. In addition, RTS on/off is used to start and stop data from the modem to the DTE.

Table 6-49. Serial-Port Flow Control (\Q).

Command	Operation
\Q	Disable DTE flow control
\Q1	Enable XON/XOFF flow control†
\Q2	Enable CTS flow control
\Q3	Enable bilateral CTS/RTS flow control

†*default*

6.14.5 XON/XOFF Passthrough (\X)

This option is active when flow control of the modem by the DTE has been selected for XON/XOFF and the connect mode is reliable or normal. It enables or disables the sending of local flow control characters (XON/XOFF) to the remote modem. In reliable mode, the modem treats incoming XON/XOFF characters from the remote modem as data characters. In normal mode, the modem will look at the \G command and act accordingly.

CAUTION

With \X1 in effect, local flow-control characters will be sent to the remote system. These characters may turn on the flow of data from the remote system before the modem is ready to receive more data, possibly resulting in a loss of data.

Table 6-50. XON/XOFF Passthrough (\X).

Command	Operation
\X	Process but do not pass XON/XOFF characters to remote DCE†
\X1	Process and pass XON/XOFF characters to remote DCE
†*default*	

6.14.6 MNP Data Compression (%C)

To enable data compression while running MNP protocol, enter AT%C1. To disable data compression, enter AT%C.

Table 6-51. MNP Data Compression (%C).

Command	Operation
%C	Data compression disabled
%C1	Data compression enabled†
†*default*	

6.14.7 Auto-Reliable Fallback Character (%An)

Selects the ASCII character to be recognized as the auto-reliable fallback character by the answering modem. During negotiation of protocol in auto-reliable mode, the answering modem switches from reliable to normal mode upon receipt of the auto-reliable fallback character from the calling modem and passes the character to the serial port.

To set the auto-reliable fallback character, enter AT%An, where n=1 to 127 decimal representing an ASCII character

The default of 0 disables auto-reliable fallback character.

Table 6-52. Auto-Reliable Fallback Character (%An).

Command	Operation
%An	Sets ASCII character to be recognized as the auto-reliable fallback character.

NOTE

The modem must be configured for auto-reliable mode (AT\N3).

6.14.8 Break Control (\Kn)

Use AT\Kn (n =0-5) to indicate the action taken by the modem when a break is encountered.

Table 6-53. Break Control (\Kn).

Command	Operation
\K	Break option 0
\K1	Break option 1
\K2	Break option 2
\K3	Break option 3
\K4	Break option 4
\K5	Break option 5†
†*default*	

Conditions under which breaks may occur are explained below with descriptions of the modem's response under the different \K command break options.

1. If a break is sent to the serial port while the modem is in connect state during a reliable or normal connection (no protocol, data buffered):

Table 6-54. Break-Control Command Effects.

Command	Effect
\K, \K2, \K4	Enter command mode but do not send break to the remote modem
\K1	Empty the data buffers and send break to the remote modem
\K3	Immediately send break to the remote modem
\K5	Send break to the remote modem in sequence with any data received from the serial port

2. If a break is sent to the serial port while the modem is in connect state during a direct connection (no protocol, data not buffered):

Table 6-55. Break-Control Command Effects.

Command	Effect
\K, \K2, \K4	Immediately send a break to the remote modem and enter command state when break is through
\K1, \K3, \K5	Immediately send a break to the remote modem

3. If a break is received from the remote modem while the modem is in connect state during a normal connection (no protocol, data buffered):

Table 6-56. Break-Control Command Effects.

Command	Effect
\K, \K1	Empty the data buffers and send a break to the serial port
\K2, \K3	Immediately send a break to the serial port
\K4, \K5	Send a break to the serial port in sequence with any data received from remote modem

4. If a transmit break command is issued while the modem is in command state during a reliable (MNP) or normal connection (no protocol, data buffered):

Table 6-57. Break-Control Command Effects.

Command	Effect
\K, \K1	Empty the data buffers and send a break to the remote modem
\K2, \K3	Immediately send a break to the remote modem
\K4, \K5	Send a break to the remote modem in sequence with any data received from the serial port

6.14.9 Maximum MNP Block Size (\A)

Sets the maximum transmit block size for reliable connections. Use this command to force the modem to transmit smaller blocks when in a reliable connection. The modem sends a block up to the size specified by the AT\A command.

Table 6-58. Maximum MNP Block Size (\A).

Command	Operation
\A	Maximum transmit block size=64 characters
\A1	Maximum transmit block size=128 characters
\A2	Maximum transmit block size=192 characters
\A3	Maximum transmit block size=256 characters†

†*default*

6.14.10 MNP Inactivity Timer (\T)

Specifies the number of minutes the modem will stay online in a reliable mode without transmitting or receiving data. When time is set to 0, it is disabled. The timer is active only during a reliable connection.

Table 6-59. MNP Inactivity Timer (\T).

Command	Operation
\T	Disable inactivity timer†
\Tn	Set inactivity to n (n=1-90) minutes

†*default*

6.14.11 Protocol Result Codes (\V)

Enables or disables protocol result codes. See **Table 6-60**.

Table 6-60. Protocol Result Codes (\V).

Command	Operation
\V	Disable protocol result codes†
\V1	Enable protocol result codes
†*default*	

6.14.12 Transmit Break/Set Break Length (\B)

AT\B commands the local modem to send a break signal to the remote modem. In all modes except direct, S-register 79 determines the length of the break sent to the DTE by the modem when it receives a break signal over the link. S79 may be set directly or via AT\Bn, where n=1-255 in 20-ms increments. The default is 35 (700 ms).

Table 6-61. Transmit Break/Set Break Length (\B).

Command	Operation
\B	Sends a break signal to the remote modem (does not modify S79)
\Bn	Sets S79 to length of break desired: n=1-255 in 20-ms increments. Default is 35 (700 ms).

6.14.13 Set Auto-Reliable Buffer (\C)

Determines whether or not the answering modem will buffer data received from the non-reliable originate modem during the 4-second interval the answer modem attempts to establish a reliable link. Use these commands when the modem is in the auto-reliable mode and is expected to process a non-reliable call. Refer to **Chapter 9** for information on reliable mode.

Table 6-62. Set Auto-Reliable Buffer (\C).

Command	Operation
\C	Disable auto-reliable data buffer†
\C1	Buffer data for 4 seconds or 200 characters
†*default*	

6.14.14 Originate MNP Link (\O)

The AT\O command forces the local modem to return online and initiate a MNP link regardless of whether it originated or answered the call. For this command to succeed, the remote modem must have received the AT\U command. The modem sends two link requests (18 seconds); if the remote modem does not respond, the modem returns to normal mode.

Table 6-63. Originate MNP Link (\O).

Command	Operation
\O	Originate a reliable link

6.14.15 Accept an MNP Link (\U)

Forces the modem to return online and accept a reliable link independent of whether the modem originated or answered the call. For this command to succeed, the remote modem must have received the AT\O command.

This command will cause the modem to wait indefinitely for the remote modem to issue the "originate MNP link" command.

Table 6-64. Accept an MNP Link (\U).

Command	Operation
\U	Accept an MNP link

6.14.16 Switch from Normal to MNP (\Y)

Entering \Y causes the modem to return online and attempt a reliable link while connected in normal or direct mode. If the modem was in originate mode for the call, it will initiate a reliable link; if it was in answer mode, it will accept a reliable link from the remote modem. The remote modem must switch to reliable mode for this command to succeed. The modem will return to a normal connection if a reliable link is not established in 18 seconds.

Table 6-65. Switch from Normal to MNP (\Y).

Command	Operation
\Y	Switch from normal to MNP

6.14.17 Switch from MNP to Normal (\Z)

This command causes the modem to return online and switch from a reliable connection to a normal connection.

Table 6-66. Switch from MNP to Normal (\Z).

Command	Operation
\Z	Switch from MNP to normal

NOTE

If \J1 and \C are set, the \Z command forces the modem to the direct mode.

7. Status Registers

Most users can skip this chapter. Your communications software, or the AT commands described in **Chapter 6**, will be enough to configure your modem for everything you need it to do.

However, manipulating the status registers (usually called "S-registers") directly gives programmers more sophisticated capabilities. This chapter explains what the S-registers are and how to use them to change the configuration of the modem.

7.1 How S-Registers Work

The S-registers hold all the modem's configuration information. When you send—or your software sends—an AT command to change the configuration, the AT command changes a number in one of the S-registers.

You can also change the S-registers directly by "writing" to them—using ATS commands to change the numbers stored in the registers. Except for certain "read-only" registers, which cannot be changed by ATS commands, every S-register can be manipulated this way.

See **Appendix D** for a complete list of the modem's S-registers.

Bit values for S-registers must not be confused with the total register value. In some S-Registers, bit values are counted separately for each option group (a technique called bit-mapping), while the register value is the cumulative decimal or hexadecimal total. The decimal value counts all eight bits as a single group. Hexadecimal values split the bits into two groups of four each. Writing to an S-register changes the total value.

Figure 7-1 illustrates the difference between decimal calculation and hexadecimal calculation.

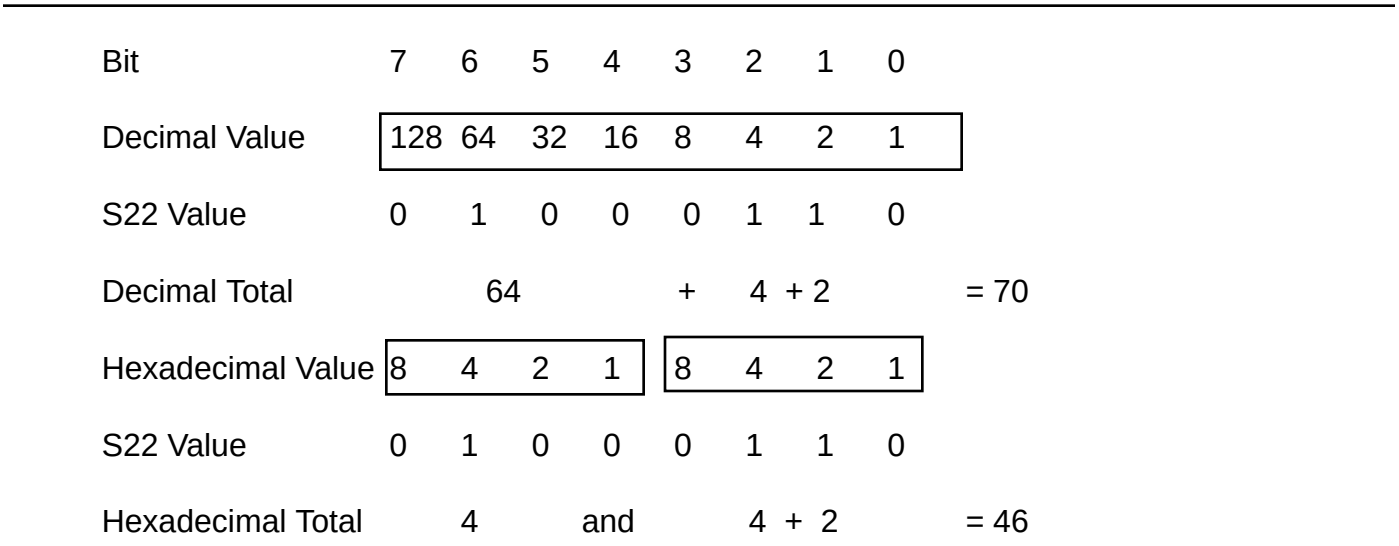

Figure 7-1. Calculating S-Register Values.

7.2 S-Register Operation

To read a register value:

Enter ATSn? (n=register number) for decimal value

or ATSn?^ for hexadecimal value

For example, to determine the current backspace character

Enter ATS5?

The screen will show the ASCII value of the backspace character stored in register S5.

To change (write to) a register value:

Enter ATSn=v (n=register number, v=decimal value)

or ATSn=^v (^v=hexadecimal value)

NOTE

Not all registers can be set by the ATSn=v (or ^v) command. Remember that some registers are read-only.

To change the escape character from + to the ESC key (ASCII value of 27):

Enter ATS2=27

To return the modem to the command mode press the ESC key three times:

(pause) ESC ESC ESC (pause)

7.2.1 Individual Bit Command (Sn .(bit#) = v)

Most operators use AT commands as the primary method of changing S-register options. However, some options stored in registers do not have an associated AT command. For these options, an individual bit AT command can be used to change the setting of the bit controlling the option.

