2400 SECURITY MODEM
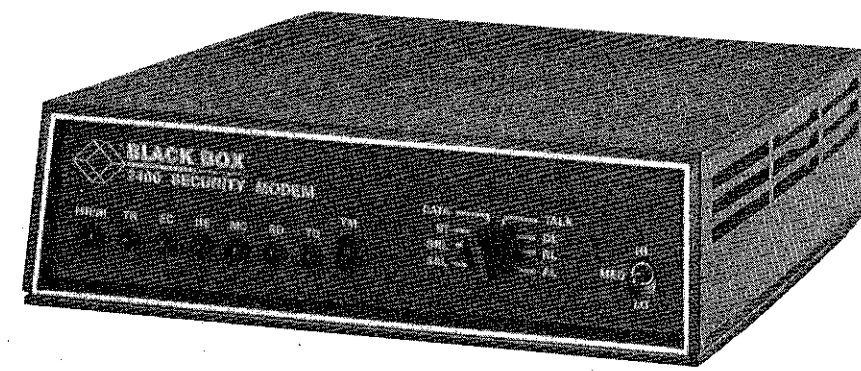
- **TEST AND DIAGNOSTIC CAPABILITIES**
- **STORES 16 TELEPHONE NUMBERS IN NONVOLATILE MEMORY**

FCC REQUIREMENTS

This equipment complies with FCC rules Part 68. Located on the equipment is the FCC Registration Number and Ringer Equivalence Number (REN). You must provide this information to the telephone company if requested.

The Registration Number and REN will be inscribed on the printed circuit board on insert cards or on a label attached to either the chassis bottom or metal end plate on standalone or rack models. In any case the FCC requires these numbers be prominently displayed on an outside surface of the equipment.

The REN is used to determine the number of devices you may legally connect to your telephone line. In most areas, the sum of the REN of all devices connected to one line must not exceed five (5.0). You should contact your telephone company to determine the maximum REN for your calling area.

The telephone company may change technical operations or procedures affecting your equipment. You will be notified of changes in advance to give you ample time to maintain uninterrupted telephone service.

If you experience trouble with this telephone equipment, the telephone company may ask that you disconnect this equipment from the network until the problem has been resolved. If your equipment continues to disrupt the network, the telephone company may temporarily disconnect service. If this occurs, you will be informed of your right to file a complaint with the FCC.

This equipment may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

WARNING

This equipment uses, generates, and can radiate radio frequency energy interfering with radio communications if not installed and used according to the instruction manual. It has been tested and complies with the limits for a Class A computing device according to FCC Rules, Part 15, Subpart J. Operation of this equipment in a residential area may cause interference. If it does, you must correct the cause of the interference.

Special Requirements for Canada

The following requirements exist for modems manufactured for use in Canada:

Department of Communications (DOC) Requirements:

DOC stamps are affixed to the rear of each standalone unit sold in Canada. Card modems which are installed in the user's equipment are shipped with a stamp included. The user should place the stamp on the outside of his equipment as close as possible to the telephone line connector. This stamp has the registration number for that particular unit. The numbers are different for each modem model.

The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment. For their own protection users should ensure that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

```
                        CAUTION

        Users should not attempt to make installation connections
        themselves, but should contact the appropriate electric
        inspection authority or electrician.
```

DOC Connector Codes:

MODE	CODE
Permissive	CA12
Programmable	CA47A
Private Line	CA02A

Canadian Standards Association (CSA) Requirements:

The CSA number and CSA logo are on the rear panel or a tag contains this information. The CSA number is LR50893.

CSA requirements apply only to standalone modems, not to card modems.

With these exceptions, all units perform exactly as described in this manual.

PREFACE

This manual is written for users of the modem. Please read it
before you change any options on the printed circuit board or operate
the modem. This manual includes the following:

Chapter 1   Introduction - Contains introductory
                     information;

Chapter 2   Installation - Contains instructions for
                     mechanical and electrical installation of the
                     modem;

Chapter 3   Option Selection - Describes strap and switch
                     option selection and instructions for using the
                     Call Guard feature;

Chapter 4   Operation - Describes modem operating
                     procedures;

Chapter 5   Operating Commands - Describes operating
                     commands;

Chapter 6   Diagnostics - Describes modem test procedures;

Chapter 7   Maintenance - Provides maintenance
                     information;

Appendix A   Specifications

Appendix B   Quick Reference

Appendix C   Pin Functions

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Chapter 1
Introduction

GENERAL

The 2400 Security Modem provides full duplex operation on the 2-wire switched telephone network or 2-wire private lines, with transmission and reception data rates of 2400, 1200, or 0-300 bps. The terminal equipment can operate at 9600, 4800, 2400, 1200, 600, 450, or 0-300 bps. The modem connects to the telephone network through the appropriate Universal Service Ordering Code (USOC) plug and jack. Modem performance allows the user maximum freedom in the design of his communication network with such features as:

● Compatibility with CCITT V.22 bis and V.22 except for 600 bps, guard tones, and synchronous operations. Bell 103 compatible.

● Automatic data rate selection.

● Complete test and diagnostic capabilities.

● Eight front panel LEDs and an eight-position rotary switch to monitor and generate modes of operation.

● Integral Automatic Call Unit (ACU) with AT command set.

● Compatible with most 2400 full duplex modems.

● MNP service class 2-3 compatible.

- Speed conversion.

- 16 telephone number storage in nonvolatile memory.

- Three levels of security

COMMAND SET

The command set is "AT" compatible and includes extensions to provide additional features and flexibility. The extensions are a superset of the AT set and do not affect the compatibility with the standard AT set of commands. The extensions are identified by a % sign as part of the command and allow for selection of additional speeds, flow control, protocols and more. The modem can be used with standard software packages and the additional features may still be used by selecting them with DIP switches or with the extended commands.

DESCRIPTION

The modem is available in a standalone configuration consisting of a printed circuit (PC) board and an associated "piggyback" card.

The modem asynchronous operating modes are shown in Table 1-1.

Operating Mode	DTE (Rates in bps)	Characters	DCE (Rates in bps)
224 ATD Native	0-300	Transparent	0-300
	1200 +1%, -2.5%	7 bits + parity, 8 bits, 8 bits + parity *	1200
	2400 +1%, -2.5%	7 bits + parity, 8 bits, 8 bits + parity *	2400
Buffered 224 ATD EC100/ MNP	110 ±3%	7 bits + parity, 8 bits, 8 bits + parity *	110
	300 ±3%		300
	450 ±3%		450
	600 ±3%	↑	
	1200 ±3%		1200
	2400 ±3%	⇐ Any Combination ⇒	2400
	4800 ±3%		
	9600 ±3%		

* Parity - odd, even, mark (2-stop bits), space

Table 1-1
Asynchronous Operating Modes

GENERAL

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

**RECEIPT
INSPECTION**

After unpacking the equipment, check the contents against the packing list. Inspect the equipment carefully for damage that may have occurred in shipment. If there is damage or material shortage, contact the shipper's agent and the factory

**SITE
PREPARATION**

Install the modem within six feet of a 115 or 230 Vac grounded outlet as required for the specific model and no further than 50 feet from the terminal equipment. The Telco wall jack must be within 5 feet of the modem for the supplied cables to reach.

The installation area should be clean, well lighted, and free from extremes of temperature, humidity, appreciable shock, and vibration. Allow at least a 4-inch space at the rear of the modem for cable clearance and air flow.

TELEPHONE LINES

Leased Lines

The telephone company will install the leased line and wall jack at your site. The line connects to the modem at the 8-position TELCO receptacle. Pin assignments are shown in Table 2-1.

Pin	Name	Description
1	Not used	
2	Not used	
3	Not used	
4	R	Ring side of telephone line
5	T	Tip side of telephone line
6	Not used	
7	Not used	
8	Not used	

Table 2-1
Leased Line Pin Assignments

Switched Lines (PSTN)

Switched lines also connect to the modem at the 8-position TELCO receptacle. Pin assignments are shown in Table 2-2. Some pins are not used depending on the type of data jack installed.

Pin	Name	Description
1	Not used	
2	Not used	
3	MI or (A)	Switch-hook signal for exclusion key
4	R	Ring side of telephone line
5	T	Tip side of telephone line
6	MIC or (A1)	Switch-hook signal for exclusion key
7	PR	Programming resistor (not used in permissive
8	PC	Programming resistor common (not used in permissive)

Table 2-2
Switched Line Pin Assignments

Connection Types

Permissive - This is the most common type of telephone line connection. Normal domestic telephone lines are used in this arrangement. The type of jack the telephone company usually installs is an RJ11. Signal quality may suffer with this type.

Programmable - The telephone company applies higher standards to the quality of programmable lines. In some installations, the programmable arrangement will give better performance than the permissive. The telephone company installs a special jack for this, typically an RJ45 or RJ41. If an RJ41 jack is installed, its built-in switch must be set to programmable.

Telephone Handset

The TELSET receptacle provides the connection for a telephone to make normal voice calls. Voice and data cannot be used at the same time.

Exclusion Key Telephone

A special exclusion key telephone can be used with the modem. In this arrangement, the telephone company installs a special jack and telephone that gives control of the telephone line to the handset. This feature allows the phone to be used for normal voice calls when the phone is located away from the modem. If an exclusion key phone is used in permissive mode, the jack used will be an RJ16. Programmable jacks already have connections for the exclusion key phone, but the telephone company must be told what options to install. The options are shown in Table 2-3.

Connection	Option
A1	Telephone set controls line
A2	Data set controls line
B3	No aural monitoring
B4	Aural monitoring provided
C5	Pushbutton dial phone
C6	Rotary dial phone
D7	Switch hook indication
D8	No switch hook indication

Table 2-3
Exclusion Key Telephone Options

Telephone Line Connection

If you are operating on leased lines, connect a cable to the modem jack labeled TELCO. Figure 2-1 shows how you connect this cable to the telephone lines.

As stated previously for switched phone lines, the telephone company will install a jack that connects to the modem with a cable. This cable plugs into the modem jack labeled TELCO. A typical hook-up for a permissive arrangement is shown in Figure 2-2. The programmable arrangement is similar.

Telephone Handset Connection

If a normal telephone is used, it connects with a cable between the phone and the modem jack labeled TELSET. See Figure 2-2.