To change a single bit value within a register:

Enter ATSn . (bit#) = v, where n= register number, v= bit value 1 or 0

Example:

S-register 27, bit 2 selects dial-up or leased-line operation.

- AT command method:

  AT&L selects dial-up operation (sets S27 bit 2 to 0)

  AT&L1 selects leased-line operation (sets S27 bit 2 to 1)

- Individual bit method:

  ATS27.2=0 selects dial-up operation (sets S27 bit 2 to 0)

  ATS27.2=1 selects leased line operation (sets S27 bit 2 to 1)

NOTE

This method of option selection can be used on all S-registers except read-only registers.

7.2.2 AUTOANSWER (S0 = 0-255)

This register turns autoanswer on or off. Set the register to 0 to turn autoanswer off.

Set the register to any nonzero (1-255) value to turn autoanswer on. The number selected is the ring count the modem answers on. For example, if S0 equals 4, the modem answers the call on the fourth ring. The default value is 1.

7.2.3 RING COUNT (S1 = 0-255)

This register contains the ring count for each incoming call. There is no need to change its value since it is reset by each call or if no rings occur after 8 seconds. If you are developing communications software, you can have the program read the register to determine the ring total.

7.2.4 ESCAPE CHARACTER (S2 = 0-255)

The standard escape character is a + sign (ASCII value of 43). To change the character, set S2 to the desired ASCII value.

To disable the escape command, set S2 to any value greater than 127.

7.2.5 END-OF-LINE CHARACTER (S3 = 0-127)

The standard character is the carriage return (ASCII value of 13). This character ends each command as it is sent to the modem. It is also sent by the modem after each status message or number code.

To change the character, set S3 to the desired ASCII value (0-127).

7.2.6 LINE-FEED CHARACTER (S4 = 0-127)

The standard character is the line feed (ASCII value of 10). This character is sent by the modem after each status message. To change it, set S4 as desired (0-127).

7.2.7 BACKSPACE CHARACTER (S5 = 0-127)

The standard character is the backspace (ASCII value of 8). To change it, set S5 to the desired value (0-127).

7.2.8 PAUSE BEFORE DIALING (S6 = 0-255)

When dial tone detection is disabled (command X, X1, or X3 in effect), the modem waits the number of seconds (0-255) stored in this register before dialing. The default value is 2 (seconds).

7.2.9 PAUSE FOR RINGBACK DETECTION/PAUSE FOR CARRIER DETECTION (S7 = 1-30)

If no ringback is detected in the number of seconds in S7 (1-30), the modem disconnects and sends the NO CARRIER message or code. If ringback is detected, the modem begins to look for a carrier.

If no carrier is detected within the number of seconds in S7, the modem hangs up and sends the NO CARRIER message or code.

Values between 1 and 30 may be used. The default value is 30 (seconds).

7.2.10 Pause Interval for Comma (S8 = 0-255)

When a dial command contains a comma, the modem pauses the number of seconds in S8. Change S8 to change the basic pause interval (0-255), or use several commas in a row for greater delay during dialing.

The default value is 2 (seconds).

7.2.11 Carrier Detect Time (S9 = 0-255)

Amount of time (0-255) in 0.1-second increments the carrier must be present to be recognized. The default value is 6 (0.6 second). Data Carrier Detect (DCD) will be raised when carrier is recognized. This timer can be extended to lessen the likelihood of false detection of carrier.

7.2.12 Lost Carrier Detect Time (S10 = 0-255)

Amount of time (0-255) in 0.1-second increments needed to recognize the loss of carrier. Data carrier detect (DCD) will be dropped when the loss of carrier is recognized and the modem disconnects. The default value is 14 (1.4 seconds).

NOTE

If S10 is less than S9, any loss of carrier results in a disconnect. When S10 is larger than S9, the length of time that a carrier loss can be tolerated is the difference between S10 and S9.

7.2.13 DTMF Tone Duration (S11)

Determines the length of DTMF tones in 1-ms increments. The period of silence is equal to the duration of the tone. The value of this register must be entered in multiples of 10. Default value is 80 (80 ms).

7.2.14 Escape Sequence Pause Interval (S12 = 0-255)

Using the escape sequence to return to command mode from data mode requires two pauses, one before and one after the escape characters.

The pauses prevent the modem from responding to a character sequence which might contain the escape sequence as part of its normal data transmission.

S12 contains the pause interval in 0.02-second increments. The factory setting is 50, equivalent to 1 second (50 x 0.02 sec). When S12 is 0, timing is not a factor.

The timing between the three escape characters must be less than the pause interval, or the escape sequence will not be detected. The data rate also affects the timing and must be taken into account when changing the pause interval.

To disable the escape command, set S2 to a value greater than 127 instead of changing S12. Values between 0 and 255 may be used for S12.

7.2.15 S13

Not used

NOTE

When S-registers have parallel AT commands, the commands are listed in the register tables as a cross reference. If no command exists for the option, the column is left blank.

7.2.16 S14 (Bit-Mapped Options)

Table 7-2. S14 (Bit-Mapped Option).

Bit	Value	Command	Description
0	—	—	Reserved
1	0 †1	E E1	Local character echo off Local character echo on
2	†0 1	Q Q1	Response displays on Response displays off
3	0 †1	V V1	Response digit messages Response word message
4	†0 1	 Q2	Ignore Response display on in originate mode only
5	†0 1	T P	Tone dial Pulse dial
6	0 †1	H2 H3	V.32 cleardown enabled V.32 cleardown disabled
7	0 †1	*OR1 *OR	Forced answer Normal answer
†*default*			

NOTE

If status bits are of interest, read the register value to find which bits are set.

7.2.17 S15

Not used

7.2.18 System Tests (S16)

Contains the status of system-test settings.

Table 7-3. System Tests (S16).

Bit	Value	Command	Description
0	0	—	Analog loopback inactive
			Analog loopback in progress
1	—	—	Reserved
2	0		Digital loopback inactive
	1		Digital loopback in progress
3	0		Slaved digital loopback inactive
	1		Slaved digital loopback in progress
4	0		Remote digital loopback inactive
	1		Remote digital loopback in progress
5	0		Self test remote digital loopback inactive
	1		Self test remote digital loopback in progress
6	0		Self test analog loopback inactive
	1		Self test analog loopback in progress
7	—	—	Reserved

7.2.19 S17

Not used

7.2.20 Test Timeout (S18)

Amount of time (0-255), in 1-second increments, that a diagnostic test will run. A value of 0 disables the timer. The default value is 0.

7.2.21 S19, 20

Not used

7.2.22 S21 (Bit-Mapped Options)

Table 7-4. S21 (Bit-Mapped Options).

Bit	Value	Command	Description
6, 0	†00	&S	DSR always on
	10	&S1	DSR on when off hook in data mode
	01	&S2	DSR off 5 seconds after disconnect
	11	&S3	DSR follows off hook (OH)
5, 1	†00	&C	DCD always on
	10	&C1	DCD follows carrier from remote modem
	01	&C2	DCD on except for 5 seconds after disconnect
	11	&C3	DCD follows RTS on remote modem; in reliable mode follows carrier only
2	0	&R	CTS follows RTS by S26 delay
	†1	&R1	CTS always on
4, 3	†00	&D	DTR ignored
	01	&D1	DTR on/off transition recalls asynchronous command state
	10	&D2	DTR on/off transition causes disconnect
	11	&D3	DTR on-to-off transition disconnects and resets modem to current stored configuration
7	0	Y	Long space disconnect disabled
	†1	Y1	Long space disconnect enabled
†*default*			

7.2.23 S22 (Bit-Mapped Options)

Table 7-5. Bit Mapped (S22).

Bit	Value	Command	Description
1, 0	00	L	Speaker volume low
	01	L1	Speaker volume low
	†10	L2	Speaker volume medium
	11	L3	Speaker volume high
3, 2	00	M	Speaker off
	†01	M1	Speaker on until carrier detect
	10	M2	Speaker always on
	11	M3	Speaker off when modem is dialing
6, 5, 4	000	X	CONNECT message only, blind dials, no busy detect
	001	X1	CONNECT/appropriate code for rate, blink dials, no busy detect
	010	X2	CONNECT/appropriate code for rate, waits for dial tone, no busy detect
	011	X3	CONNECT/appropriate code for rate, blind dials, reports BUSY
	†100	X4	CONNECT/appropriate code for rate, waits for dial tone, reports BUSY
7	†0	&P	Make/break ratio (US) 39/61
	1	&P1	Make/break ratio (UK) 33/67

†default

7.2.24 S23 (Bit-Mapped Options)

Table 7-6. S23 (Bit-Mapped Options).

Bit	Value	Command	Description
0	0	&T5	Remote digital loopback disabled
	†1	&T4	Remote digital loopback enabled
5-1	—	—	Reserved
7, 6	†00	&G	No guard tone
	01	&G1	550-Hz guard tone
	10	&G2	1800-Hz guard tone
	11	—	Not used

†default

7.2.25 S24

Not used

7.2.26 DTR State Recognition Time (S25)

The S25 register specifies the amount of time (0-255) in 0.01-second (10-ms) increments that DTR must stay high or low in order to be recognized as such. The default value is 5 (0.05 second).

7.2.27 RTS/CTS Delay (S26)

The S26 register specifies the amount of time (0-255) in 0.01-second (10-ms) increments between the RTS signal and the CTS signal. The default value is 0.

7.2.28 S27 (Bit-Mapped Options)

Table 7-7. S27 (Bit-Mapped Options).

Bit	Value	Command	Description
1, 0	†00	&M	Async
	01	&M1	Sync data/async dial
	10	&M2	Sync data/dial through DTR
	11	&M3	Sync data/manual dial
2	†0	&L	Dialup line
	1	&L1 and &L2	Leased line
3	—	—	Reserved
5, 4	†00	&X	Internal clock
	01	&X1	External clock
	10	&X2	Receive clock
	11	—	Not used
6	1		Enable async DTR dialer
	0		Disable async DTR dialer
7	—	—	Reserved

†default

7.2.29 Lookback Timer (S28)

Amount of time in 1-minute increments that the modem will remain in dial-backup mode before retrying leased-line mode. This is only used if automatic dial backup is enabled. A zero will disable automatic lookback to leased-line mode. The default value is 15 minutes.

Table 7-8. Lookback Timer (S28).

Bit	Value	Command	Description
7-0	0-255		Time in 1-minute increments (0=disabled)

7.2.30 S29 (Bit-Mapped Options)

Table 7-9. S29 (Bit-Mapped Options).

Bit	Value	Command	Description
0	†0		Enable AT command set
	1	*NT	Disable AT command set
1	†0	*RO	Options retained at disconnect
	1	*RO1	Options restored at disconnect
2	†0	*FT	Disable V.32 fast train
	1	*FT1	Enable V.32 fast train
6-3	—	—	Reserved
7	†0	*FB	DTE fallback disabled
	1	*FB1	DTE fallback enabled

†*default*

7.2.31 S30 (Bit-Mapped Options)

Table 7-10. S30 (Bit-Mapped Options).

Bit	Value	Command	Description
0	—	—	Reserved
1	†0 1		V.25 ASCII V.25 EBCDIC
4-2	—	—	Reserved
5	†0 1		NRZ NRZI
7, 6	00 01 †10 11	 &M4 &M5 —	V.25 disabled V.25 Bisync V.25 SDLC Reserved

†*default*

7.2.32 S31

Reserved

7.2.33 S32 (Bit-Mapped Options)

Table 7-11. S32 (Bit-Mapped Options).

Bit	Value	Command	Description
0	0 1	&L1 &L2	2-wire (leased line only) 4-wire (leased line only)
1	0 †1	*LC1 *LC2	Line current disconnect=short Line current disconnect=long
2	0 †1	*LC *LC1 or *LC2	Line current disconnect=disable Line current disconnect=enable
3	†0 1	*DB *DB1	Dial backup=manual Dial backup=automatic
7-4	—	—	Reserved

†*default*

7.2.34 S33

Reserved

7.2.35 S34 (BIT-MAPPED OPTIONS)

Table 7-12. S34 (Bit-Mapped Options).