If an exclusion key phone is desired, the telephone company will wire it to the connection arrangement shown in Figure 2-3.
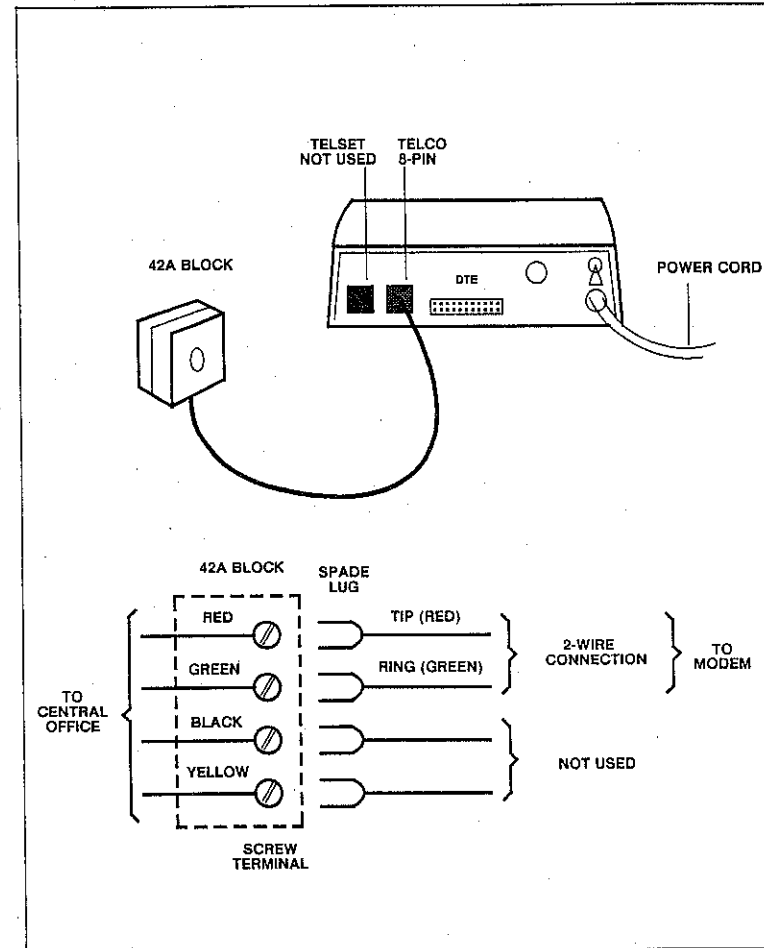
Figure 2-1
Leased Line Cabling
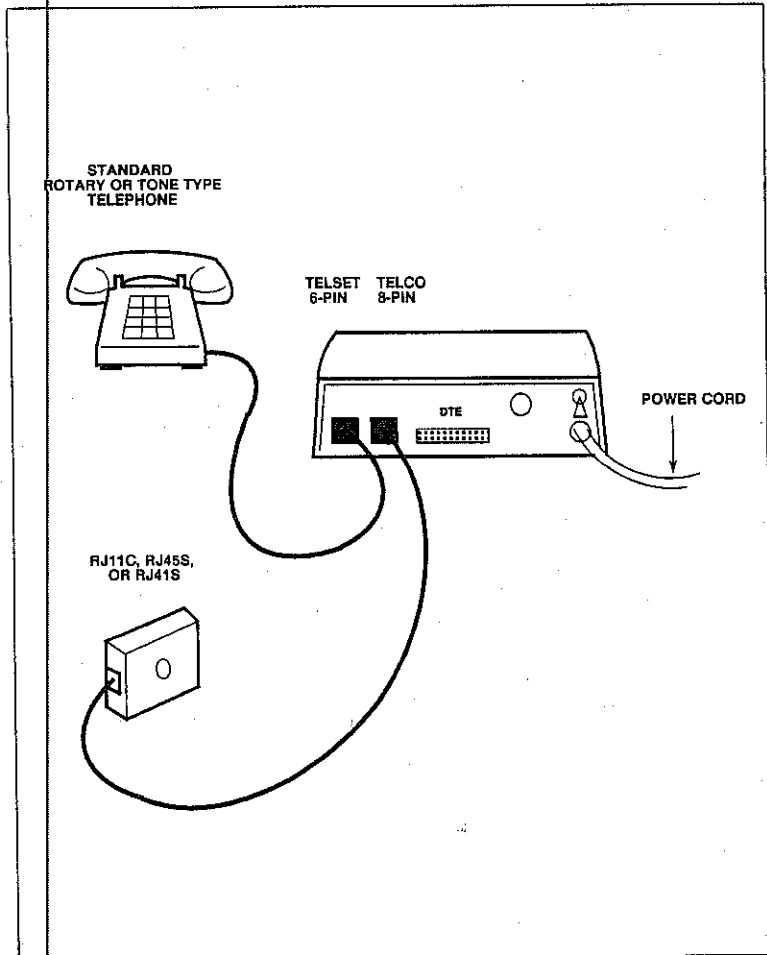
Figure 2-2
Phone Line and Handset Cabling with Standard Telephone
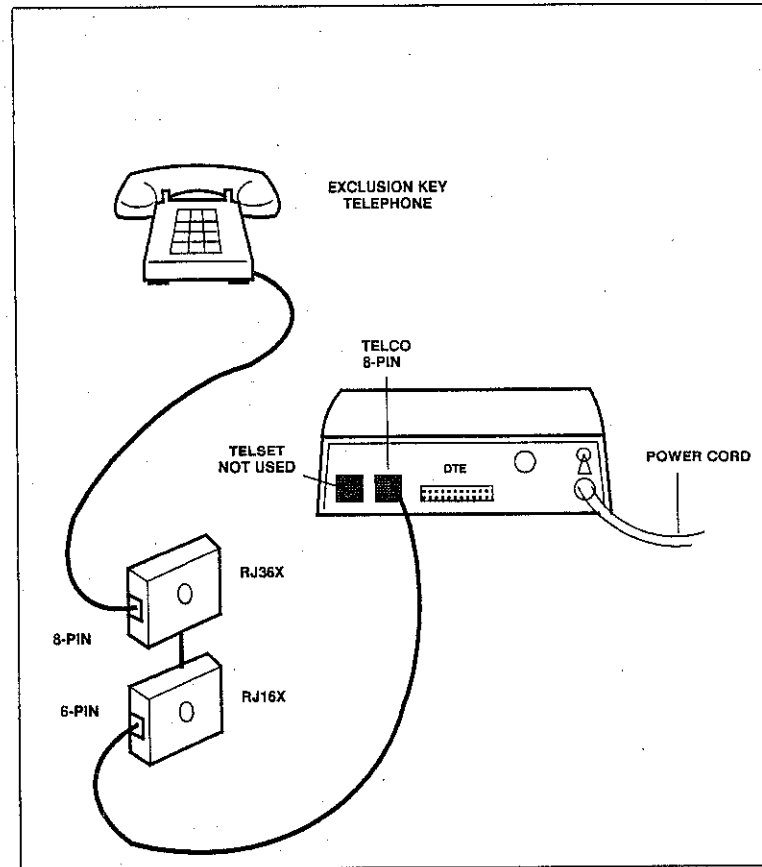
Figure 2-3
Phone Line and Handset Cabling with Exclusion Key Telephone

UDS Telephone Cables

The cables used for connection between the modem and the various TELCO jacks are illustrated in Figure 2-4.

DTE EIA-232C INTERFACE CONNECTION

The interface between the modem and DTE uses the 25-pin connector labeled DTE. Use a small blade screwdriver to fasten the cable in place. This interface is further described in the Operation chapter.

MODEM CONNECTION	MECHANICAL LAYOUT	TELCO CONNECTION	TELCO JACK
8-PIN ... 6-PIN 6 FEET 2-WIRE CABLE			RJ11C PERMISSIVE
8-PIN ... 8-PIN 6 FEET 6-WIRE CABLE			RJ45S PROGRAMMED RJ41S (PROG ONLY)
8-PIN ... 4-SPADE LUG 6 FEET 4-WIRE CABLE			PRIVATE LINE

Figure 2-4
Telephone Cables

OPTION SELECTION

Because of the versatile nature of the modem, several decisions must be made before installation. Proper operation is possible only if you choose the correct option switches and jumpers. Carefully read the following "strapping" information before attempting to operate the modem.

The programming of the modem is done with 4 jumper options (see Figure 3-1), commonly referred to as straps, and 3 DIP switches; S1, S2, and S3. Options set by DIP switches may also be set by commands to the ACU.

Cover Removal

To select or inspect options, remove the modem cover.

> **WARNING**
> Do not remove the cover unless the power cord is unplugged.

Stand the unit on its side with the bottom facing you. Release the cover by pressing the locking tabs through the slots with your thumbs (see Figure 3-2). Repeat this with the tabs on the other side and remove the cover. The cover is inscribed "FRONT" on the underside.

CSA Security Requirements

On modems sold in Canada, security latches are inserted alongside two of the locking tabs. To disengage those locking tabs, the security latches must first be pried out with a small screwdriver.

Replace the cover by aligning front and rear guide grooves, then the lock tabs in the slots and press until they engage.