Bit	Value	Command	Description
0	†0 1	*AN *AN1	Bilateral analog=disable Bilateral analog=enable
1	†0 1	*DG *DG1	Bilateral digital=disable Bilateral digital=enable
2	†0 1	*LA *LA1	DTE commanded LAL=disable DTE commanded LAL=enable
3	0 1	*RD *RD1	DTE commanded RDL=disable DTE commanded RDL=enable
7-4	—	—	Reserved

†*default*

7.2.36 S35-38

Reserved

7.2.37 S39 (BIT-MAPPED OPTIONS)

Table 7-13. S39 (Bit-Mapped Options).

Bit	Value	Command	Description
0-4	—	—	Reserved
5	†0 1		DTE rate is sent with CONNECT message DCE rate is sent with CONNECT message
6-7	—	—	Reserved

†*default*

7.2.38 S40-51

Reserved

7.2.39 S52 (Bit-Mapped Options)

Selects leased-line transmit level from 0 to -15 dBm in 1-dB increments.

Table 7-14. S52 (Bit-Mapped Options).

Bit	Value	Command	Description
3-0	†0 to 15	*TLn (n=0-15)	Transmit level in dB 0 dB through -15 dB)
7-4	—	—	Reserved

†*default*

7.2.40 801 V.32 Timeout (S53)

Selects 801 (ACU) V.32 timeout.

Table 7-15. 801 V.32 Timeout (S53).

Bit	Value	Command	Description
0	†0 1		801 V.32 timeout long 801 V.32 timeout short
7-1	—	—	Reserved

†*default*

7.2.41 Flow Control (S54)

Selects flow-control options.

Table 7-16. Flow Control (S54).

Bit	Value	Command	Description
1, 0	00	\Q	Disable DTE flow control
	*01	\Q1	Enable DTE XON/XOFF flow control
	10	\Q2	Enable DTE CTS flow control
	11	\Q3	Enable bilateral CTS/RTS flow control
2	—	—	Reserved
3	†0	\G	Disable modem port flow control
	1	\G1	Enable modem port XON/XOFF flow control
4	†0	\X	No XON/XOFF characters to remote
	1	\X1	Pass XON/XOFF characters to remote
7-5	—	—	Reserved

†*default*

7.2.42 S55, 56

Reserved

7.2.43 Number Code Application (S57)

Table 7-17. Number Code Application (S57).

Bit	Value	Command	Description
0	†0	*RC	Standard number codes 15—4800 bps 18—9600 bps
		*RC1	Alternate number codes 11—4800 bps 12—9600 bps
7-1	—		Reserved

†*default*

7.2.44 MNP Inactivity Timer (S58)

Specifies the number of minutes the modem waits before terminating a call when no data is sent or received. 0 disables timer.

AT\Tn load inactivity timer, n=0-255 minutes.

Table 7-18. MNP Inactivity Timer (S58).

Bit	Value	Command	Description
7-0	†0 1-255	\T \Tn (n=1-255)	Disable Timer value in minutes

†*default*

7.2.45 MNP Break Control (S59)

Determines action taken when a break is encountered. Refer to **Section 6.14.8** for further explanation.

Table 7-19. MNP Break Control (S59).

Bit	Value	Command	Description
2, 1, 0	000 001 010 011 100 †101	\K \K1 \K2 \K3 \K4 \K5	MNP break option 0 MNP break option 1 MNP break option 2 MNP break option 3 MNP break option 4 MNP break option 5
7-3	—	—	Reserved

†*default*

7.2.46 Bit Mapped (S60)

Table 7-20. Bit Mapped (S60).

Bit	Value	Command	Description
0	0	%E	Disable auto retrain
	†1	%E1	Enable auto retrain
1	0	%C	Disable data compression
	†1	%C1	Enable data compression
2	†0	\C	Disable auto reliable data buffer
	1	\C1	Buffer data for 4 seconds or 200 characters
5, 4, 3	111	\O	Originate an MNP link
	110	\U	Accept an MNP link
	101	\Y	Switch to MNP from normal
	100	\Z	Switch to normal from MNP
	†001-000		Normal mode selected from S70
6	0	\R	RI blinks for ring and remains on for duration of call
	†1	\R1	RI blinks for ring and turns off when call is answered
7	†0	\V	Disable protocol result codes
	1	\V1	Enable protocol result codes

†*default*

7.2.47 DTE Speed (S61)

Indicates DTE rate. Works in conjunction with the DCE rate in S69.

This register is read-only.

Table 7-21. DTE Speed (S61).

Bit	Value	Command	Description
2, 1, 0	001		0-300
	010		1200
	011		2400
	100		4800
	—	—	Not used
	†110		9600
	111		19200
	—	—	Not used
3	0		7 bit word length
	1		8 bit word length
5, 4	01		No parity
	10		Odd parity
	11		Even parity
7, 6	—	—	Reserved

†*default*

7.2.48 Disconnect Buffer Delay (S62)

Determines delay to allow buffers to empty before disconnect when disconnect conditions exist.

Table 7-22. Disconnect Buffer Delay (S62).

Bit	Value	Command	Description
7-0	†0	%D	Buffer disabled
	1-255	%Dn	Disconnect buffer delay value (seconds)

†*default*

7.2.49 Maximum MNP Block Size (S63)

Sets maximum transmit block size.

Table 7-23. Maximum MNP Block Size (S63).

Bit	Value	Command	Description
7-0	63	\A	Maximum block size=64
	127	\A1	Maximum block size=128
	191	\A2	Maximum block size=192
	†255	\A3	Maximum block size=256

†*default*

7.2.50 Auto-Reliable Fallback Character (S64)

Stores the selected ASCII value of the auto-reliable fallback character.

Table 7-24. Auto-Reliable Fallback Character (S64).

Bit	Value	Command	Description
6-0	†0	%A	Disable auto-reliable fallback character
	1-127	%An	ASCII value 1-127
7	—	—	Reserved

7.2.51 S65-66

Reserved

7.2.52 Link Speed Status (S67)

Indicates the true data link speed. This register is read-only.

Table 7-25. Link Speed Status (S67).

Bit	Value	Command	Description
2, 1, 0	001		300 bps
	010		1200 bps
	011		2400 bps
	100		4800 bps
	101		9600 bps
7-3	—	—	Reserved

7.2.53 S68

Reserved

7.2.54 DCE-Independent Speed (S69)

Selects DCE-independent rate operation. When S69 is 0, DTE and DCE rates are equal and the maximum originate connect rate is determined by S61. When S69 is non-zero, the maximum originate connect rate is determined by S69.

Table 7-26. DCE-Independent Speed (S69).

Bit	Value	Command	Description
2, 1, 0	000	%B	Use rate indicated by S61
	001	%B1	0-300 bps
	010	%B2	1200 bps
	011	%B3	2400 bps
	100	%B4	4800 bps
	101	%B5	9600 bps uncoded
	†110	%B6	9600 bps trellis
7-3	—	—	Reserved

†default

7.2.55 Operating Mode (S70)

Table 7-27. Operating Mode (S70).

Bit	Value	Command	Description
1, 0	00	\N	Normal mode (no error control, data is buffered)
	01	\N1	Direct mode (no error control, no buffering)
	10	\N2	MNP mode (reliable only)
	†11	\N3	Auto-reliable mode (try MNP, fall back to normal)
7-2	—	—	Reserved

†default

7.2.56 Operating Mode Status (S71)

Indicates level of MNP error-controlling protocol. This register is read-only.

Table 7-28. Operating Mode Status (S71).

Bit	Value	Command	Description
2, 1, 0	000		No MNP
	001		Negotiating MNP
	010		MNP level 2
	011		MNP level 3
	100		MNP level 4
	†101		MNP level 5
7-3	—	—	Reserved

†*default*

7.2.57 S72 (Bit-Mapped Options)

Table 7-29. S72 (Bit-Mapped Options).

Bit	Value	Command	Description
0	0†	\J	Disable slaved DTE/DCE (constant speed DTE on)
	1	\J1	Enable slaved DTE/DCE (constant speed DTE off)
1	0†		Link parity option disabled
	1		Link parity option enabled
2	0†		No link parity error
	1		Link parity error received (cleared on read)
3	0†		CTS does not follow DCD
	1	&R2	CTS follows DCD
4	0†		CTS does not equal RTS
	1	&R9	CTS equals RTS
6-5	—	—	Reserved
7	0†		Disable autocallback
	1		Enable autocallback

†*default*

7.2.58 S73-77

Reserved

7.2.59 Autocallback Timer (S78)

Specifies the time in seconds that the modem waits for autocallback. Default is 30 seconds.

Table 7-30. Autocallback Timer (S78).

Bit	Value	Command	Description
7-0	0-255		Time in seconds to wait for autocallback

7.2.60 Break Length (S79)

Sets length of the break sent to the DTE when a break signal is received. Range from 1-255 in 20-ms increments. Default is 35 (700 ms).

Table 7-31. Break Length (S79).

Bit	Value	Command	Description
7-0	1-255	\B \Bn	Send break Set break length (n=1-255)

7.2.61 S80-83

Reserved

7.2.62 S84 (Bit-Mapped Options)

Table 7-32. S84 (Bit-Mapped Options).

Bit	Value	Command	Description
0	0† 1		Any-key abort enabled Any-key abort disabled
1	0† 1		Remote DCD goes low in RDL and remote configuration Remote DCD stays high in RDL and remote configuration
2	0† 1		Fallback to V.22 rates normally Reduced time to fallback to V.22 rates
3	0† 1		Answerback normally Reduces answerback time
4	0† 1		With DTR disconnects, 4 DTR transitions initiate autodial backup With DTR disconnects, 1 DTR transition initiates autodial backup
5	—	—	Reserved
6	0† 1		Allow switch-hook capability while in leased-line mode Disallow switch-hook capability while in leased-line mode
7	0† 1		Pin 25 of DTE used for test-mode status Pin 25 of DTE used for in dial-backup status

†*default*

8. V.25 bis Autodialer

8.1 General

V.25 bis is an option that allows dialing functions to be controlled using synchronous data.

Select this option by the front panel LCD or by the appropriate &M command in the AT command set (**see Section 6.11.12**).

If using the LCD:

- Scroll through the menu to Main Menu 5, MODIFY CONFIGURATION.
- Advance to and enter the DTE OPTIONS submenu.
- Select SYNC DATA.
- Advance to DIAL METHOD.
- Select either V.25 BISYNC DIALER or V.25 SDLC DIALER and then select either ASCII or EBCDIC character format.

NOTE

The modem must be configured as V.25 SDLC ASCII NRZ to use it with an IBM® AS/400® computer.

AUTODIALER COMMAND STRINGS AND PARAMETERS

Most command strings for the autodialer include two parts: the command itself and the parameter(s) that follow. For the purposes of this chapter, parameters can be telephone numbers or anything appropriate to V.25 bis as described in the following text. Parameters are separated by semicolons.

For example:

PRN a; nnn . . . n (where a=the phone number address in memory and nnn . . . n = the phone number)

The a and the nnn . . . n are both parameters.

Not all commands have parameters. For example, the CIC command has no parameter.

8.2 Guidelines

Use the following guidelines when working with V.25 bis software:

- An indicator enclosed in angle brackets < > represents a specific character in the appropriate character set, ASCII or EBCDIC.

  <sp> - space

- Each response below is considered an individual message per V.25 bis conventions. A dial command with intermediate call progress enabled is illustrated:

From DTE	*To DTE*
<sy><sy><stx>CRN<sp>(205)555-0124<etx>	
	<sy><sy><stx>VAL<etb>
	<sy><sy><stx>CNX<sp>@9600BPS<etx>

- Spaces in a command from the DTE are optional and ignored.
- Command strings can be upper- or lower-case. Responses are always upper-case.
- Only synchronous data formats are implemented. They include Bisync and SDLC (NRZ format) in ASCII or EBCDIC. Select NRZ or NRZI format as required by altering register S30.

EXPLANATIONS OF INVALID RESPONSES

Except when stated otherwise, the following explanations for invalid INV responses apply:

INVCU Any transmission error (parity, framing, etc.).

INVMS Receiving too many characters for any command.

INVMS Any command followed by a semicolon (;).

INVPS This message has one of three possible meanings:

- Any parameter set ending with a semicolon (;).
- Any parameter set containing too many or not enough parameters; this includes

— any command entered without parameters that requires parameters

— any command entered with parameters that does not require parameters.

- Any parameter containing too many characters.

8.3 Dial Parameters

Table 8-1 describes the parameters used in autodialing. The memory available for dialing can hold up to 40 characters. Parameters inserted for readability are not counted.