All option straps and DIP switches are on the bottom printed circuit board. See Figure 3-3 for strap and switch locations.
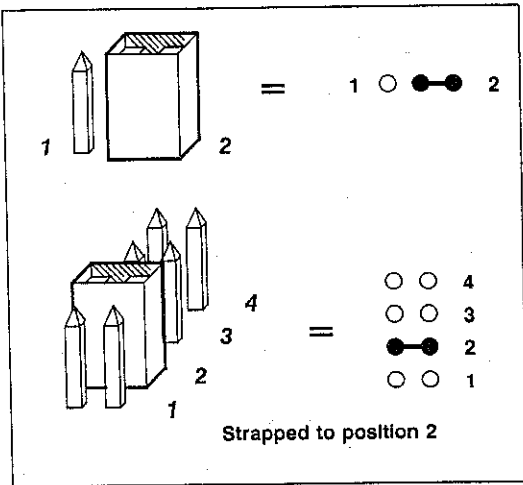
Figure 3-1
Hardware Jumper Options (Straps)
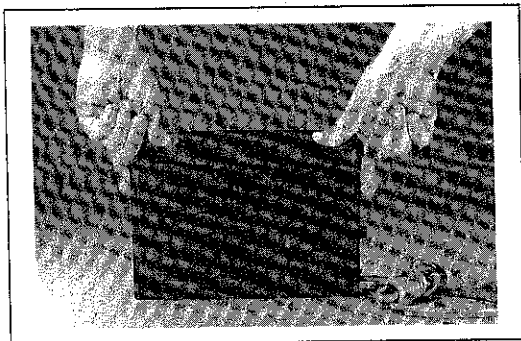
Figure 3-2
Removal of Cover
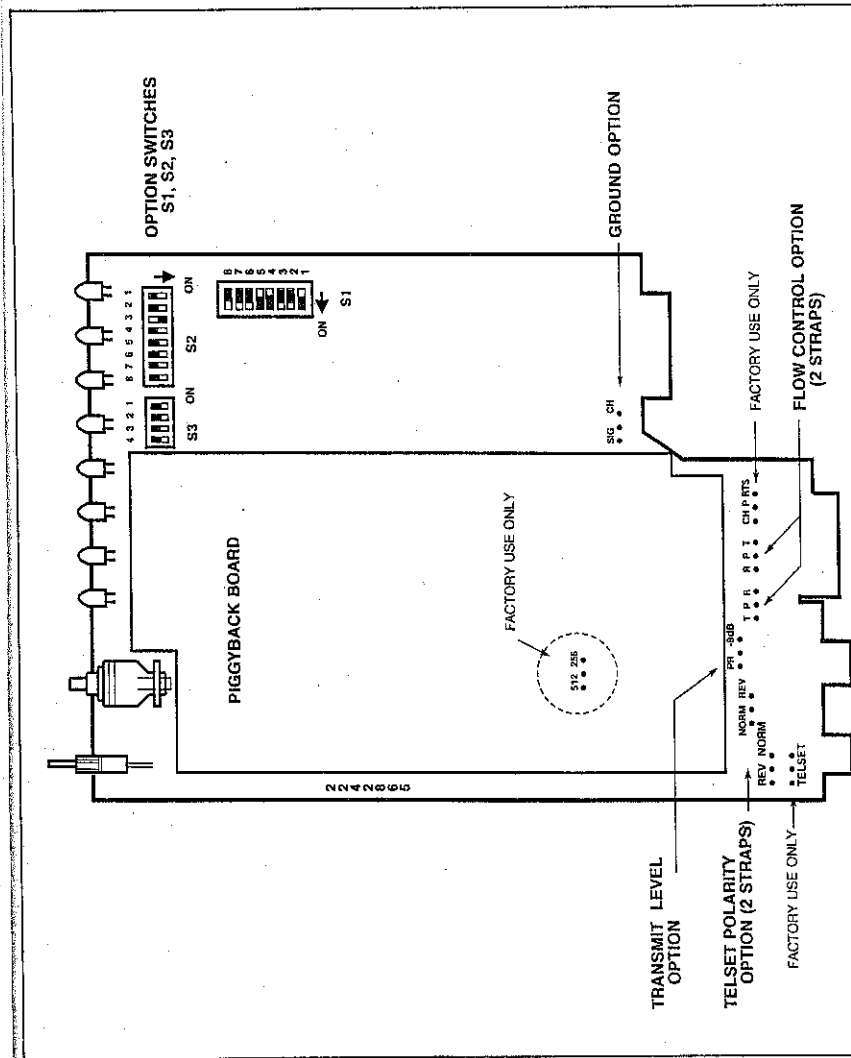
Figure 3-3
Option Switches and Jumper Locations

Jumper Options

In the following sections, the "*" indicates factory settings.

EIA-232C Flow Control Option (2 Straps)

This option sets the direction of flow control. To flow control the DTE device if the modem is on the host side, set both jumpers to the T position. To flow control the modem when on the printer side, set both jumpers to the R position. This option disables DTE Analog Loopback. This feature can be disabled using switch S3 position 4 or Register S53 bit 3.

T
R

R
T
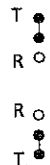
*Flow Control DTE

Transmit Level Option

Using an RJ11C jack requires the – 9 dBm permissive option. The RJ45S jack requires the programmable option.

INT
PR

* -9 dBm, Permissive
Selected

TELSET Polarity Option (2 Straps)

This option applies to Touch-Tone® telephones. If you hear a dial tone after dialing, the polarity on your phone is reversed. Reverse the jumpers to solve the problem.

NOR
REV

NOR
REV
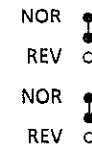
* Normal Polarity Selected

Ground Option

Chassis ground and signal ground can be electrically connected. Most choose chassis ground. If you have interference problems use signal ground.

SIG o ●—● CH

* Chassis Ground
Selected

OPTION SWITCHES Option switches S1, S2, and S3 affect the operation of the modem indirectly by selecting initial values of S-Registers. Chapter 5 has more information about S-Registers.

Switch 1 (S1)
Position 1 - Protocol OFF causes the modem to pass user data in a 224 ATD mode.

ON causes the modem to use the MNP protocol for error-free communications. If the other modem does not support the MNP protocol the modem will fall back to a 224 ATD mode.

POSITION 1 PROTOCOL		S-Register Values	
Setting	Mode	S91	S92
off	224 ATD	0	255
on	* MNP	2	0

Position 2 - DCE
Independent Speed OFF disables the DCE independent speed.

ON enables the DCE independent speed. DTE speed (S61) is set at 9600 bps. The maximum permissible line operation speed (S69) is initialized with a value dependent on the front panel switch. LOW, MED, and HI for 300, 1200, and 2400 bps respectively.

POSITION 2 DCE INDEPENDENT SPEED		S-Register Values	
Setting	Mode	S61	S69
off	* disabled	XX	0
on	enabled	8 (9600)	1 LO 2 MED 3 HI

Switch S1 Continued
Position 3 - Line Set to the SWITCHED position on the public switched telephone network and to PRIVATE for private line operation.

POSITION 3 LINE		S-Register Values S27 Bit 2
Setting	Mode	
off	* switched	1
on	private	0

Position 4 - Answer/
Originate For private line operation one modem must be set to ORIGINATE, the other to ANSWER.

POSITION 4 ANSWER/ORIGINATE		S-Register Values S14 Bit 7
Setting	Mode	
off	answer	0
on	* originate	1

Position 5 - Auto
Answer ON lets the modem respond to an incoming call without manual intervention. Automatic answer is prevented when DTR is low and DTR disconnect is enabled. Automatic answer is also prevented if the front panel switch is not in DATA position or if a command line is partially entered.

POSITION 5 AUTO ANSWER		S-Register Values S0
Setting	Mode	
off	disable	0
on	* enable	1

Switch S1 Continued
Position 6 - ACU

ON disables the automatic call unit.

OFF enables the Automatic Call Unit.

POSITION 6 ACU		S-Register Values S14 BIT 4
Setting	Mode	
off	* enable	0
on	disable	1

Position 7 - TX
Space Disconnect

ON causes the modem to transmit a data space for 4 seconds after the disconnect mechanism is activated. This signals the other modem that call termination has occurred. The other modem must have receive long space disconnect enabled also.

POSITION 7 TX SPACE DISCONNECT		S-Register Values S51 BIT 6
Setting	Mode	
off	* disable	0
on	enable	1

Position 8 - RX
Space Disconnect

ON causes the modem to hang up upon receipt of a 2 second data space. This signals the modem that the other modem has hung up.

POSITION 8 RX SPACE DISCONNECT		S-Register Values S51 BIT 7
Setting	Mode	
off	* disable	0
on	enable	1

Switch 2 (S2)
Positions 1-3 -
Parity/Word Length

Initializes settings for word length and parity of the async characters used.

POSITIONS 1-3 PARITY/WORD LENGTH				S-Register Values					
				S23			S53		
POS 1	POS 2	POS 3	Mode	BIT 5	BIT 4	BIT 7	BIT 6	BIT 5	BIT 4
off	off	off	7 bits odd	1	0	0	0	1	0
off	off	on	*7 bits even	0	0	0	1	0	0
off	on	off	7 bits mark/7 bits 2 stop bits	1	1	0	1	1	0
off	on	on	7 bits space	0	1	1	0	0	0
on	off	off	8 bits none	1	1	0	0	0	0
on	off	on	8 bits odd	1	0	0	0	1	1
on	on	off	8 bits even	0	0	0	1	0	1
on	on	on	8 bits mark/ 8 bits 2 stop bits	1	1	0	1	1	1

Positions 4-5 -
Flow Control DTE

Prevents the DTE from overflowing the modem buffers when not operating in the 224 ATD mode. When selecting pin 11 flow control, the straps must be in the T position.

POSITIONS 4-5 FLOW CONTROL DTE			S-Register Values
POS 4	POS 5	Mode	S54
off	off	* none	0
off	on	CTS	1
on	off	DC1/DC3 (XON/XOFF)	2
on	on	pin 11 **	8

Switch S2 Continued
Positions 6-7 -
Flow Control DCE

Prevents the modem from overflowing the DTE buffers when not operating in the native 224 ATD mode. When selecting pin 11 flow control, the two flow control straps must be in the R position. See Figure 3-3.

POSITIONS 6-7 FLOW CONTROL DCE			S-Register Values
POS 6	POS 7	Mode	S55
off	off	* none	0
off	on	DTR	1
on	off	DC1/DC3 (XON/XOFF)	2
on	on	pin 11 **	8

Positions 4-5-6-7
Wang Flow Control

**** NOTE**
DTE and DCE flow control is determined by S2 positions 4, 5, (DTE) and 6,7 (DCE) in conjunction with flow control straps in the T or R option respectively.

If S2 positions 4, 5, 6, and 7 are all in the ON position both DTE and DCE flow control is in Wang mode.

POSITIONS 4-5-6-7 FLOW CONTROL					S-Register Values	
Pos 4	Pos 5	Pos 6	Pos 7	Mode	S-54	S-55
on	on	on	on	Wang	16	16

Position 8 -
1200 Mode

OFF selects BELL 212A operation in medium speed.

ON selects CCITT V.22 operation in medium speed.

POSITION 8 1200 MODE		S-Register Values
Setting	Mode	S27 BIT 6
off	* BELL	1
on	CCITT (V.22)	0

Switch 3 (S3)
Position 1 -
DTR Disconnect

OFF disables this feature.

ON causes the modem to "hang up" when the DTR pin is low.

POSITION 1 DTR DISCONNECT		S-Register Values	
Setting	Mode	S21 BIT 4	S21 BIT 3
off	* disable	0	0
on	enable	1	0

**Position 2 -
CD Disconnect**

OFF causes the modem to hang up if the carrier is lost for 1.4 seconds.

ON causes the modem to hang up if the carrier is lost for 0.1 seconds.

POSITION 2 CD DISCONNECT		S-Register Values
Setting	Mode	S10
off	* 1.4 seconds	14
on	100 milliseconds	1

**Position 3 -
CH Disable**

OFF disables this feature.

ON causes the modem to use the CH pin in conjunction with the front panel toggle switch when making a connection. See SPEED SELECTION.

POSITION 3 CH DISABLE		S-Register Values
Setting	Mode	S53 BIT 2
off	* disable	0
on	enable	1

**Position 4 -
DTE AL Disable**

OFF disables this feature.

ON causes the modem to go to analog loopback test when P3 pin 25 is high.

POSITION 4 DTE AL DISABLE		S-Register Values
Setting	Mode	S53 BIT 3
off	* disable	0
on	enable	1

SPEED SELECTION

The speed the modem originates a call (DCE speed) can be tied to the DTE speed the modem communicates with, or it may be set independent of DTE speed.