Table 8-1. V.25bis Dial Parameters.

Character	Function
0 through 9	DTMF and pulse digit
* and #	DTMF digit
: (colon)	Wait for dial tone
W	Wait for second type of dial tone
>	Pause for 1 second
=	Pause for 3 seconds
<	Pause for programmed delay time
P	Pulse-dial
T	Tone-dial
&	Flash (go on hook) for ½ ms
; (semicolon)	Parameter separator
Space, dash, parenthesis, period	Parameters inserted for readability

8.4 V.25 bis Command and Response Definitions

The following sections describe the commands used with the V.25 bis autodialer and explain the responses received when each command is executed.

8.4.1 Dial Command (CRN *nn...n)*

The dial command is CRN followed by the number to be dialed (*nn...n)*. The modem accepts up to 40 dial parameters, excluding the CRN command and any leading spaces.

Responses:

VAL Valid command received. Transmitted on receiving an error-free command with no transmission error such as a parity error. This confirmation is sent before the command is executed.

INVCU Invalid command—command unknown.

Example:

TRN (205)-555-0124

INVMS Invalid command—message syntax error.

Examples:

CRN;(205)-555-0124

CRN; (semicolon invalid)

INVPS Invalid command—parameter syntax error.

Examples:

CRN (205)-555-0124

CRN (205)-555;0124

CRN

INVPV Invalid command—parameter value error.

Examples:

CRN (205)-555-012Q

CRN - - - -

CFIET Call failure—reorder or busy.

CFIRT Call failure—timeout occurred.

CFIDT Call failure—no dial tone.

INC Incoming ring detected.

8.4.2 Program Number Command (PRN *a; nn...n)*

The program number command is PRN followed by the one-digit decimal address (*a*) and the number to be stored (*nn . . . n)*. Each address can store up to 32 dial parameters. Ignored characters in the dial number are not stored. Nine stored numbers are available at addresses 1-9.

Responses:

Same as for the CRN command.

8.4.3 Intermediate Call Progress Responses

The following responses are given only if enabled. See Option Definition 002 below.

CNX<sp>@*nnnnn*BPS<sp>*ccccc*—where *nnnnn* is the line speed and *ccccc* is an identifier with a maximum of five characters, such as V.29. This connect response appears after handshake completed, but before DSR is activated. This response is required if the intermediate call progress option is enabled.

8.4.4 Dial Stored Number (CRS *a)*

The command for dialing a stored number is CRS followed by the one-digit address a for the stored number to be dialed.

Responses:

Same as for the CRN command plus

CFINS Call failure—number not stored.

If the number is linked with other numbers, via the PRL command, failure responses are returned as

{sep}*a*;{call progress messages} . . .

where *a* is the address dialed, followed by the separator field <etb><sy><sy><stx> and call progress messages (CFI, etc.).

If the call fails to connect and the number is linked with other numbers, the autodialer tries to call the next number in the list of linked numbers.

If the last number in the list fails to connect, a CFILD (Call failed—link done) message is sent to the DTE.

8.4.5 Request List of Stored Numbers (RLN)

The request list of stored numbers command is RLN.

Responses:

INVCU—Invalid command—command unknown.

Example: TLN

INVMS—Invalid command—message syntax error.

Example: RLN;

If no number is stored at the specified address, nothing is returned for that address. The separator {sep} is a

<etb><sy><sy><stx>LSN<sp>

sequence for BISYNC format (the last LSN string terminates with <etx> per V.25 bis. For synchronous bit-oriented operation, each LSN string is treated as an individual message per V.25 bis.

All stored numbers are sent to the DTE as

LSN<sp>*a;nn...n* {sep}*a;nn...n...*

where *a* is the stored number address; *nn....n* is the number stored.

8.4.6 Disregard Incoming Call (DIC)

The command for disregarding an incoming call does not require parameters. If no call is incoming, the command is ignored.

Responses:

VAL — Valid command received. Transmitted on receiving an error-free command with no transmission error such as a parity error. This confirmation is sent before the command is executed.

INVCU — Invalid command—command unknown.

Example: TIC

INVMS — Invalid command—message syntax error.

Example: DIC;

8.4.7 Connect Incoming Call (CIC)

No parameters are required. If there is an incoming call, the modem immediately answers the call. If no call is incoming, the command is ignored.

Responses:

VAL — Valid command received. Transmitted on receiving an error-free command with no transmission error such as a parity error. This confirmation is sent before the command is executed.

INVCU — Invalid command—command unknown.

Example: TIC

INVMS — Invalid command—message syntax error.

Example: CIC;

8.4.8 Redial Last Number (CRR *n*)

The CRR *n* command redials the last number a maximum of *n* times. If no parameters are present, the modem redials once. Also, the maximum number of redials, the amount of time between redials, and other parameters may vary depending on application and national requirements if outside the U. S.

Responses:

Same as for the CRS command.

Failure response is

{sep}*r*;{call progress messages}...

where *r* is the recall count (1 < = r < = n ; 1, 2..., etc.), followed by a separator field

<etb><sy><sy><stx>

and call progress messages (CFI, etc.). If the call fails to connect, this is repeated for the specified number of times.

8.4.9 Link Number by Address (PRL *a;b)*

This command links the number at address *a* with the number at address *b*. The addresses are one-digit decimal values. Linking numbers enables different numbers to be dialed if a call failure occurs.

Only forward linking to one other number is allowed, so address 1 can be linked to 4, then to 8, then to 9, and so on; however (using this example), if address 4 is dialed by a CRS command without connection, it links forward to 8 then to 9.

If all these fail to connect, the autodialer will not back-link to address 1 unless circular linking is used. Numbers may be linked as 4 to 5 to 3; however, if address 3 is dialed, back-linking to 5 is not allowed.

If circular linking (1 to 8 to 7 to 1) is used, dialing is discontinued after the addressed number in the dial command has been dialed twice. If only one parameter follows the PRL command, the number at address *a* is unlinked from its forward link.

For example, if the link list 4 to 8 to 3 to 7 to 9 to 1 exists and PRL 7 is received, 7 would be unlinked from 9, but not from 3. This would result in two link lists: 4 to 8 to 3 to 7 and 9 to 1.

Responses:

VAL — Valid command received. Transmitted on receiving an error-free command with no transmission error such as a parity error. This confirmation is sent before the command is executed.

INVCU — Invalid command—command unknown.

Example: TRL 1;5

INVMS — Invalid command—message syntax error.

Examples:

PRL;1;5
PRL;

INVPS — Invalid command—parameter syntax error.

Examples:

PRL 1;5;
PRL 1;0;0
PRL 1;
PRL
PRL 001;5

INVPV Invalid command—parameter value error.

Examples:

PRL 1;Q
PRL Q;1
PRL 1;45 where only addresses
01 - 09 are defined

8.4.10 Request List of Linked Numbers (RLL)

The request list of linked numbers command is RLL without parameters.

Responses:

INVCU Invalid command—command unknown.

Example: TLL

INVMS Invalid command—message syntax error.

Example: RLL;

LSL List linked numbers.

In all LSL examples, if no number is stored at the specified address no response is sent. The separator field is an

<etb><sp><sp><stx>LSL<sp>

The last LSL string ends with <etx> per V.25 bis. For synchronous bit oriented operation, each LSL string is treated as an individual message per V.25 bis. All linked numbers are sent to the DTE as

LSL<sp>*a*;l{sep}*a*;l

where *a*=stored address and l=link address.

8.4.11 Request List of Version (RLV)

The request list of version information command is RLV with no parameters.

Responses:

INVCU Invalid command—command unknown.

Example: TLV

INVMS Invalid command—message syntax error.

Example: RLV;

LSV List version

The version information is sent to the DTE as

LSV<sp>S327409*xxx*39*yyy*ddr<sp>

where *xxx* is the code revision of the microcontroller PROM and *yyy* is the code revision of the V.25 bis PROM.

The dd is the dash number and the r is the printed circuit board revision.

8.5 Modem Options Command (PRO xxx;yy;0;0...)

The program options command is PRO followed by the starting register address (1 to 3 decimal digits), option count (1 or 2 decimal digits) and the data for each option (1 to 3 decimal digits per option). The Options section below lists all available options with definitions, possible settings, and default values.

The modem must be able to accept 40 non-ignored characters besides the PRO command (leading zeros and semicolons are not considered ignored characters).

Responses:

VAL Valid command received. Transmitted on receiving an error-free command with no transmission error such as a parity error. This confirmation is sent before the command is executed.

INVCU Invalid command—command unknown.

Example: TRO 0;1;1

INVMS Invalid command—message syntax error.

Examples:

PRO;0;1;1
PRO;

INVPS Invalid command—parameter syntax error.

Examples:

PRO 0;1;0;
PRO 0;1;1;1
PRO
PRO 0;001;1

INVPV Invalid command—parameter value error.

Examples:

PRO 0;1;Q
PRO Q;1;1
PRO 0;0;0
PRO 68;1;0

when option 68 is undefined for the modem.

INVPV<sp>xxx Invalid command—parameter value error.

Examples: PRO 10;5;0;0;0;2;1

This invalid message can be returned when a block of options is being changed. The conditions for this invalid response are as follows:

- An undefined option number is specified. In the example above, if option 12 is undefined for a certain modem (and no other error conditions apply) options 10 and 11 would be changed as specified in the command message. The next option to be changed would be option 12. The modem would detect that this is an undefined option, stop execution of the command, and return an INVPV<sp>012 message. Options 10 and 11 would still be changed as commanded; options 13 and 14 would be unchanged.
- An out-of-range value for a particular option is specified. In the example above, if the fourth value in the option string is undefined or out-of-range for option 13 in a certain modem (and no other error conditions apply) options 10 through 12 would be changed as specified in the command message. The next option to be changed would be option 13. The modem would then detect that the value is undefined or out-of-range for that option, stop execution of the command, and return an INVPV<sp>013 message. Options 10 through 12 would still be changed as commanded; options 13 and 14 would be unchanged.

8.5.1 Save Current Settings (PRK)

PRK saves current option settings.

Responses:

VAL — Valid command received. Transmitted on receiving an error-free command with no transmission error such as a parity error. This confirmation is sent before the command is executed.

INVCU — Invalid command—command unknown.

Example: TRK

INVMS — Invalid command—message syntax error.

Examples:

PRK;0
PRK Q

8.5.2 Restore Factory Settings (PRP *n*)

PRP *n* restores current option settings to factory option set *n*, where *n* is a 1-digit decimal number.

NOTE

Restoring a factory option set disables the V.25 synchronous dialer.

If no parameter follows the command, the modem automatically selects factory option set 1.

Responses:

VAL — Valid command received. Transmitted on receiving an error-free command with no transmission error such as a parity error. This confirmation is sent before the command is executed.

INVCU — Invalid command—command unknown.

Example: TRP

INVMS Invalid command—message syntax error.

Examples:

PRP;1
PRP Q

INVPS Invalid command—parameter syntax error.

Examples:

PRP 1;
PRP 1;1
PRP 001

INVPV Invalid command—parameter value error.

Example: PRP 5 where factory default 5 is not defined for the modem. Current modem factory options are 1, 2, 3, and 4.

8.5.3 Request List of Stored Options (RLO *xxx;yy)*

The request list of stored options command is RLO followed by an optional 1- to 3-digit decimal address and a 1- or 2-digit decimal count. The Options section below lists all available options with definitions, possible settings, and default values.

Responses:

INVCU Invalid command—command unknown.

Example: TLO 0;1

INVMS Invalid command—message syntax error.

Examples:

RLO;0;1
RLO Q;1

INVPS Invalid command—parameter syntax error.

Examples:

RLO 0;1;
RLO 0;1;4
RLO 0;001

INVPV Invalid command—parameter value error.

Examples:

RLO 0;Q
RLO 0;0
RLO999;45

LSO List stored options.

The separator {sep} is a

<etb><sp><sp><stx>LSO<sp>

sequence for the sync format (the last LSO string terminates with <etx> per V.25 bis). For synchronous bit-oriented operation, each LSO string is treated as an individual message per V.25 bis.

If no parameters follow, all stored options are sent to the DTE as

LSO<sp>*xxx;ooo*{sep}*xxx;ooo*...

Each value must be padded with leading zeros so that each field has three characters. Option zero would be sent as

LSO<sp>000;000

If only an address follows the command, the single requested option is sent to the DTE as

LSO<sp>*xxx;ooo*

If address and count follow the command, the requested count of options starting with the specified address are sent to the DTE as

LSO<sp>*xxx;ooo*{sep}*xxx;ooo*...