The speed the modem answers a call is always HI speed. The speed for communication of data is determined during the initial "handshaking" or pre-data protocol of the originating and answering modems. During this protocol, the speed of operation is selected. This will be the lower of the two maximum speeds. S-61 and 69 control DTE and DCE speed respectively. S- 70 controls the DCE low speed bit rate. These are in turn controlled by:

- Switch 1 position 2
- Pin 23 (CH)
- Front panel toggle switch
- Auto baud
- Commands:
    S69 = n
    S70 = nn

When DCE speed is 0, it is tied to DTE speed. The following settings are used in S61 and S70:

1   110 bps
2   300 bps
3   450 bps
4   600 bps
5   1200 bps
6   2400 bps
7   4800 bps
8   9600 bps

Initialization

Switch 1 position 2 OFF disables the DCE independent speed feature.

ON sets the DCE independent speed feature. The DTE speed will be set at 9600 bps and the maximum permissible DCE speed will be initiated with a value selected by the front panel rotary switch.

SWITCH 1 POS 2	FRONT PANEL TOGGLE SWITCH	DTE SPEED S61	DCE SPEED S69
off	LO	2 (300)	0 (DTE)
off	MED	5 (1200)	0 (DTE)
off	HI	6 (2400)	0 (DTE)
on	LO	8 (9600)	1 (103)
on	MED	8 (9600)	2 (212A/V.22)
on	HI	8 (9600)	3 (V.22 bis)

CH (Pin 23 EIA-232C) and Toggle Switch

A transition of pin 23 or movement of the toggle switch affects the maximum originate connect speed. When DCE speed is 0, DTE speed controls the maximum and is altered by CH and the toggle switch. When DCE speed is not 0, it is the maximum of the register that is altered.

CH	Toggle	DTE Speed S61	DCE Speed S69
H	H	6	3
L	H	5	2
H	M	5	2
L	M	2	1
H	L	2	1
L	L	2	1

Auto Baud

Auto baud determines the bit rate, word length and parity on the AT prefix of each command line when DCE speed is 0.

S-Registers

The S-Registers may be set directly with the command S69 = n, or S70 = n, where n is the desired setting.

CALL GUARD SECURITY

The 2400 Security Modem incorporates multilevel security features to effectively prevent unauthorized access via its dial-in line. The security features are transparent to the host computer software and can be used with the same remote modems and communications protocols such as MNP. Security features are selected and programmed using the standard AT command format with extensions to support the additional functions.

FEATURES

☐ Three levels of security operation
  ● unsecured direct access
  ● password controlled direct access
  ● password controlled callback from a list

☐ Compatible security commands
  ● programmed by host computer in industry standard format
  ● no additional equipment required

☐ Internal nonvolatile storage
  ● up to 16 passwords of up to 7 characters each
  ● up to 16 callback numbers of up to 33 digits each

☐ Unobtrusive operation
  ● unobvious to hackers
  ● resists penetration by password generators
  ● impervious to unauthorized entry when callback is used

DESCRIPTION

When operated with security disabled, the modem functions as a full featured autoanswer modem. It signals the host computer when a ring signal is detected and when communications are established with the calling modem.

When the security features are activated, a barrier is effectively placed between the autoanswer function and the host computer. A password must be received to disable the barrier. On receipt of a correct password, depending on the level of security programmed, the modem will either immediately signal an incoming call to the host computer or will terminate the call, dial a preprogrammed callback number, reestablish communications and only then signal an incoming call to the host.

OPERATION

Security Disabled

Operation of the modem obeys the following procedure when operated with security disabled:

● The modem immediately signals its host computer on detection of a ring signal on its TELCO line.

● The modem answers after the programmed number of rings and establishes communication with the calling modem. The calling modem speed and modulation type are determined at this time.

● As soon as communication is established, the modem signals its host computer that a connection has been made.

● The modem will disconnect when carrier is lost for the length of time programmed, when DTR goes inactive, or when it is commanded to disconnect by the host.

Password Security

This procedure is used to provide password only direct access:

● The modem does not indicate the occurrence of a ring signal to its host computer.

● The modem answers an incoming call after the programmed number of rings and establishes communications with the calling modem. The calling modem speed and modulation type are determined at this time.

● After modem communication is established, the modem transmits "PASSWORD", then waits for receipt of a password for a programmed time. If the time expires prior to receipt of an identifiable

password, the modem hangs up and no further action is taken.

● On receipt of a valid password, if no corresponding callback number is programmed, the modem signals its host computer that an incoming call was detected and a connection established.

● The modem will disconnect when carrier is lost for the length of time programmed, when DTR goes inactive, or when it is commanded to disconnect by its host.

Callback Security

This procedure is used to provide password and automatic callback operation:

● The modem does not indicate the occurrence of a ring signal to its host computer.

● The modem answers an incoming call after the programmed number of rings and establishes communications with the calling modem. The calling modem speed and modulation type are determined at this time.

● After communication is established, the modem transmits "PASSWORD", then waits for receipt of a password for a programmed time. If the time expires prior to receipt of an identifiable password, the modem hangs up and no further action is taken.

● On receipt of a valid password, if a corresponding callback number is programmed, the modem disconnects the call, waits for the initial callback delay time, then goes off hook and dials the programmed number.

● If the call cannot be placed successfully the modem waits for the callback retry delay time and tries again. This process is repeated until

its succeeds or the selected retry limit is reached. During this process the modem will not accept incoming calls.

● On successful completion of the callback, and after communication has been established with the remote site, the modem signals an incoming call and connects to its host computer.

● The modem will disconnect when carrier is lost for the length of time programmed, when DTR goes inactive, or when it is commanded to disconnect by its host.

PROGRAMMING SECURITY

SECURITY REGISTERS
Security functions are controlled by the contents of selected "S-registers" in the modem. The following S-registers apply to security functions.

Security ON/OFF

REGISTER S71

Bit	Value	Description
0	0 1	Security Off Security On

Password Timeout

REGISTER S72
The length of time the modem waits for a password after receiving a call, (0 to 255 seconds) typically 30 seconds.

Callback Delay

REGISTER S73
The length of time the modem waits after receiving a valid password and before calling back the call originator, (0 to 255 seconds) typically two seconds.

Callback Retry

REGISTER S74
If a callback fails to reach the call originator, the callback retry allows up to ten (1 to 10) attempts to establish a connection, typically three tries.

Callback Retry Delay

REGISTER S75
The length of time between callback retries, (0-255 seconds) typically two seconds.

AT SECURITY COMMANDS

The S register passwords and corresponding callback numbers are read and programmed using the following AT commands.

Set Decimal

To set a register number in decimal,

Type $S(n) = X$

Sets S register number n to the value X where X is in decimal.

Set Hexadecimal

To set a register number in hexadecimal,

Type $S(n) = X^$

Sets S register number n to the value X where X is hexadecimal.

Request Decimal

To request a register number in decimal,

Type $S(n)?$

Requests the contents of S register n in decimal.

Request Hexadecimal

To request a register number in hexadecimal

Type $S(n)?^$

Requests the contents of S register number n in hexadecimal.

Password

To set a password

Type $\%P(n) = X$

Sets password number n to X where X is up to 7 characters terminated with a carriage return.

Callback Number

To set a callback number

Type $\&Z(n) = X$

Sets callback number n to X where X is up to 33 digits and dial modifiers terminated with a carriage return. If no callback number is set for the corresponding password, the callback feature is disabled and the password alone establishes communications.

NOTE

(n) equals location number from   1 - 15.

Example:

To program the first password and its' corresponding call back number, type:

%P1 = password
&Z1 = number

GENERAL

This chapter describes the function of the controls and indicators, also the operating and test procedures. Following initial power on, the modem can operate either unattended or under control of a user or computer.

CONTROLS AND INDICATORS

Modem Status

The front panel of the modem enclosure has eight diagnostic LEDs that show the operating status of the modem.

- MR/RI . . .   Modem Ready. On when modem is off hook.
  Flashing when receiving a ring signal.

- TR . . . . .   Terminal Ready. On when DTR is active.

- EC . . . . .   Error Control. On when modem is operating in an error control mode.

- HS . . . . .   High/Low Speed. There are three conditions for this LED:

  - On when modem is in high speed, 2400 bps
  - Off when modem is in medium speed, 1200 bps
  - Flashing when modem is in low speed, 0-300 bps

- MC . . . . . Modem Check. On when errors are received (self test is active) or when data is being retransmitted in error control mode. Also on when modem is inactive after power is turned on.

- RD . . . . . Receive Data. On when receive side of modem is active (space = on).

- TD . . . . . Transmit Data. On when transmit side of modem is active (space = on).

- TM . . . . . Test Mode. On when any test function is active.

The front panel rotary switch selects normal operation, six diagnostic tests, or voice transmission on the telephone connected to the modem.

- AL . . . . . Analog Loopback Test. Modem transmit signals are connected to the modem receiver. This permits a local evaluation of the modem that is independent of telephone line connections. Data transmitted by the terminal equipment is processed by the modem circuits and returned as terminal receive data.

- RL . . . . . Remote Digital Loopback Test. This test may be activated only after a data connection is established with an answering modem. This test is effective in high or medium speed only. Selecting this test signals the answer modem to enter the

digital loopback mode. The local operator can test one entire communications channel. Error controlling protocol will be shut off for the duration, then re-initialized.

```
CAUTION
DL is not recommended if the
remote modem is running an error
controlling protocol.
```

- DL . . . . . Digital Loopback Test. This test is effective only after a data connection is established with a second modem. The terminal equipment is isolated from the modem data circuits. The modem connects digital receive data into the transmitter so that the second modem can evaluate the communications channel.

- TALK . . . . The TALK position puts the modem in an idle condition. The TELCO line is connected to the TELSET jack for use of the telephone. The modem will not automatically answer an incoming call when in TALK. However, a ringing signal causes the answer mode to be set and retained.

- DATA. . . . The DATA position permits an incoming call to be automatically answered if the Autoanswer option strap is enabled. This position is also used to originate a call. Switching from TALK to DATA causes the modem to go off hook if DTR is active.

- ST ..... Self Test. This test is effective only after a data connection has been established. The terminal equipment is isolated from the modem data circuits. The modem transmits an alternating 1/0 data pattern. Receive data is monitored for the same pattern. Receive data errors are shown by blinking of the MC indicator. The receive data test is meaningful only if the other modem is selected for ST or DL.

- SRL .... Self Test Remote Digital Loop. The data path is established in the same manner as for RL. Terminal equipment is isolated from the modem data circuits. The modem generates test data and monitors the returned data for errors, as in self test.