8.6 Options

This section lists the options for the V.25 bis autodialer. These options can be changed using the PRO command or listed using the RLO command.

000 - 001: Not applicable

002: Intermediate call progress messages
0 - Disable
1 - Enable
Default value = 0

003: Blind dial
0 - Disable
1 - Enable
Default value = 0

004 - 006: Not applicable

007: Long space disconnect
0 - Disable
1 - Enable
Default value = 1

008 - 019: Not applicable

020: Programmable / permissive operation
0 - Permissive
1 - Programmable
Default value = 0

021 - 022: Not applicable

023 - 049: Reserved for future use.

050: Mode
0 - 2-wire dial-up operation (PSTN)
1 - 4-wire leased line operation
2 - 2-wire leased line operation
Default value = 0

051: Primary transmit / receive rate
(See the **Rate Select** section at the end of this chapter.)
Default value = 36 (9600 bps)

052 - 054: Not applicable

055: Transmit clock
0 - Internal
1 - External
2 - Receive (slave)
Default value = 0

056: Leased line transmit level
Transmit level ({decimal} dBm)
Default value = 0

057 - 062: Not applicable

063: Autoanswer
0 - Disable
Enable
(Answer after 1 to 255 rings)
Default value = 1

064: Line current disconnect
0 - Off
1 - Short (8 ms)
2 - Long (90 ms)
Default value = 2

065 - 075: Not applicable

076: Speaker control
0 - Off
1 - On
2 - N/A
3 - N/A
4 - On until CD
5 - N/A
6 - N/A
Default value = 4

077: Speaker volume
0 - Low
1 - Medium
2 - High
Default value = 1

078 - 084: Not applicable

085: Constant carrier RTS/CTS delay
0 to 250 ms
Must be set in increments of 10 ms:
10, 20, 30 . . . 250
Default value = 0

086: Not applicable

087: DTR dropout timer
0 to 255 in 10-ms increments
DTR must turn off for this length of time to be recognized.
Default value = 5 (50 ms)

088: Not applicable

089: Delay time
0 - invalid
1 to 255 seconds
Default value = 5

090: Carriage return character
(13 decimal is ASCII and EBCDIC default)

091: Line feed character
(10 decimal is ASCII default; 37 decimal is EBCDIC default)

092: Guard tone
0 = None
1 = 550Hz
2 = 1800Hz
Default value = 0

093: Carrier detect delay
0 - Off
1 to 255 in increments of 10 ms
Default value = 6 (60 ms)

094: Loss of carrier disconnect
0 - Off
1 to 255 in 100-ms increments
Default value = 14 (1.4 sec)

095: DTR dial address
Address to dial on DTR off-to-on transition
Default value = 1

096: DTR dial
0 - Disable
1 - Enable
2 - N/A
Default value = 0

097: Not applicable

098: Call timeout
0 - Off
1-255 sec
Default value = 30 sec

099 - 102: Not applicable

103: Signal quality retrain
0 - Disable
1 - Send training sequence on poor quality
Default value = 1

104 - 106: Not applicable

Options 107-899: Reserved for future use.

900-902: Not applicable

903: Bilateral loop
0 - Disable
1 - Enable
Default value = 0

If enabled and a test is commanded, bilateral loop is defined as follows:

Test Commanded	Bilateral Loop
Loop 1	Loop 2
Loop 2	Loop 1
Loop 3	Loop 4
Loop 4	Loop 3

Loop definitions are per CCITT V.54.

904: DTE-commanded remote digital loopback
0 - Disable
1 - Enable
Default value = 0

905: DTE-commanded local analog loopback
0 - Disable
1 - Enable
Default value = 0

906: Remote-commanded test
0 - Disable
1 - Enable
Default value = 1

907: Test timer
0 - Until DTR drops
1 to 255 sec
Default value = 0

908: Not applicable

Options 909-999 are reserved for future use.

RATE SELECT

000 - 006:	Not applicable	
007:	V.22	1200 bps
008:	V.22 bis	2400 bps
009 - 033:	Not applicable	
034:	V.32	4800 bps echo canceling
035:	V.32	9600 bps echo canceling
036:	V.32	9600 bps trellis echo canceling
037 - 045:	Not applicable	

Rate selections 046-999 are reserved for future use.

9. Protocols

9.1 MNP Reliable Mode

MNP (Microcom Networking Protocol) provides error detection and automatic retransmission of data upon detection of an error. The modem supports MNP levels 2, 3, 4 and 5. Level 2 is the asynchronous version. Level 3 is the synchronous version and level 4 is synchronous with optimized headers for increased efficiency. Level 5 compresses the data for increased effective throughput.

9.2 Auto-Reliable

Allows the modem to operate in a non-reliable mode if a reliable connection cannot be established.

9.3 Constant-Speed Interface

The modem serial port adapts to the data rate of the DTE and does not change speed if the (modem) data link connects at another speed. Therefore the DTE-to-DCE interface speed is constant.

9.4 Data Compression

A technique of replacing repeated characters in a file being transmitted by a shorter symbol allowing a higher effective data rate.

9.5 Normal Mode

No error control with or without constant-speed DTE interface. Data is buffered.

9.6 Direct Mode

The DTE speed and DCE speed are forced to be the same. No error correction or buffering.

9.7 Flow Control

If the serial-port speed exceeds that of the modem connection, characters may be sent by the DTE to the modem faster than it can send them to the remote modem. The modem holds characters in an internal buffer until they can be transmitted. When this buffer is full, the modem uses flow control to cause the DTE to stop sending characters. As the modem continues to transmit data and the buffer empties, flow control is again used to cause the DTE to resume sending data.

10. Maintenance

WARNING

Disconnect power before performing maintenance. Although dangerous voltage levels are not exposed, disconnecting power will ensure no electric shock hazard is present.

The modem contains no internal electronic components that can be serviced or replaced by the user. Repairs should not be attempted by the user.

10.1 Relacing the Fuse

If a fuse fails, replace it with one of equal rating. Repeated failure indicates a more serious problem. If this happens, refer to the section on maintenance.

10.2 Cleaning

The modem provides maintenance free service. Periodically, you must remove dust that has collected on internal components. Remove dust with a soft bristle brush and low pressure air or vacuum.

10.3 Preparing for Tests

Before attempting diagnostic tests, check that all connectors and plugs are firmly inserted. The test procedures will identify the faulty component in a bad communications link. See **Appendix B** for troubleshooting instructions.

If the modem appears faulty, call for technical support. Do not return the modem without prior instructions.

Appendix A: Phone Jack Descriptions

A.1 Dial-Line Pin Functions

The 8-pin phone jack connects to the PSTN dialup lines. Pin functions for this jack are:

Pins 1, 2—Not used

Pin 3 MI—Switch hook on exclusion-key telephone
Not used in some systems

Pin 4 R—Ring side of telephone line

Pin 5 T—Tip side of telephone line

Pin 6 MIC—Switch hook on exclusion-key telephone

Pin 7 PR—Data-jack program position

Pin 8 PC—To data-jack program resistor

A.2 Telset/Leased-Line Pin Functions

The 8-pin TELSET/LEASED LINE jack allows a standard telephone set or a leased line to be connected to the modem. The pin functions for this jack are:

Pins 1, 2—Transmit pair—4-wire leased line or TX and RX for 2-wire leased line

Pins 4, 5—Ring and tip (respectively) of telephone line for TELSET

Pins 7, 8—Receive pair—4-wire leased line

Appendix B: Fault Isolation Procedure

This diagnostic test procedure and the indicator lights built into the modem allow a rapid check of the terminals, modems, and telephone-line interface. This procedure can be used to verify normal system operation and to isolate faulty equipment in case of failure.

Make sure the units are turned on and remote loops are enabled at both sites before starting the fault isolation procedure.

B.1 Telephone Interface

Connect the modem to the dial-up line via the DIAL jack on the back panel.

- If the dial line is installed with a standard permissive data jack, connect a standard telephone to the TELSET/LEASED LINE jack on the back panel of the modem and use the standard phone procedure (**Section B.3**).
- If the dial line is installed with an exclusion key telephone wired for data set controls the line, connect an exclusion key telephone to the RJ36X jack and use the exclusion-key telephone procedure (**Section B.4**).

B.2 Standard Phone

Configure the modem to V.32 IDLE mode by pressing the TALK/DATA button, and then lift the receiver. No dial tone is heard. Press the TALK/DATA button to display V.32 TALK and wait for dial tone.

Dial out; the phone should operate normally.

B.3 Exclusion-Key Telephone

Configure the modem to V.32 IDLE mode, lift the receiver of the exclusion key telephone and place the telephone in talk mode. Wait for the dial tone. Placing the telephone in data mode silences the tone.

With the telephone in talk mode, dial out. The telephone should operate normally.

If the telephone interface procedures are successful, the telephone interface is operating properly.

B.4 Fallback Rates

Since there is no standard fallback procedure from V.32 rates to V.22 rates, problems may arise when a V.32 optioned for 9600 originates a call to a V.22 modem. If this is a problem, change the originate modem speed to 2400 bps from the front panel or with the AT command AT%B3.

B.5 Modem and Telephone Line Check

Step 1: Configure the modem for LOCAL ANALOG LOOP WITH TEST PATTERN. This terminates the local modem telephone lines into 600 ohms and connects the local modem transmit output amplifier back to its own receiver through the AGC. Transmit input data from the terminal is inhibited and is substituted with a V.52 test pattern.

This test checks operation of the local modem's modulator and demodulator circuitry and should be attempted at both local and remote sites if operators are available.

- When random errors are present, the TEST PATTERN ERRORS display counts receive errors.
- If the circuitry is working properly, the front-panel indicators show the following:

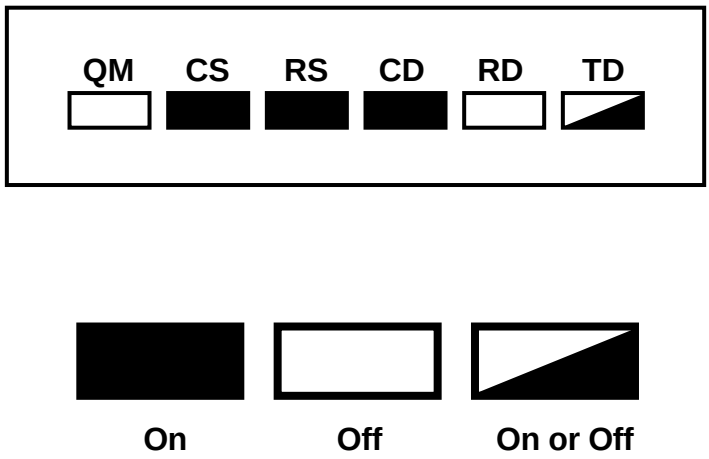

Figure B-1. Front-Panel Indicators.

Configure the modem for LOCAL ANALOG LOOP to switch the transmitter back to its normal data input.

- If the transmit data input is in a mark hold condition, both the TD and RD indicators should remain off.
- If the transmit data input is in a space hold condition, both the TD and RD indicators should come on. All other indicators should remain the same except for CS, which should turn on.
- If the indicators are correct, the modem is probably operating correctly.
- If the preceding tests were not successful, call for technical support.

Step 2

This step determines the performance of the local and remote modems and the telephone circuits. It also determines each modem's ability to receive a transmitted signal from the other site, properly equalize and decode the signal, and then loop this regenerated signal into the transmitter for transmission back to the other modem. This test applies to both leased-line and dial-line applications.

Configure the local modem for REMOTE DIGITAL LOOP WITH TEST PATTERN. This signals the remote modem to go into digital loop. The remote modem receives the data and then transmits it back to the local mode. If digital bilateral loop is enabled at the remote, the remote DTE is looped back to itself.

An alternative to the above procedure is to request the operator at the remote modem to configure his modem for LOCAL DIGITAL LOOP. Configure the local modem for TEST PATTERN. The remote modem receives and retransmits the data back to the local modem.

The TEST PATTERN ERRORS display will count received errors.

At the local modem, the indicators should look the same as those pictured in Figure B-1.

NOTE

The QM indicator may flash on while no errors are detected. The QM indicator responds to the average noise and distortion in the demodulator and is an indication of receive signal quality.