- SAL .... Self Test Analog Loopback. The modem operates in the analog loop mode with the transmitter connected into the receiver circuits. The test does not involve a second modem. Terminal equipment is isolated from the modem. Transmit data is internally generated while receive data is monitored for errors. Data errors cause the MC indicator to flash on.

NOTE

The respective TD and RD LEDs are ON when TX and RX data are in a space condition and OFF in a mark condition.

Front Panel Toggle Switch

- HI ..... High speed, 2400 bps operation.

- MED .... Medium speed, 1200 bps operation.

- LO ..... Low speed, 0-300 bps operation.

POWER ON/OFF PROCEDURES

When modem power is turned on, operating personnel are not exposed to voltages in excess of 30 volts on any card or accessible area of the power supply.

Cycle Redundancy Checking

Upon power up the modem performs six self diagnostic tests. The first test computes a CRC on the EPROM.

Erasable Programmable Read Only Memory

Initially the five left side LEDs are on. As each test is passed, its corresponding LED goes off. If any of the five tests fail, the modem will "freeze" with one or more of the first five LEDs on. See Figure 4-1. If this happens repeatedly the modem must be returned for servicing. The first five tests in order are:

- EPROM
- MPU registers
- MPU register banks
- MPU RAM
- Auxiliary RAM

The sixth test is on the nonvolatile RAM which contains configuration parameters and phone numbers. If this test fails, the nonvolatile RAM is reloaded to its factory configuration settings and the phone numbers cleared. To notify the user of this, the first five LEDs will all flash in sequence five times. Also, S50 will be set to 1. If the test is passed, S50 is set to 0.

MR/RI TR EC HS MC RD TD TM   EPROM failed

MR/RI TR EC HS MC RD TD TM   MPU registers failed

MR/RI TR EC HS MC RD TD TM   MPU register banks failed

MR/RI TR EC HS MC RD TD TM   MPU RAM failed

MR/RI TR EC HS MC RD TD TM   Auxiliary RAM failed

● LED on   ○ LED off
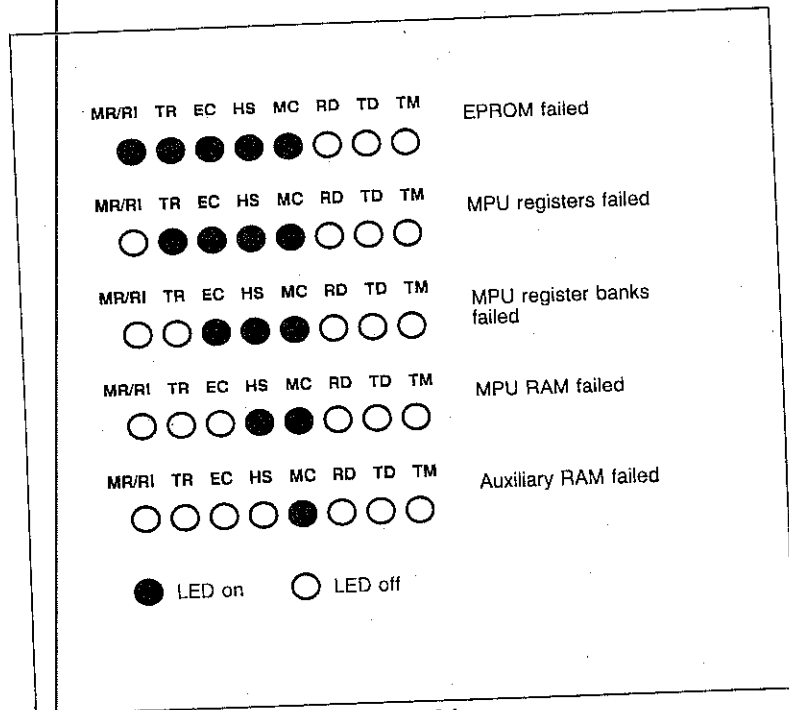
Figure 4-1
Initial Tests

MANUAL CALL ORIGINATION

There are two ways to originate a call depending on the type of telephone line connection.

Manual Call Origination with a Standard Telephone (RJ11C Type Connection)

For this connection, select the TALK position and then place the call through the telephone. The remote modem autoanswers with a high-pitched answer back tone. Upon hearing the tone, switch the modem to DATA and hang up the phone. If manually answered at the remote site, both should switch to DATA at about the same time. In either case, the modems handshake after DATA is selected.

Manual Call Origination with an Exclusion Key Telephone (RJ45S Type Connection)

The RJ45S connector can operate with an exclusion key telephone. This requires a connection from contacts 3 and 6 of the TELCO jack to the exclusion key switch contacts. The front panel switch must be in the data position. Lift the handset, pull the exclusion key up and place the call. When finished talking, or if the remote modem autoanswers, replace the handset on the cradle and the phone will go on hook. The data set will go into DATA mode if DTR is enabled.

AUTOANSWER

The modem will automatically answer a call if DTR is enabled, the Autoanswer option is activated, and DATA position is selected.

DATA/TALK OPERATION

There are two modes of data/talk transfer used by the modem.

Voice Operation with a Standard Telephone (RJ11C Option)

To start talking, lift the phone handset and select the TALK position.

Voice Operation with an Exclusion Key Telephone (RJ45S Option)

To start talking, lift the phone handset and pull the exclusion key plunger up.

> **NOTE**
> The carrier disconnect feature should be disabled (by switch hook or talk switch) if both users expect any voice dialogue to take place during the transmission or reception. The DATA position should be selected if RJ45S option is used.

When modem power is applied, MC is ON and will go OFF when normal data mode is initiated. MC will also turn on in data/talk transfer.

CALL TERMINATION

The following conditions cause call termination:

● Abort Disconnect	Default 30 sec. Software selectable 1 to 30 sec.
● Loss of Carrier Disconnect	Switch selectable 100 ms or 18 sec. Software selectable 100 ms to 25.5 sec.
● Receive Long Space Disconnect	Switch or software selectable for disabled or 2 sec.
● Transmit Long Space Disconnect	Switch or software selectable for disabled or .4 sec.
● DTR Disconnect	Switch selectable for disabled or 500 ms. Software selectable for disabled or 10 ms to 2.55 sec.

● EC100 Link Establishment Failure	Default 6 sec. Software selectable for disabled or 100 ms to 25.5 sec.
● MNP Link Establishment Failure	18 sec. or 6 sec. when protocol fallback is enabled.
● MNP Inactivity Timeout	Default disabled. Software selectable for disabled or 1 to 90 minutes.
● MNP Retry Limit Exceeded	12 retransmissions of the frame.

● The modem is switched to analog loopback or self test analog loopback.

● Modem power is turned off.

PROTOCOLS

AUTO FALLBACK

When originating a call in dialup the modem tries connecting with successive protocols until the list is exhausted or a connection is achieved. The list is in registers S91-99.

FLOW CONTROL

Flow control adjusts for differences in speed between the modem and DTE. The difference can be caused by running different bit or character rates, and overall throughput rates. When the modem runs a synchronous error controlling protocol, it doesn't transmit the start and stop bits of each character. This gives it an overall faster character rate than the asynchronous DTE running the same bit rate. When the quality of the connection with the remote modem deteriorates, the modem may be

forced to retransmit, lowering its overall throughput to the point where it may be lower than the DTE running the same bit rate.

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. Any combination of these may be enabled and you may choose any combination of four methods (including none and all) for each direction independently. The four methods include two in band and two out of band methods. The two in band methods are the character pairs DC1/DC3 (11H/13H ↑Q/↑S) and DC2/DC4 (12H/14H ↑R/↑T) to enable and disable transmission respectively. The two out of band methods are Pin 11 and DTR or CTS signal leads. DTR is for flow controlling the modem and CTS is for flow controlling the DTE. Pin 11 maybe be used in either direction.

MNP

MNP (Microcom Networking Protocol) provides error detection and automatic retransmission of data upon detection of an error. The modem supports MNP levels 2 and 3. Level 2 is the asynchronous version and level 3 is the synchronous version.

NATIVE 224 ATD

Native 224 ATD is the absence of error controlling protocols. The modem operates according to CCITT V.22/V.22 bis and Bell 212A/103. No error detection is used.

BUFFERED 224 ATD

Buffered 224 ATD is the absence of error controlling protocols. The modem is compatible with CCITT V.22/V.22 bis and Bell 212A/103. No error detection is used but DTE and DCE speeds may be dissimilar and the data is buffered requiring flow control.

4-10

Chapter 5
Operating Commands

OPERATING COMMANDS

AT - Attention Code

Modem commands begin with the letters AT unless indicated otherwise. The AT alerts the modem to expect a control command. For example, to dial a telephone number, type AT D followed by the number.

The D (dial) and other commands are explained in this chapter to help you get up and running as quickly as possible. Use the QUICK REFERENCE (Appendix C) once you're familiar with the commands.

Command Storage

When you type a command, it is temporarily stored in a portion of the modem memory called a buffer. The command buffer holds 80 characters including dial modifiers and spaces but excluding the AT command prefix.

Use the backspace key to go back to an incorrect entry, then retype the desired characters.

When the command is ready to send to the modem, press Carriage Return.

Numbered Commands

Commands that start with the same letter are distinguished by a number following the letter.

For example, the B0 command selects CCITT 1200 bps operation, while the B1 command selects Bell 212A operation.

In all cases, the zero (0) may be omitted so the commands B and B0 are identical.

5-1

For clarity, this manual uses the no-zero form of command. If you wish to add zeros, feel free. The modem treats both the same but zeros count against the buffer total.

Command and Data Modes

When the modem is powered up or reset, it awaits your AT command. This is called command mode. Only in command mode will the modem respond to commands.

When the modem is connected to another modem and is transmitting or receiving data, it is in data mode.

Commands are provided to let you easily switch from one mode to another. Refer to COMMAND MODE for more information.

Status Registers

Certain modem operating features are controlled by storage locations called status (S) registers. These registers are referred to by their numbers as S1, S6, and so on. The section on S-REGISTERS gives details of their use and contents.

Repeating a Command

To repeat the last command,

Type   A/

AT does not precede this command because AT would clear the command buffer to make room for the new command. If you typed AT A/ , the buffer would be empty and there would be no command to repeat.

Use the A/ command to redial when a line is busy.

Bell/CCITT Operation

This command defines the mode of operation when the modem connects at 1200 bps. If the modem connects at any other speed it has no effect.

Command	Operation
AT B	CCITT V.22/V.22 bis 1200 bps
AT B1	Bell 212A 1200 bps*

*factory setting
Bell/CCITT Option

Local Character Echo

Type AT without a carriage return. If the screen shows "AT" everything is fine. Proceed with other commands as desired.

If the screen shows "AATT" type the AT E command to correct the double characters.

If the screen shows no characters, type AT E1 to turn the echo on.

Command	Operation
AT E	echo off
AT E1	echo on*

*factory setting
Echo Option

STATUS DISPLAYS

The modem normally displays status phrases (CONNECT, BUSY, etc.) on your screen to keep you informed of the progress of a call.

Number Codes

To display a number code instead of its corresponding message:

Type   AT V

For example, if you are developing a communications software package, the number codes will be easier to use than the longer status phrases.

Command	Operation
AT V	number codes
AT V1	messages*

*factory setting
Number Codes/Message Option

Printout Status Display

To omit the status information from the printout if the modem is connected directly to a printer:

Type   AT Q1

Command	Operation
AT Q	status display on*
AT Q1	status display off

*factory setting
Set Status Display Option

The modem still responds to your commands when the status display is inhibited.

Status Display Codes

Status display number codes, messages, and their corresponding meanings are listed in Table 5-1.

Code	Message	When displayed
0	OK	command received ok
1	CONNECT	connection made at 0-300 bps (X command in effect) connection made at 0-300, 1200, or 2400 bps (X1 command in effect)
2	RING	ring detected
3	NO CARRIER	valid carrier not detected within period specified by register S7, or carrier lost for 300 ms 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 30 seconds or period specified by register S7 (W command and X, X1, or X3 command in effect) no dial tone detected for 5 seconds (X2 or X4 command in effect)
7	BUSY	dialed number busy (X3 or X4 command in effect)
8	NO ANSWER	5 seconds of silence not detected (dial modifier @ in effect)
10	CONNECT 2400	connection made at 2400 bps

Table 5-1
Status Display Codes

Extended Status Displays

Enabling the extended status displays provides more information. If these interfere with or confuse a software package, they may be left disabled and only the normal messages or codes will be displayed.

Command	Operation
AT %U	extended displays off *
AT %U1	extended displays on

*factory setting
Extended Display Option

Table 5-2 shows the codes, messages, and meanings of the extended status displays.

Code	Message	When displayed
64	UNABLE TO CONNECT MNP	connection made but protocol was unable to establish link.
65	DISCONNECT RECEIVED	a link disconnect request was received from the remote protocol resulting in a disconnect.
66	RETRY LIMIT EXCEEDED	the protocol was unable to receive acknowledgment within the specified number of retries, resulting in a disconnect.
67	INACTIVITY TIMEOUT	no data has been transmitted within the specified time limit, resulting in a disconnect.
68	CONNECT MNP ASYNC PROTOCOL	MNP connected service class 2.
69	CONNECT MNP SYNC PROTOCOL 3	MNP connected service class 3.

Table 5-2
Extended Status Display Codes

Connect Speed Displays

When calling, the modem automatically sets its speed to the same as your terminal. When answering, the modem sets its speed the same as the originating modem. In both cases, a satisfactory connection is indicated by a CONNECT message or code.

A single CONNECT message can be used for ALL connections, regardless of speed. To do this, type AT X.

Command	Message
AT X	CONNECT (code 1)
AT X1	CONNECT (code 1) CONNECT 1200 (code 5) CONNECT 2400 (code 10) (as appropriate)

Connect Display Option

When AT X or AT X1 is in effect, dial tones are not detected. Instead, the modem waits 2 seconds (or the time set by S6) and then dials.

> **NOTE**
> When an X2, X3 or X4 command is in effect, CONNECT speeds are also displayed, as for X1.

When X2 or X4 is in effect, the modem waits for a dial tone before dialing. If no dial tone is detected in 5 seconds, the NO DIAL TONE message or code appears.

When X3 or X4 is in effect, the BUSY message or code appears if the dialed number is busy.

> **NOTE**
> There is no dial tone detection when X3 is in effect. Instead, the modem waits 2 seconds, or the time set by S6, then dials.

Command	Operation
AT X2	wait for dial tone
AT X3	detect busy signal
AT X4	wait for dial tone and detect busy signal *

* factory setting

Dial Tone and Busy Signal Detect Option

SETTING OPTIONS

Dial/Leased Line

If operating on the public switched telephone network, type AT &L. For private line operation, type AT &L1.

Command	Operation
AT &L	dial (switched) *
AT &L1	leased (private) *

* initial setting determined by DIP switch

Dial/Leased Line Option

Long Space Disconnect

When an alternate method of disconnect detection is desired, type AT Y1 to enable the long space disconnect feature. The modem will send 4 seconds of space preceding any disconnect and will disconnect if it receives 2 or more seconds of space. If you send break sequences of 2 or more seconds, type AT Y to disable this feature to prevent unintentional disconnects.

Command	Operation
AT Y	long space disconnect off *
AT Y1	long space disconnect on *

*initial setting determined by DIP switch

**Long Space Disconnect Option
(Transmit and Receive)**

Command	Operation
AT %X	transmit long space disconnect off *
AT %X1	transmit long space disconnect on *

* initial setting determined by DIP switch

Transmit Long Space Disconnect Option

Data Set Ready Option

When using DSR to indicate readiness to accept data for transmission, type AT &S1. Some terminals and other devices require DSR in order to transmit at all. To use these with the ACU the factory setting is "DSR always on."

Command	Operation
AT &S	DSR always on *
AT &S1	DSR on when off hook in data mode after protocol is installed and not in self test, self test remote digital loopback, or digital loopback.

* factory setting

Data Set Ready Option

Data Carrier Detect Option

When using DCD to indicate the presence of a valid carrier, type AT &C1. Some terminals and other devices require DCD in order to transmit at all. To use these with the ACU the factory setting is "DCD always on."

Command	Operation
AT &C	DCD always on *
AT &C1	DCD is on when modem recognizes the remote modem carrier and the protocol is installed.

* factory setting

Data Carrier Detect Option

Data Terminal Ready Option

A DTR on to off transition allows one of four selections to be made.

- To ignore DTR, type AT &D.
- To force the ACU to be recalled from the data mode when DTR goes off, type AT &D1.
- To use DTR to disconnect and disable autoanswer, type AT &D2.
- To use DTR to completely initialize the modem, type AT &D3.

Command	Operation
AT &D	ignore DTR *
AT &D1	on to off transition recalls the ACU
AT &D2	on to off transition causes the modem to disconnect and disables the autoanswer while DTR is off *
AT &D3	on to off transition resets the modem

* initial setting determined by DIP switch

Data Terminal Ready Option

EPROM Check

PC software packages may issue the AT I command to verify the modem will support all commands needed by the software package. This will return 3 ASCII characters in the form of 24X where X is the revision level. To request the CRC to be calculated on the EPROM, type AT I1. This will return 4 ASCII characters representing the CRC in hexadecimal form. Typing AT I2 will also calculate the CRC and return "OK" or "ERROR" to indicate EPROM state.

Command	Operation
AT I	request product code
AT I1	request EPROM CRC value
AT I2	request EPROM CRC test

Request EPROM Check

DTE Flow Control

When running an error controlling protocol or Buffered 224 A/D mode, it can become necessary to flow control DTE. Select a method that is supported by your DTE device.

Command	Operation
AT %V0	DTE CTS flow control on *
AT %V1	DTE CTS flow control off *
AT %V2	DTE DC1/DC3 flow control on *
AT %V3	DTE DC1/DC3 flow control off *
AT %V4	DTE DC2/DC4 flow control on *
AT %V5	DTE DC2/DC4 flow control off *
AT %V6	DTE pin 11 flow control on *†
AT %V7	DTE pin 11 flow control off *
AT%V8	DTE Wang flow control on
AT%V9	DTE Wang flow control off

* initial setting determined by DIP switch
† This option requires coordination with the pin 11 strap.
DTE Flow Control

DCE Flow Control

When running an error control protocol or Buffered 224A/D mode, it can become necessary to flow control the modem. Select a method that is supported by your DTE device.

Command	Operation
AT %N0	DCE DTR flow control on *
AT %N1	DCE DTR flow control off *
AT %N2	DCE DC1/DC3 flow control on *
AT %N3	DCE DC1/DC3 flow control off *
AT %N4	DCE DC2/DC4 flow control on *
AT %N5	DCE DC2/DC4 flow control off *
AT %N6	DCE pin 11 flow control on *†
AT %N7	DCE pin 11 flow control off *
AT %N8	DCE Wang flow control on
AT %N9	DCE Wang flow control off

* Initial setting determined by DIP switch
† This option requires coordination with the pin 11 strap.
DCE Flow Control

MNP Break Control   This defines the action taken upon receiving a break sequence from the DTE when running MNP:

Data mode:
- 0, 2, 4 . . . Recall the ACU
- 1 . . . . Flush buffers and send a break to the remote
- 3 . . . . Send an expedited break to the remote
- 5 . . . . Send a sequenced break to the remote

Command mode:
- 0, 1 . . . . . . Flush buffers and send a break to the remote
- 2, 3 . . . . . . Send an expedited break to the remote
- 4, 5 . . . . . . Send a sequenced break to the remote

Command	Operation
AT %B	MNP break option 0
AT %B1	MNP break option 1
AT %B2	MNP break option 2
AT %B3	MNP break option 3
AT %B4	MNP break option 4
AT %B5	MNP break option 5 *

* initial setting

MNP Break Control

MNP Initiate/Accept   When dialing, this is set to Initiate, and set to Accept when answering. This can be overridden by using the semi-colon (;) dial modifier and the %I command.

Example: AT D721-8100; %I0 < CR >

Command	Operation
AT %I	accept
AT %I1	initiate

MNP Initiate/Accept Option

Protocol Selection   Use this command to set the protocols in the protocol list.

Example: AT %L3

This adds MNP protocol to the protocol list. After connection in dialup, the modem attempts to connect in MNP and falls back to transparent mode if an MNP connection cannot be established.

Command	Operation
AT %L1	Initiates 224 ATD mode call
AT %L3	initiates MNP protocol call

Set Protocol Selection

TESTS

When diagnostic tests are initiated via the AT &Tn commands (n = 0 to X), they will terminate after the period of time specified by S18. If S18 is set to 0, the timer is disabled. They may also be terminated by the AT &Tn commands except remote digital loopback and analog loopback, which must first recall the ACU and then may issue the AT &Tn command.

Command	Operation
AT &T	terminate any test
AT &T1	initiate analog loopback test
AT &T3	initiate digital loopback test
AT &T4	allows acceptance of slaved digital loopback
AT &T5	disallows acceptance of slaved digital loopback
AT &T6	initiate remote digital loopback test
AT &T7	initiate self test remote loopback test
AT &T8	initiate self test analog loopback test

Perform Diagnostic Tests

DIALING

To dial a number, for example 555-1212,

Type   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.