To further test the modem and communications link, reverse the system loopback. First exit the existing loopback test. Reverse the roles of the local and remote modems and repeat step two.

NOTE

If the bilateral digital loop is enabled at the local modem, the DTE interface is looped to itself, so the DTE can check the interface circuitry as well as itself.

Step 3

This step determines the performance of the telephone line. This test is valid for 4-wire operation only.

Configure the modem for REMOTE ANALOG LOOP WITH TEST PATTERN. This signals the remote to connect its receive pair to its transmit pair through a gain amplifier stage. The test pattern transmitted locally is now looped back to the local modem.

An alternative to the above procedure is to request the operator at the remote modem to place his modem in LOCAL ANALOG LOOP and enable his bilateral analog option. This places the remote modem in local analog loop test. It also connects the transmit phone line to the receive phone line through a gain amplifier stage. At the local modem, configure for TEST PATTERN. The test pattern transmitted by the local modem is looped back through an amplifier stage at the remote modem.

At the local modem, the front-panel indicators under ideal conditions should look like those pictured in Figure B-1.

The TEST PATTERN ERRORS display counts received errors.

In this test you are connecting two telephone-line links in series, doubling the distortion effects. A telephone link indicated as marginal by this test may be satisfactory as used in normal operation.

After determining the quality of the telephone lines, exit the test.

If fault remains unidentified, call for technical support.

Appendix C: Command Index and Defaults

C.1 General

This guide provides async command characters and their meanings. Pages listed provide initial information on the commands. S-registers are listed as a cross reference. † indicates factory defaults.

Command	Page	S-Reg	Description
AT	52		Attention code—command prefix
A/	54		Repeat last command
+++	72	S2, S12	Escape sequence (pause, +++, pause)
A	66		Answer
D	63		Dial
T	64	S14	Tone-dial†
P	64	S14	Pulse-dial
,	64	S8	Pause (2 sec or S8 value)
W	64	S7	Wait for 2nd dial tone (S7 value)
!	64		Flash switchboard
R	64		Switch to answer mode after dialing
@	64		Wait for 5 seconds of silence
;	65		Return to command mode after dialing
S	65		Dial number stored at location 1
Sn	65		Dial number stored at location n
E	72	S14	Local character echo off
E1	73		Local character echo on†
H	73		Hang up
H2	73	S14	V.32 cleardown enabled
H3	73		V.32 cleardown disabled†
I	73		Request product code
I1	73		Request EPROM CRC value
I3	73		Request product version

Command	Page	S-Reg	Description
L or L1	74	S22	Speaker volume low
L2	74		Speaker volume medium†
L3	74		Speaker volume high
M	74	S22	Speaker off
M1	74		Speaker off when carrier is present
M2	74		Speaker always on
M3	74		Speaker off when dialing and carrier is present
O	74		Restore data mode (after escape)
Q	59	S14	Response displays on†
Q1			Response displays off
Q2			Response displays on in originate mode only
Sn.(bit #)=v	97		Set single bit value in register
V	59	S14	Response codes
V1	59		Response messages†
X	60	S22	CONNECT (code 1) for all speeds, no dial tone or busy signal detection
X1	60		Appropriate connect codes for rate, no dial tone detection
X2	60		Wait for dial tone (appropriate connect codes)
X3	60		Detect busy signal (appropriate connect codes)
X4	60		Wait for dial tone, detect busy signal † (appropriate connect codes)
Y	75	S21	Long space disconnect off
Y1	75		Long space disconnect on†
Z	83		Reset to stored configuration
&C	67	S21	DCD always on†
&C1	67		DCD on while carrier is present
&C2	67		DCD off 5 seconds after disconnect
&C3	67		DCD follows remote RTS

Command	Page	S-Reg	Description
&D	68	S21	DTR ignored†
&D1	68		DTR recalls command mode
&D2	68		DTR disconnects
&D3	68		DTR disconnects and resets modem to stored configuration
&F or &F1	84		Restore factory configuration 1†
&F2	84		Restore factory configuration 2
&F3	84		Restore factory configuration 3
&F4	84		Restore factory configuration 4
&G	75	S23	No guard tone†
&G1	75		550 Hz guard tone
&G2	75		1800 Hz guard tone
&L	76	S27, S32	Dial line†
&L1	76		Leased line 2-wire
&L2	76		Leased line 4-wire
&M	76	S27	Asynchronous dial/asynchronous data†
&M1	76		Asynchronous dial/synchronous data
&M2	76		Dials stored number when DTR off/on transition is detected/synchronous data
&M3	76		Manual dial/synchronous data
&M4	76	S30	V.25 bis autodialer with BISYNC protocol/ synchronous data
&M5	76		V.25 bis autodialer with SDLC protocol/ synchronous data
&P	77	S22	39/61 pulse make/break ratio†
&P1	77		33/67 pulse make/break ratio
&R	69	S21	CTS normal operating state
&R1	69	S21	CTS forced on†
&R2	69	S72	CTS follows DCD
&R9	69	S72	CTS equals RTS
&S	67	S21	DSR always on†
&S1	67		DSR on when ready to accept data
&S2	67		DSR off for 5 seconds after disconnect
&S3	67		DSR follows off hook (OH)

Command	Page	S-Reg	Description
&T	70		Terminate any test or exit remote configuration mode
&T1	70		Initiate analog loopback
&T2	70		Initiate remote analog loopback
&T3	70		Initiate digital loopback
&T4	70	S23	Allow acceptance of remote commanded digital loopback†
&T5	70	S23	Denies acceptance of remote commanded digital loopback
&T6	70		Initiate remote digital loopback
&T7	70		Initiate self-test remote digital loopback
&T8	70		Initiate self-test analog loopback
&T9	70		Initiate self-test remote analog loopback
&V	84		View configuration profiles
&V1	84		Display received signal status
&W	82		Store current configuration
&X	77	S27	Internal clock†
&X1	77		External clock
&X2	77		Receive clock
&Zn	84		Store dial string n=string to be stored
%An	89		Set auto-reliable fallback character to n (n=ASCII 1-127)
%B	77	S69	Use DTE speed
%B1	78		300 bps max
%B2	78		1200 bps max
%B3	78		2400 bps max
%B4	78		4800 bps max
%B5	78		9600 bps max
%B6	78		9600 bps trellis coded max
%C	89	S60	Data compression disabled
%C1	89		Data compression enabled†
%D	78	S62	Disable disconnect buffer delay†
%Dn	78		Set disconnect buffer delay in seconds n (n=1-255)
%E	79	S60	Disable auto retrain
%E1	79		Enable auto retrain†

Command	Page	S-Reg	Description
%P=	85		Sets security code to value entered after equal sign (0-99999999)
%P=D	85		Disabled
%P?	85		Displays security code of local modem
%T	70		Transmit test pattern
%T=	86		Followed by a security code, establishes remote configuration
%V	79		Display product revision level
$V	79		Display product serial number
%Z	79		Permissive†
%Z1	79		Programmable
\A	92	S63	Maximum MNP block size of 64 characters
\A1	92		Maximum MNP block size of 128 characters
\A2	92		Maximum MNP block size of 192 characters
\A3	92		Maximum MNP block size of 256 characters†
\B	93	S79	Transmit a break level
\Bn	93		Sets break length in 20 ms increments, n=1-255, default is 35 (700 ms)
\C	93	S60	Disable auto-reliable buffer†
\C1	93		Buffer data for 4 seconds or 200 characters
\G	87	S54	Disable modem port flow control†
\G1	87		Enable modem port XON/XOFF flow control
\J	87	S72	Disable slaved DTE/DCE speed† (constant speed DTE on)
\J1	87		Enable slaved DTE/DCE speed (constant speed DTE off)
\Kn	90	S59	Determines action taken when a break is encountered
\K	90		MNP Break option 0
\K1	90		MNP Break option 1
\K2	90		MNP Break option 2
\K3	90		MNP break option 3
\K4	90		MNP break option 4
\K5	90		MNP break option 5†

Command	Page	S-Reg	Description
\N	86	S70	Normal mode
\N1	87		Direct mode
\N2	87		Reliable only
\N3	87		Auto reliable mode†
\O	94	S60	Originate on reliable link
\Q	88	S54	Disable DTE flow control
\Q1	88		Enable DTE XON/XOFF flow control†
\Q2	88		Enable DTE CTS flow control
\Q3	88		Enables bilateral CTS/RTS flow control
\R	68	S60	RI, blinks for ring and remains on for duration of call
\R2	68		RI, blinks for ring and turns off when call is answered†
\T	92	S58	Disable inactivity timer†
\Tn	92		Set inactivity timer to n (n=1-255 minutes)
\U	94	S60	Accept an MNP link
\V	93	S60	Disable protocol result codes†
\V1	93		Enable protocol result codes
\X	88	S54	No XON/XOFF characters to remote DCE†
\X1	89		Pass XON/XOFF characters to remote DCE
\Y	94	S60	Switch to MNP from normal mode
\Z	95	S60	Switch to normal from MNP mode
*AN	71	S34	Disables bilateral analog loop†
*AN1	71		Enables bilateral analog loop
*AUn	65		Dial number stored at location n upon transition of DTR in command mode (n=1-9) or number used in autodial backup sequence
*DA	80		Switches modem to talk mode
*DA1	80		Switches modem to data mode
*DB	80		Manual dial-backup operation†
*DB1	80		Automatic dial-backup operation

Command	Page	S-Reg	Description
*DG	71	S34	Disables bilateral digital loop†
*DG1	71		Enables bilateral digital loop
*FB	69	S29	Ignore pin 23†
*FB1	69		Pin 23 transition causes DTE speed fallback
*FT	80	S29	Disable fast train†
*FT1	80		Enable fast train
*LA	71	S34	Ignore pin 18†
*LA1	72		DTE commanded LAL enabled
*LB	81		Wait for dial backup call
*LC	81	S32	Line current disconnect disabled
*LC1	81		Short (8 ms) line current disconnect
*LC2	81		Long (90 ms) line current disconnect†
*LD	81		Dial autodial number
*NT	81	S29	AT command set disabled
*OR	82	S14	Originate†
*OR1	82		Forced answer
*RC	61	S57	15-4800 bps, 18-9600 bps†
*RC1	61		11-4800 bps, 12-9600 bps
*RD	71	S34	Ignore pin 21†
*RD1	71		DTE commanded RDL enabled
*RO	85	S29	Retain options at disconnect
*RO1	85		Restore options at disconnect
*TLn	82	S52	Sets leased line TX level to n where n is a number between 0 and 15 corresponding to 0 to -15 dB
$S=x	47		Sets an empty password location to x
$C=x, y	47		Changes either password where x represents the old password and y is the new one
$C=x, -	47		Deletes password x from memory

Command	Page	S-Reg	Description
$E=x	47		Enables security where x is either password
$E?	47		Displays the current security status
$D=x	47		Disables security where x is either password
$DR	47		Reset security
$D?	47		Displays the current status of security

C.2 Status Registers

S-Reg	RO/RW	Page	Function	Factory-Default Option Set #1
S0	RW	98	Ring to answer	(0=auto answer off)
S1	RO	98	Ring count	
S2	RW	98	Escape sequence character	43 (+)
S3		98	End-of-line character	13 (CR)
S4	RW	98	Line feed character	10 (LF)
S5	RW	98	Backspace character	8 (BS)
S6	RW	98	Pause before blind dialing	2 (2 sec)
S7	RW	98	Pause for carrier	30 (30 sec)
S8	RW	99	Pause for comma	2 (2 sec)
S9	RW	99	Carrier validation	6 (0.6 sec)
S10	RW	99	Loss-of-carrier disconnect delay	14 (1.4 sec)
S11	RO	99	DTMF tone length	80 (80 ms)
S12	RW	99	Escape sequence pause	50 (1 sec)
S14	RW	100	Bit mapped	
S16	RW	101	System tests	0
S18	RW	102	Test timer	0
S21	RW	102	Bit mapped	

RO=Read-Only *RW=Read or Write*

S-Reg	RO/RW	Page	Function	Factory-Default Option Set #1
S22	RW	103	Bit mapped	
S23	RW	103	Bit Mapped	
S25	RW	104	DTR recognition time	5 (0.5 sec)
S26	RW	104	RTS/CTS delay	0
S27	RW	104	Bit mapped	
S28	RW	105	Lookback timer	15 min
S29	RW	105	Bit mapped	
S30	RW	106	Bit mapped	
S32	RW	107	Bit mapped	
S34	RW	108	Bit mapped	
S39	RW	108	Bit mapped	
S52	RW	109	Bit mapped	
S53	RW	109	801 V.32 timeout	0 (long)
S54	RW	110	Flow control DTE	0
S57	RW	110	Number code application	0
S58	RW	111	Disable MNP Inactivity timer, timer value in minutes	0
S59	RW	111	MNP break control	5
S60	RW	112	Bit mapped	
S61	RO	113	Indicates DTE speed, character size, parity	6
S62	RW	113	Disconnect buffer delay	0
S63	RW	114	Maximum MNP block size	255

RO=Read-Only *RW=Read or Write*

S-Reg	RO/RW	Page	Function	Factory-Default Option Set #1
S64	RW	114	Auto-reliable fallback character	0
S67	RO	114	Link speed status	
S69	RW	115	DCE speed	
S70	RW	115	Operating mode	1
S71	RO	116	Operating mode status	
S72	RW	116	Bit mapped	
S78	RW	117	Autocallback timer	30
S79	RW	117	Break length	35
S84	RW	118	Bit mapped	

RO=Read-Only *RW=Read or Write*

C.3 V.25 bis Dialer Commands

Synchronous Command	Page	Description
CIC	124	Connect incoming call
CRN *nn...n*	121	Dial (*nn...n*=number to be dialed)
0-9	121	DTMF and pulse digit
*#	121	DTMF digit
:	121	Wait for dial tone
W	121	Wait for second type of dial tone
>	121	Pause for 1 second
=	121	Pause for 3 seconds
<	121	Pause for programmed delay time
P	121	Pulse dial
T	121	Tone dial
&	121	Flash (go on hook) for 1/2 second
;	121	Parameter separator
Space	121	Clarity characters
dash	121	
parenthesis	121	
period	121	
CRR *n*	124	Redial the last number a maximum of *n* times

Synchronous Command	Page	Description
CRS *a*	123	Dial stored number (*a*=address)
DIC	124	Disregard incoming call
PRK	128	Save current option settings
PRL *a;b*	125	Link number at address *a* with number at address *b*
PRN *a; nn...n*	123	Program number (*nn...n*=number to be dialed, *a*=address)
PRO *xxx;yy;*0;0...	127	Program options (*xxx*=register address, *yy*=option count)
PRP *n*	128	Restores current option settings to the factory defaults in default bank *n* (1-9)
RLL	126	Request list of linked numbers
RLN	123	Request list of stored numbers
RLO *xxx;yy*	129	Request list of stored options (*xxx*=register address, *yy*=option count)
RLV	126	Request list of version information

Response Message	Meaning
CFIDT	Call failure—no dial tone
CFIET	Call failure—reorder or busy
CFINS	Call failure—number not stored
CFIRT	Call failure—timeout occurred
INC	Incoming ring detected
INVCU	Invalid command—command unknown
INVMS	Invalid command—message syntax error
INVPS	Invalid command—parameter syntax error
INVPV	Invalid command—parameter value error
VAL	Valid command received

C.4 Factory Option Sets

Factory Option Set #1 (Asynchronous Dialup with MNP)

- Modem Options

  DCE rate—9600
  Normal originate
  Fast train originate
  Auto retrain enabled
  Transmit clock internal
  Dial line
  Jack type RJ-11 (permissive)
  Line current disconnect long enabled
  Long space disconnect enabled
  V.22 guard tone disabled

- Test Options
  Bilateral analog loop disabled
  Bilateral digital loop disabled
  DTE local test disabled
  DTE remote test disabled
  Remote commanded test enabled
  Test timeout off

- MNP Options
  MNP protocol enabled
  Auto fallback enabled
  XON/XOFF pass through disabled
  Data compression enabled
  MNP activity timer off
  MNP break control 5

- Dial Line Options
  Tone dial
  Auto dial #1
  Wait for dial tone
  Wait delay 2 seconds
  Pause delay 2 seconds
  Call timeout 30 seconds
  Answer on 1 ring
  801 V.32 timeout long
  Autocallback disabled

- DTE Options
  Async data
  DTE rate—9600
  8 bit
  No parity
  Async controlled dialer
  AT command set enabled
  Ignores DTR
  DSR forced high
  DCD forced high
  CTS forced high
  DTE fallback disabled
  Options retained at disconnect

- Speaker Options
  Volume medium
  On until carrier detect

Factory Option Set #2 (Asynchronous Dialup Without MNP)

- Modem Options
  DCE rate=DTE rate*
  Normal originate
  Fast train disabled
  Auto retrain enabled
  Transmit clock internal
  Dial line
  Jack type RJ-11 (permissive)
  Line current disconnect long enabled
  Long space disconnect enabled
  V.22 guard tone disabled

- Test Options
  Bilateral analog loop disabled
  Bilateral digital loop disabled
  DTE local test disabled
  DTE remote test disabled
  Remote commanded test enabled
  Test timeout off

- MNP Options
  MNP protocol disabled*
  DTE speed=DCE speed*
  Flow control disabled*
  XON/XOFF pass through disabled
  Data compression enabled
  MNP activity timer off
  MNP break control 0*

- Dial Line Options
  Tone dial
  Auto dial #1
  Wait for dial tone
  Wait delay 2 seconds
  Pause delay 2 seconds
  Call timeout 30 seconds
  Answer on 1 ring
  801 V.32 timeout long
  Autocallback disabled

- DTE Options
  Async data
  DTE rate=9600
  8 bit
  No parity
  Async controlled dialer
  AT command set enabled
  Ignores DTR
  DSR forced high
  DCD forced high
  CTS forced high

 *Different from Factory Option Set #1

DTE fallback disabled
Options retained at disconnect

- Speaker Options
  Volume medium
  On until carrier detect

Factory Option Set #3 (Synchronous Dialup Without MNP)

- Modem Options
  DCE rate—9600 trellis
  Normal originate
  Fast train disabled
  Auto retrain enabled
  Transmit clock internal
  Dial line
  Jack type RJ-11 (permissive)
  Line current disconnect long enabled
  Long space disconnect disabled*
  V.22 guard tone disabled

- Test Options
  Bilateral analog loop disabled
  Bilateral digital loop disabled
  DTE local test disabled
  DTE remote test disabled
  Remote commanded test enabled
  Test timeout off

- Protocol Options
  MNP protocol disabled*
  DTE speed=DCE speed*
  Flow control disabled*
  XON/XOFF pass through disabled
  Data compression enabled
  MNP activity timer off
  MNP break control 0*

- Dial Line Options
  Tone dial
  Auto dial #1
  Wait for dial tone
  Wait delay 2 seconds
  Pause delay 2 seconds
  Call timeout 30 seconds
  Answer on 1 ring
  801 V.32 timeout long
  Autocallback disabled

- DTE Options
  Sync data*
  Dial method manual*
  AT command set disabled*
  Responds to DTR*
  DSR normal*
  DCD normal*
  CTS follows RTS*

RTS/CTS delay 0 ms*
DTE fallback disabled
Options retained at disconnect

- Speaker Options
  Volume medium
  On until carrier detect

Factory Option Set #4 (Synchronous 4-Wire Leased Line without MNP)

- Modem Options
  DCE rate—9600 trellis
  Normal originate
  Fast train disabled
  Auto retrain enabled
  Transmit clock internal
  Leased line*
  4-wire*
  Tx level—0 dBm*
  Dial backup manual*
  Lookback timer—15 min*
  Jack type RJ-11 (permissive)
  Line current disconnect long enabled
  Long space disconnect enabled
  V.22 guard tone disabled

- Test Options
  Bilateral analog loop enabled*
  Bilateral digital loop enabled*
  DTE local test disabled
  DTE remote test disabled
  Remote commanded test enabled
  Test timeout off

- MNP Options
  MNP protocol disabled*
  DTE speed=DCE speed*
  Flow control disabled*
  XON/XOFF pass through disabled
  Data compression enabled
  MNP activity timer off
  MNP break control 0*

- Dial Line Options
  Tone dial
  Auto dial #1
  Wait for dial tone
  Wait delay 2 seconds
  Pause delay 2 seconds
  Call timeout 60 seconds
  Answer on 1 ring
  801 V.32 timeout long
  Autocallback disabled

- DTE Options
  Sync data*
  AT command set disabled*

Ignores DTR
DSR normal*
DCD normal*
CTS follows RTS*
RTS/CTS delay 0 ms*
DTE fallback disabled
Options retained at disconnect

- Speaker Options
  Volume medium
  On until carrier detect

Appendix D: Abbreviations and Acronyms

ABT—Abort Time or Answer Back Tone

AC—Alternating Current

ACK—Acknowledgement, Positive

ACR—Abort Call, Retry

ACU—Automatic Call Unit

A/D—Analog to Digital

ADD—Address Field

ADDR—Address

AGC—Automatic Gain Control

ASCII—American Standard Code for Information Interchange

AT&T—American Telephone and Telegraph

BC—Bearer Capability

BCD—Binary Coded Decimal

BER—Bit Error Rate

BERT—Bit Error Rate Test (set)

BIL LB—Bilateral Loopback

Bit—Binary Digit

bps—Bits per Second

BSC—Binary Synchronous Communications

BUFF—Elastic Buffer

C—Celsius

CA—Circuit Assurance

CBX—Computerized Private Branch Exchange

CC—Carrier Control

CCITT—International Consultative Committee for Telegraph and Telephone

CCU—Communications Control Unit

CD—Carrier Detect

CFICB—Call Failure Indication—Local DCE Busy

CFIDT—Call Failure Indication—No Dial Tone

CFINT—Call Failure Indication—No Answer Back Tone

CFIRT—Call Failure Indication—Ringback Detected

Ch Gnd—Chassis Ground

CIC—Connect Incoming Call

CMOS—Complementary Metal Oxide Semiconductor

CNX—Connect Complete

COM—Computer Output Microfilm

CO—Central Office

COS—Call Originate Status

CPE—Customer Premise Equipment

CPH—Characters per Hour

CPU—Central Processing Unit

CR—Carriage Return

CRC—Cyclic Redundancy Check

CRQ—Call Request

CSA—Canadian Standards Association

CSDC—Circuit Switched Digital Capability

CSU—Channel Service Unit

CSULL—Channel Service Unit Local Loopback

CTRL—Control Field

CTS, CS—Clear to Send

DAA—Data Access Arrangement (AT&T)

Dataset—Synonym for Modem (see Modem)

dB, db—Decibel

DC—Direct Current or Digital Connection

DCE—Data Circuit-Terminating Equipment or Data Communications Equipment

DCD—Data Carrier Detect

DCPSK—Differentially Coherent Phase-Shift Keying

DDD—Direct Distance Dialing

DDS/MR—Digital Data Service/Multi Rate

DIC—Disregard Incoming Call

DIP—Dual In-line Package

DIS, DS—Disable

DLE—Data Link Escape

DLO—Data Line Occupied

DMS—Digital Multiplexor System

DOC—Department of Communications (Canada)

DOS—Disk Operating System

DPR—Digit Present

DRS—Data Rate Select

DSR—Data Set Ready

DSU—Data Service Unit

DTE—Data Terminal Equipment

DTMF—Dual Tone Multi Frequency

DTN—Dial Tone Detected

DTR—Data Terminal Ready

EBCDIC—Extended Binary Coded Decimal Interchange Code (8 level)

EIA—Electronic Industries Association

EIA-232C, EIA-232D—Interface between DTE and Data Interchange Communication Equipment employing serial binary data

EN—Enabled

ENQ—Enquiry

EOA—End of Address

EOM—End of Message

EON—End of Number

EOT—End of Text or End of Transmission

EPROM—Erasable Programmable Read Only Memory

ER—Error

ESC—Escape (key)

ETB—End of Block

ETC—External Transmit Clock

ETX—End of Text

EXT—External

FA—Feature Activator

FB—Fallback

FCC—Federal Communications Commission

FDM—Frequency Division Modulation

FDX—Full-Duplex Transmission

FF—Form Feed

FGND—Frame Ground

FL—Flag

FLL—Fixed loss loop

FM—Frequency Modulation

Fox message—Test message ("The quick brown fox jumps over the lazy dog 0123456789")

FSK—Frequency-Shift Keying

FX—Foreign Exchange

HDLC—High Level Data Link Control

HDX—Half-Duplex Transmission

Hz—Hertz (cycles per second)