Use spaces, hyphens, parentheses, or other punctuation except dial modifiers as desired to make the command line easier to read and type. For example, these are all treated the same:

AT D 1-800-555-1212
AT D 1 (800) 555-1212
ATD18005551212

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 (1/2 second)
R	switch to answer mode after dialing
@	wait for silence
;	return to command mode after dialing
S	dial stored command line or number

* factory setting
Dial Modifiers

Tone Dialing

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

Type   AT D T 323-1111

In this example, the modem tone dials the telephone number. Tone dialing will remain in effect until you change to pulse dialing (or reset the modem).

Pulse Dialing

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

Type   AT D P 555-9902

This example is similar to the tone dial example except that pulse dialing is used.

Insert Long Pause

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

Type   AT D P 9, T 1-800-555-1000

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

Wait for 2nd Dial Tone

To wait for second dial tone,

Type   AT D 9 W 323-8000

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

Flash the Switchboard

To flash the switchboard, type an exclamation point. This inserts a 1/2-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.

Switch to Answer Mode After Dialing

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

AT D 555-2345 R

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

Place a Voice Call

To place a voice call, put the front panel rotary switch in the TALK position and dial the number. If you wish to use the dial command for the call,

Type   AT D (number);

put the rotary switch in the TALK position to give the telephone control of the phone line. The ; recalls the command mode.

Switch from Voice to Data

After dialing in the TALK position, put the rotary switch to the DATA position

USING ELECTRONIC SERVICES

Phone ordering and electronic banking services require additional numbers or codes after dialing. Remain in the AT command mode after the phone connection has been made.

Remain in Command Mode

To remain in command mode after dialing, use a semicolon at the end of the dialing command.

AT D 234-5678 ;

This is used to retain control after entering a sequence of digits to the service.

Wait for 5 Seconds of Silence

To wait for 5 seconds of silence after accessing an electronic service, use the @ command.

AT D 399-4700 @ 2251 ;

Here the modem dials the phone number, waits for ring indication, waits for 5 consecutive seconds of silence, enters a service code, then

returns to the AT command mode for further input from you. At this point, you may enter the desired information according to the service's requirements.

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

AT D 1400 ;

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

To terminate your call,

Type   AT H

to hang up.

If the 5-second silent period is not detected, the NO ANSWER message or code appears.

STORING COMMAND LINES   The command line can be stored in battery backed memory for later retrieval. The stored command is retained until replaced by another command. Modem power can be turned off without affecting what is stored.

Storing a Command Line   To store a command line,

Type   AT &Z

followed by the desired command sequence of digits and modifiers.

AT &Z T 1-800-555-1212

Here the command sequence to tone dial the indicated number is stored for later dialing.

To store additional command lines, type AT &Zn = followed by the desired command sequence where n is a number between 1 and 15 (n = 0 is equivalent to using the AT &Z command).

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

Dialing a Stored Command Line   Use the S command to dial a previously stored command line.

AT D S

To dial one of the multiple stored numbers, type AT D S%n% where n is between 0 and 15.

AT D S% 15%

In this case the entire dialing sequence stored with the &Z command is retrieved and sent.

HANGING UP   To terminate a call, enter the command AT H. This command tells the modem to go on hook, disconnecting the 2 linked modems.

You must be in command mode to use this command. This is assured by putting the ; command at the end of each dialing command. Or, use the escape sequence described in the next section.

COMMAND MODE   When the modem is in data mode, it will not respond to your commands. Use the following escape sequence to return to the command mode.
                      pause + + + pause

If transmitting data via the keyboard, stop keyboard typing for at least one second before

and after the escape sequence so the modem will recognize the + signs as escape characters and not data transmission characters.

This escape sequence temporarily suspends data mode transmissions and permits command mode operations without hanging up or having to reestablish the connection.

The pauses must be as long as the delay time stored in S12 (factory setting = 1 sec.).

The standard escape characters are " + " signs. These can be changed as desired by altering S2.

Returning to Data Mode

Use the AT 0 command to restore data mode after using an escape sequence to return to command mode. Your modem will reestablish transmission according to the connection parameters presently in effect.

Modem Powerup Configuration

This command stores the configuration parameters in battery backed memory. The stored configuration is retained, even when power is off, until a new &W command is used or the factory configuration is restored with the &F command.

To store the current configuration,

Type   AT & W

When the modem is reset with the Z command or power is first turned on, the stored values become the current values. Once you establish a proven configuration, this command can save time.

To reset the parameters,

Type   AT Z

Type the AT Z command to initialize the modem and reinstate the powerup configuration stored in the modem memory.

If you use an escape sequence to return to command mode - and then type AT HZ - the modem will hang up the interrupted call.

To restore the factory configuration,

Type   AT & F

The AT &F command restores the current and powerup configuration to the factory settings.

S-REGISTERS

The modem stores essential operating information in parts of its memory called status (s) registers. The modem internal program constantly refers to the contents of these registers. You may also read their values and change them as desired. To display the contents in hexadecimal notation, include a " ^ " (carat) character.

To read a register value,

Type   AT Sn? or AT Sn?^

where n = register number

For example, to determine the current backspace character, type

AT S5?

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

To change a register value:

Type   AT Sn = (decimal value) or
        AT Sn = (hexadecimal value)

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

    AT S2 = 27

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

    (pause) ESC ESC ESC (pause)

Autoanswer

Register S0
This register turns the option on or off. (Refer to Chapter 3, Option Switches - Autoanswer for more information if needed.)

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 will answer on. For example, if S0 equals 4, the modem will answer the call on the 4th ring. The default value is controlled by Switch 1 position 5.

Ring Count

Register S1
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. However, if you are developing communications software, your program can read the register to determine the ring total.

Escape Character

Register S2
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.

End of Line Character

Register S3
The standard character is the carriage return (ASCII value of 13). This character ends each command and sends it 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).

Line Feed Character

Register S4
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).

Backspace Character

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

Pause Before Dialing

Register S6
When dial tone detection is disabled (command X, X1, or X3 in effect), the modem will wait the number of seconds stored in this register before dialing.

The default value is 2 (seconds).

Pause for Ring Back and Carrier Detection

Register S7
If no ring back is detected within the number of seconds in S7, the modem disconnects and sends the NO CARRIER message or code. If ring back is detected then 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).

Pause Interval for Comma

Register S8
When a dial command contains a comma, the modem pauses the number of seconds in S8.

Change S8 if you wish to change the basic pause interval (0-255), or simply use several commas in a row for greater delay during dialing.

The default value is 2 (seconds).

Carrier Detect Time

Register S9
Amount of time in increments of 0.1 second 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 may be extended to lessen the likelihood of false detection of carrier by voices, etc.

Lost Carrier Detect Time

Register S10
Amount of time in increments of 0.1 second to recognize the loss of carrier. Data Carrier Detect (DCD) will be dropped when the loss of carrier is recognized and the modem will disconnect.

The default value is 1 or 20 (0.1 or 2.0 seconds) depending on switch 3 position 2.

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

Duration Space Tones

Register S11
Duration of pause between DTMF tones. Values range from 50 msec to 255 msecs.

Escape Sequences Pause Interval

Register S12
When you use the escape command to return the modem to command mode from data mode, two pauses are needed, one before and one after the escape characters.

The pauses prevent the modem from responding to a character sequence which might contain escape characters as part of its normal 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 then timing is not a factor.

The timing between the 3 escape characters you type 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.

If you 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.

Register S13 Not Used

Options Status

Register S14
Contains the status of certain options:

Bit	Value	Description
0	-	not used
1	0	local character echo OFF
	1	* local character echo ON
2	0	* status displays ON
	1	status displays OFF
3	0	status codes
	1	* status messages
4	0	* ACU ENABLED
	1	ACU DISABLED
5	0	tone dial
	1	* pulse dial
6	-	not used
7	0	answer
	1	* originate - controls S60 bit 0

* factory setting

If status bits are of interest, read the register value to find which bits are set. The returned value is decimal unless the "^" character is used.

Register S15 Not Used

System Tests

Register S16
Contains the status of system tests option settings.

Bit	Value	Description
0	0	Analog Loopback Inactive
	1	Analog Loopback In progress
1	-	not used
2	0	Digital Loopback Inactive
	1	Digital Loopback In progress
3	0	Slaved Inactive
	1	Remote 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	-	not used

Register S17 Not Used

Test Timer

Register S18
Amount of time in 1 second increments that a test initiated by a command will run. A value of 0 disables the timer. The default value is 0.

Register S19 Not Used

Register S20 Not Used

Options Status   Register S21

Bit	Value	Description
0	-	not used
1	-	not used
2	-	not used
3, 4	0 1 2 3	DTR ignored DTR on/off transition recalls ACU DTR on/off transition causes disconnect DTR on/off transition causes reset of modem
5	0 1	DCD always ON DCD indicates carrier recognized after protocol is installed
6	0 1	DSR always ON DSR on when off hook in data mode and not in self test, self test remote digital loopback or digital loopback
7	0 1	long space disconnect disabled long space disconnect enabled see "Y" command this bit controls register S51 bits 6 & 7.

Options Status   Register S22

Bit	Value	Command	Description
0, 1	-		not used
2, 3	-		not used
4, 5, 6	0 4 5 6 *7	X0 X1 X2 X3 X4	connect message only, blind dials connect/1200/2400, blind dials connect/1200/2400, waits for dial tone connect/1200/2400, blind dials, reports BUSY connect/1200/2400, waits for dial tone, reports BUSY
7	*0 1	39/61 33/67	make/break ratio (US) make/break ratio (UK)

Options Status   Register S23

Bit	Value	Description
0	0 * 1	slaved remote digital loopback disabled slaved remote digital loopback enable
1, 2	0 † 1 2 3	0-300 bps n/a 1200 bps 2400 bps mapped to Register S61
3	-	not used
4, 5	†† 0 1 2 3	7 bits even parity 7 bits space parity 7 bits odd parity 7 bits mark parity controls Register S53 bits 4-7
6, 7	-	not used

* factory setting
† initial setting controlled by front panel toggle switch
†† initial setting controlled by switch 2 positions 1-3

Register S24 Not Used

DTR Drop Time   Register S25
Amount of time in 0.01 second increments that DTR must stay low in order to be recognized. The default value is 5 (0.05 second).

Register S26 Not Used

Options Status   Register S27

Bit	Value	Description
0,1	--	not used
2	0	dial up
	† 1	leased
3, 4, &5	--	not used
6	†† 0	CCITT V.22 bis - 1200 bps
	1	Bell - 1200 bps
7	--	not used

† initial setting controlled by switch 1 position 3
†† initial setting controlled by switch 2 position 8

Registers S28-49 Not Used

Nonvolatile RAM Status 0-1

Register S50
Status of nonvolatile memory upon power up. A value of 0 indicates the nonvolatile memory was good. A value of 1 indicates that nonvolatile memory failed and has been reinitialized.