INC—Incoming Call

INV—Invalid

INVCU—Invalid Command–Command Unknown

INVMS—Invalid Command—Message Syntax Error

INVPS—Invalid Command—Parameter Syntax Error

INVPV—Invalid Command—Parameter Value Error

I/O—Input/Output

IS—International Standard

ISDN—Integrated Services Digital Network

KBD—Keyboard

kbps—Kilobits per Second

LAL—Local Analog Loopback

LAPD—Link Access Protocol-D Channel

LAPM—Link Access Protocol for Modems

LB OPTS—Loopback Options

LCD—Liquid Crystal Display or Line Current Disconnect

LDL—Local Digital Loopback

LDM—Limited-Distance Modem

LED—Light Emitting Diode

LF—Line Feed

LINK—Analog Telephone Line Connection

LL—Local Loopback

LO—Line Occupancy

LRC—Longitudinal Redundancy Check

LSD—Long Space Disconnect

LSI—Large-Scale Integrated (circuit)

LSO—List of Stored Options

LSV—List Version

LT—Loop or Link Termination

mA—Milliamps

MHz—MegaHertz

Modem—Modulator/Demodulator

MR—Modem Ready

MR/RI—Modem Ready/Ring Indicator

ms—Millisecond

Mux—Multiplexor

NAK—Negative Acknowledgement

NET STAT—Network Status

NRZ—Non Return to Zero

NRZI—Non Return to Zero Inverted

NS—No Signal

NT—Network Termination

OH—Off hook

OS—Out of Service

PBX—Private Branch Exchange

PC—Personal Computer

PC—Printed Circuit (board)

PIW—Power Indication

PN—Pseudo random

PND—Present Next Digit

POTS—Plain Old Telephone Service

PRI—Primary

PRO—Program Option

PROG, PR—Programmable

PROM—Programmable Read Only Memory

PRP—Restored Factory Straps

PR/TM—Power/Test Mode/Error

PSK—Phase Shift Keying

PSTN—Public Service Telephone Network

PWI—Power Indication

QAM—Quadrature Amplitude Modulation

R—Reference Designator

RAD—Random Access Method

RAL—Remote Analog Loopback

RAM—Random Access Memory

RC—Receive Clock

RCD—Receiver-Carrier Detector

RCV, RCVR—Receiver

RD—Receive Data

RD/ER—Receive Data/Error

RDI—Receive Data Inhibit

RDL—Remote Digital Loopback

RI—Ring Indication

RL—Remote Loopback

RLO—Request List of Stored Options

RLSD—Received Line Signal Detector

RLV—Request List of Version

rms—Root-Mean-Square

RMT LB—Remote Loopback

RNG—Ringback Detection

RO—Receive Only

ROM—Read Only Memory

RT—Remote Terminal

RTS, RS—Request to Send

RX—Receive

S or S/T—Reference Designator

SCC—Serial (or Satellite) Communications Controller

SD—Send Data

SDLC—Synchronous Data Link Control (IBM)

SGND, SG—Signal Ground

SH—Switch Hook

SIM SW CR—Simulated Switched Carrier

SNR—Signal/Noise Ratio

SPID—Service Profile Identifier

SQD—Signal Quality Detector

SQM—Signal Quality Monitor

SS—Systems Status

STX—Start of Text

SYN—Synchronization Character

T—Reference Designator

TA—Terminal Adapter

TC—Transmit Clock

TD—Transmit Data

TE—Terminal Equipment

TEI—Terminal Endpoint Identifier

TELCO—Telephone Company

TELSET—Telephone Set

TM—Test Mode

TP—Test Pattern

TR—Terminal Ready

TST—Test

TTD—Temporary Text Delay

TTL—Transistor-to-Transistor Logic

TX—Transmit

U—Reference Designator

UART—Universal Asynchronous Receiver/Transmitter

USOC—Universal Service Ordering Code

V.—CCITT Code Designation

V.24—List of definitions for interchange circuits between data terminal equipment and data circuit-terminating equipment (and provisional amendments, May 1977)

VAC—Volts Alternating Current

VAC—Value Added Carrier

VAL—Valid

Vdc—Volts Direct Current

WATS—Wide Area Telecommunications Access Method (AT&T)

X.—CCITT Recommendation Designation

XMIT—Transmit

XOFF—Transmitter Off

XON—Transmitter On

XTC—External Transmit Clock

Appendix E: ASCII and EBCDIC Character Table

Table E-1. Hexadecimal Equivalents of Binary and Decimal Numbers.

Binary	Decimal	Hexadecimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F

Hexadecimal examples:

0101 1011 = 5B hex

1001 1101 = 9D hex

1110 0010 = E2 hex

The following table lists the ASCII decimal, hexadecimal, equivalent character values, and EBCDIC characters. The table only goes as high as available keyboard symbols. Control keys are shown in the right column of the first table.

Table E-2. ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC	Control Key
(NUL)	0	00	NU (null)	@
(SOH)	1	01	SH (start of header)	A
(STX)	2	02	SX (start of text)	B
(ETX)	3	03	EX (end of text)	C
(EOT)	4	04	PF	D
(ENQ)	5	05	HT (horizontal tab)	E
(ACK)	6	06	LC (lower case)	F
(BEL)	7	07	delete	G
(BS)	8	08	—	H
(HT)	9	09	—	I
(LF)	10	0A	(SMM)	J
(VT)	11	0B	VT (vertical tab)	K
(FF)	12	0C	FF (form feed)	L
(CR)	13	0D	CR (carriage return)	M
(SO)	14	0E	SO (shift out)	N
(SI)	15	0F	SI (shift in)	O
(DLE)	16	10	DL (data link escape)	P
(DC1)	17	11	D1 (device control 1)	Q
(DC2)	18	12	D2 (device control 2)	R
(DC3)	19	13	D3 (device control 3)	S

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC	Control Key
(DC4)	20	14	RE (restore)	T
(NAK)	21	15	NL (new line)	U
(SYN)	22	16	BS (backspace)	V
(ETB)	23	17	IL (light)	W
(CAN)	24	18	CN (cancel)	X
(EM)	25	29	EM (end of message)	Y
(SUB)	26	1A	CC	Z
(ESC)	27	1B	C1 (CU1)	[
(FS)	28	1C	FS (form separator)	\
(GS)	29	1D	GS (group separator)	]
(RS)	30	1E	RS (record separator)	^
(US)	31	1F	US (unit separator)	DEL
(SP)	32	20	DS	—
!	33	21	SS (SOS)	—
“	34	22	—	—
#	35	23	—	—

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
$	36	24	CP (bypass)
%	37	25	LF (line feed)
&	38	26	EB (end of block)
‘	39	27	EC (escape)
(	40	28	—
)	41	29	—
*	42	2A	SM
+	43	2B	C2 (CU2)
,	44	2C	—
-	45	2D	EQ (enquiry)
.	46	2E	AK (acknowledgement)
/	47	2F	BL (bell)
0	48	30	—
1	49	31	—
2	50	32	—
3	51	33	—
4	52	34	PN
5	53	35	—
6	54	36	UC (uppercase)
7	55	37	ET (end of transmission)
8	56	38	—
9	57	39	—

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
:	58	3A	—
;	59	3B	C3 (CU3)
<	60	3C	D4 (device control 4)
=	61	3D	NK (no acknowledgement)
>	62	3E	—
?	63	3F	SB (substitute)
@	64	40	space
A	65	41	—
B	66	42	—
C	67	43	—
D	68	44	—
E	69	45	—
F	70	46	—
G	71	47	—
H	72	48	—
I	73	49	—
J	74	4A	¢ (cent)
K	75	4B	. (period)
L	76	4C	< (less than)
M	77	4D	((open parenthesis)
N	78	4E	+ (plus)

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
O	79	4F	—
P	80	50	& (ampersand)
Q	81	51	—
R	82	52	—
S	83	53	—
T	84	54	—
U	85	55	(leading pad)
V	86	56	—
W	87	57	—
X	88	58	—
Y	89	59	—
Z	90	5A	! (exclamation)
[	91	5B	$ (dollar sign)
\	92	5C	* (asterisk)
]	93	5D	) (close parenthesis)
^	94	5E	; (semicolon)
-	95	5F	^ (caret or ¬)
‘	96	60	—
a	97	61	/ (ACK1)
b	98	62	—
c	99	63	—
d	100	64	—

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
(DC4)	20	14	RE (restore)
e	101	65	—
f	102	66	—
g	103	67	—
h	104	68	—
i	105	69	—
j	106	6A	|
k	107	6B	,
l	108	6C	%
m	109	6D	-
n	110	6E	>
o	111	6F	?
p	112	70	ACK0
q	113	71	—
r	114	72	—
s	115	73	—
t	116	74	—
u	117	75	—
v	118	76	—
w	119	77	—
x	120	78	—

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
y	121	79	‘ (single quote)
z	122	7A	: (colon)
{	123	7B	# (pound)
|	124	7C	@ (at)
}	125	7D	' (apostrophe)
~	126	7E	= (equal)
DEL	127	7F	" (double quote)
—	128	80	—
—	129	81	a
—	130	82	b
—	131	83	c
—	132	84	d
—	133	85	e
—	134	86	f
—	135	87	g
—	136	88	h
—	137	89	i
—	138	8A	—
—	139	8B	—
—	140	8C	≤ (less than or equal)
—	141	8D	(
—	142	8E	+

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
—	143	8F	†
—	144	90	—
—	145	91	j
—	146	92	k
—	147	93	l
—	148	94	m
—	149	95	n
—	150	96	o
—	151	97	p
—	152	98	q
—	153	99	r
—	154	9A	—
—	155	9B	—
—	156	9C	x
—	157	9D	)
—	158	9E	±
—	159	9F	
—	160	A0	—
—	161	A1	~
—	162	A2	s
—	163	A3	t
—	164	A4	u

Table E-2 (continued). ASCII and EBCDIC Characters.

—	165	A5	v
—	166	A6	w
—	167	A7	x
—	168	A8	x
—	169	A9	z
—	170	AA	—
—	171	AB	L
—	172	AC	
—	173	AD	[
—	174	AE	≥ (greater than or equal)
—	175	AF	•
—	176	B0	S0 (SM0)
—	177	B1	S1 (SM1)
—	178	B2	S2 (SM2)
—	179	B3	S3 (SM3)
—	180	B4	S4 (SM4)
—	181	B5	S5 (SM5)
—	182	B6	S6 (SM6)
—	183	B7	S7 (SM7)
—	184	B8	S8 (SM8)
—	185	B9	S9 (SM9)
—	186	BA	—
—	187	BB	

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
—	188	BC	
—	189	BD	] (close bracket)
—	190	BE	≠ (not equal)
—	191	BF	—
—	192	C0	{ (open brace)
—	193	C1	A
—	194	C2	B
—	195	C3	C
—	196	C4	D
—	197	C5	E
—	198	C6	F
—	199	C7	G
—	200	C8	H
—	201	C9	I
—	202	CA	—
—	203	CB	—
—	204	CC	(unprintable character)
—	205	CD	—
—	206	CE	(unprintable character)
—	207	CF	—
—	208	D0	} (close bracket)

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
—	209	D1	J
—	210	D2	K
—	211	D3	L
—	212	D4	M
—	213	D5	N
—	214	D6	O
—	215	D7	P
—	216	D8	Q
—	217	D9	R
—	218	DA	—
—	219	DB	—
—	220	DC	—
—	221	DD	—
—	222	DE	—
—	223	DF	—
—	224	E0	\ (backslash)
—	225	E1	—
—	226	E2	S
—	227	E3	T
—	228	E4	U
—	229	E5	V
—	230	E6	W

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
—	231	E7	X
—	232	E8	Y
—	233	E9	Z
—	234	EA	—
—	235	EB	—
—	236	EC	(unprintable character)
—	237	ED	—
—	238	EE	—
—	239	EF	—
—	240	F0	0
—	241	F1	1
—	242	F2	2
—	243	F3	3
—	244	F4	4
—	245	F5	5
—	246	F6	6
—	247	F7	7
—	248	F8	8
—	249	F9	9
—	250	FA	|
—	251	FB	¯
—	252	FC	—

Table E-2 (continued). ASCII and EBCDIC Characters.

ASCII Symbol	Decimal	HEX	EBCDIC
—	253	FD	—
—	254	FE	—
—	255	FF	(trailing pad)

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