Options Status   Register S51

Bit	Value	Description	Comments
0,1	--	not used	--
3, 4, & 5	--	not used	--
6	0	Tx space disc disable	When this is enabled, 4 seconds of space will be
	† 1	Tx space disc enable	transmitted prior to disconnecting to allow the remote modem to detect this disconnect.
7	0	Rx space disc disable	When 2 or more seconds of continuous space are
	†† 1	Rx space disc enable	received the modem will disconnect when this is enabled.

† initial setting controlled by switch 1 position 7
†† initial setting controlled by switch 1 position 8

Register S52 Not Used

Options Status   Register S53

Bit	Value	Description	Comments
0,1	-	not used	
2	† 0 1	CH disable enable	A transition on the CH pin (pin 23) lead will affect the maximum connection speed and the DTE speed.
3	†† 0 1	DTE AL disabled enabled	When pin 25 of the DTE EIA-232C interface is high and this is enabled, the modem will be forced into analog loopback.
4	††† 0 1	WORD LENGTH 10 bits 11 bits	This determines the word length used on the DTE interface.
5, 6 & 7	††††0 1 2 3 4 5,6,7	PARITY none odd even mark space invalid	This determines the parity used on the DTE interface. When running native mode with the ACU disabled in nonbuffered mode, the parity is transparent to the modem.

† initial setting controlled by switch 3 position 3
†† initial setting controlled by switch 3 position 4
††† initial setting controlled by switch 3 position 5
†††† initial setting controlled by switch 3 positions 6-8

DTE Flow Control   Register S54
Selects the method of flow control the modem uses to flow control the DTE.

Bit	Value	Description	
0	0 1	* disable enable	FC DTE CTS
1	0 1	* disable enable	FC DTE (DC1/DC3)
2	0 1	* disable enable	FC DTE (DC2/DC4)
3	0 1	* disable enable	FC DTE PIN 11
4	0 1	* disable enable	FC DTE Wang
5, 6 & 7	-	not used	

* initial setting controlled by switch 2 positions 4-5

DCE Flow Control   Register S55
Selects the method of flow control the DTE may use to flow control the modem.

Bit	Value	Description	
0	0 1	* disable enable	FC DCE DTR
1	0 1	* disable enable	FC DCE (DC1/DC3)
2	0 1	* disable enable	FC DCE (DC2/DC4)
3	0 1	* disable enable	FC DCE PIN 11
4	0 1	* disable enable	FC DTE Wang
5, 6 & 7	-	not used	

* initial setting controlled by switch 2 positions 6-7

Register S56 Not Used

Register S57 Not Used

MNP Inactivity Timer   Register S58
This sets the MNP inactivity timer. When the
timer expires MNP will disconnect. Each time
MNP sends a data character the timer is reset. A
value of 0 disables the timer.

Options	Value	Description	Note
0-90 minutes	(0) *	MNP inactive timeout	0 = disable

* initial setting

MNP Break Control   Register S59
This defines the action taken upon receiving a
break sequence from the DTE when running the
MNP.

Options	Value
0-5	(5) *

* initial setting

MNP BREAK CONTROL MODES

Data Mode	
0, 2, 4	recall the ACU
1	flush buffers and send a break to the remote
3	send an expedited break to the remote
5	send a sequenced break to the remote
Command Mode	
0, 1	flush buffers and send a break to the remote
2, 3	send an expedited break to the remote
4, 5	send a sequenced break to the remote

MNP Initiate/Accept   Register S60
Determines which unit initiates the link request.
When using the dial up network, the modem
placing the call will initiate. When using private
lines, the modem selected as the originate
modem will initiate the link request. This may
be overridden by setting this register after
dialing using the ; dial modifier.

Bit	Value	Description
0	0	accept
	1	initiate
1-7	-	not used

DTE Speed

Register S61
Selects DTE speed. This is for reference only.

DTE SPEED	
Value	Speed
1	110 bps
2	300 bps *
3	450 bps
4	600 bps
5	1200 bps *
6	2400 bps *
7	4800 bps
8	9600 bps *

* initial setting controlled by front panel toggle
switch and switch 1 position 2

Registers S62-64 Not Used

MNP Line Idle

Register S65
Selects the line idle pattern when running MNP.

Bit	Value	Description
0	0	sync
	1	* mark
1-7	-	not used

* initial setting

DTMF Tone Length

Register S66
Sets the duration of the tones used in dialing.

Range	Note	Default
0-255	in 100ms (1)	1 (0.1 sec)

UDS Result Code

Register S67
When enabled, extended result codes provide
additional information.

Value	Description
0	* disable
1	enable

* default setting

Register S68 Not Used

**DCE Independent
Speed**

Register S69
Selects DCE independent speed operation.
When S69 is 0, DTE and DCE speed are equal.
The maximum originate connect speed is
determined by S61. When S69 is non-zero, the
maximum originate connect speed is determined
by S69 and the low speed rate is determined by
S70. Refer to Chapter 3, Speed Selection.

DCE Speed	
Value	Speed
0	use S61 *
1	LO (103) *
2	MED (212A/V.22) *
3	HI (V.22 bis) *

* initial setting determined by switch 1 position 2 and
front panel toggle switch

**DCE Independent
Low Speed**

Register S70
Selects the low speed rate when DCE speed is
independent of DTE speed.

Low DCE Speed	
Value	Low Speed Rate
1	110
2	300 *
3	450

* initial setting

Registers S71-S75 Refer to Chapter 3, Security.

Register S76 Not Used

**Auto Protocol
Recognition Timer**

Register S77

Range	Note
0-255 seconds	0 = disabled

Starts when auto protocol recognition begins. If
it expires before a protocol is recognized, auto
protocol recognition will default to **224 ATD**
mode.

Registers S78-S90 Not Used

**DCE Protocol -
First Choice**

Register S91
Selects the first choice protocol.

Value	Protocol
255	none
0	224 ATD
2	MNP

**DCE Protocol -
Second Choice
Through Ninth
Choice**

Registers S92-99
The second choice through the ninth choice
are the same as the first choice.

Value	Protocol
255	none
0	224 ATD
2	MNP

MODEM TESTS

These tests are CCITT V.54 compatible and provide a means of testing both modems as well as the telephone line quality.

If the modem MC indicator flashes at any time during a self test (SAL, ST, SRL), a failure has occurred. Repeat a failed test several times to ensure it is a consistent failure.

Testing the Modem

The local modem is tested with the Self Test Analog Loopback test (Figure 6-1). The Analog Loopback test (Figure 6-2) can isolate a problem with the DTE or data cable.

LOCAL MODEM A

DTE

TEST PATTERN   TRANSMITTER

ERROR CHECK   RECEIVER

MR/RI TR   EC   HS   MC   RD   TD   TM   HI
● ○ ○ ● ⊗ ⊗ ⊗ ●   MED
                                      SAL   LO

REMOTE MODEM (IDLE)

● ON
○ OFF
⊗ ON OR FLASHING

RECEIVER   DTE

TRANSMITTER

MR/RI TR   EC   HS   MC   RD   TD   TM   HI
○ ○ ○ ○ ○ ○ ○ ○   MED
                                                  LO

NOTES:

1. The TD and RD indicators operate at medium intensity.
The test data averages 50% mark/space data.

2. The MC indicator will flash if errors are detected.

Figure 6-1
Self Test Analog Loopback (SAL)

LOCAL MODEM A

DTE

TRANSMITTER

RECEIVER

MR/RI TR   EC   HS   MC   RD   TD   TM   HI
● ○ ○ ○ ○ ○ ⊗ ⊗ ●   MED
                                      AL   LO

REMOTE MODEM B (IDLE)

● ON
○ OFF
⊗ ON OR FLASHING

RECEIVER   DTE

TRANSMITTER

MR/RI TR   EC   HS   MC   RD   TD   TM   HI
○ ○ ○ ○ ○ ○ ○ ○   MED
                                                  LO

NOTES:

1. Only modem A is involved in the AL test.
2. The HS indicator will be on if HI speed is selected.
3. The TD and RD indicators operate according to the data
presented at pin 2 of theEIA-232 interface.
4. DTR need not be active for this test.
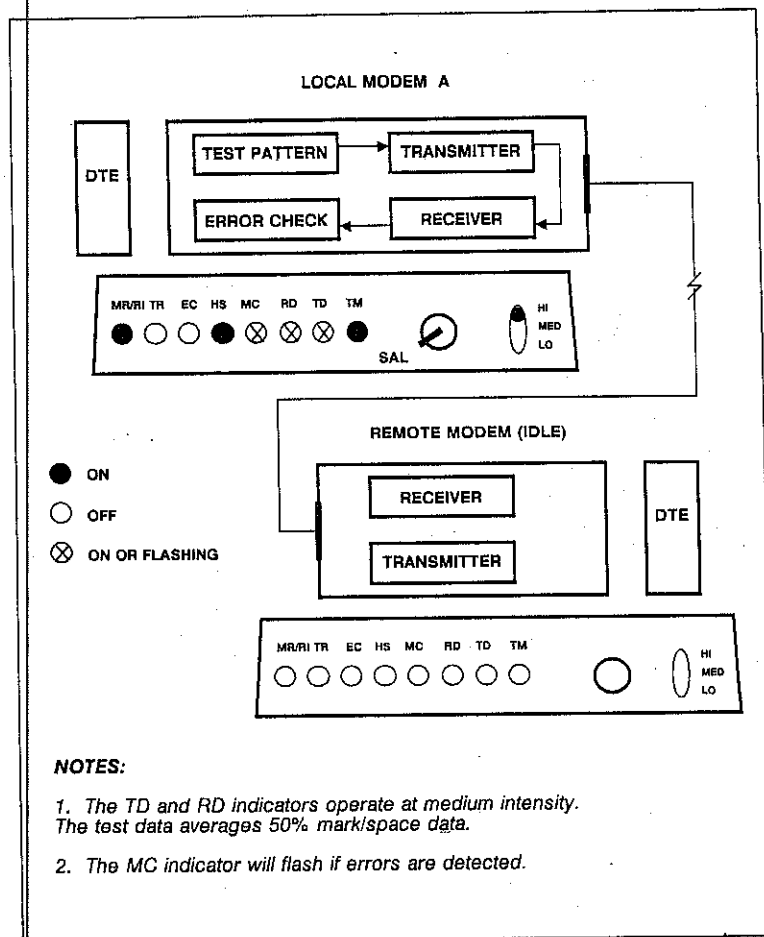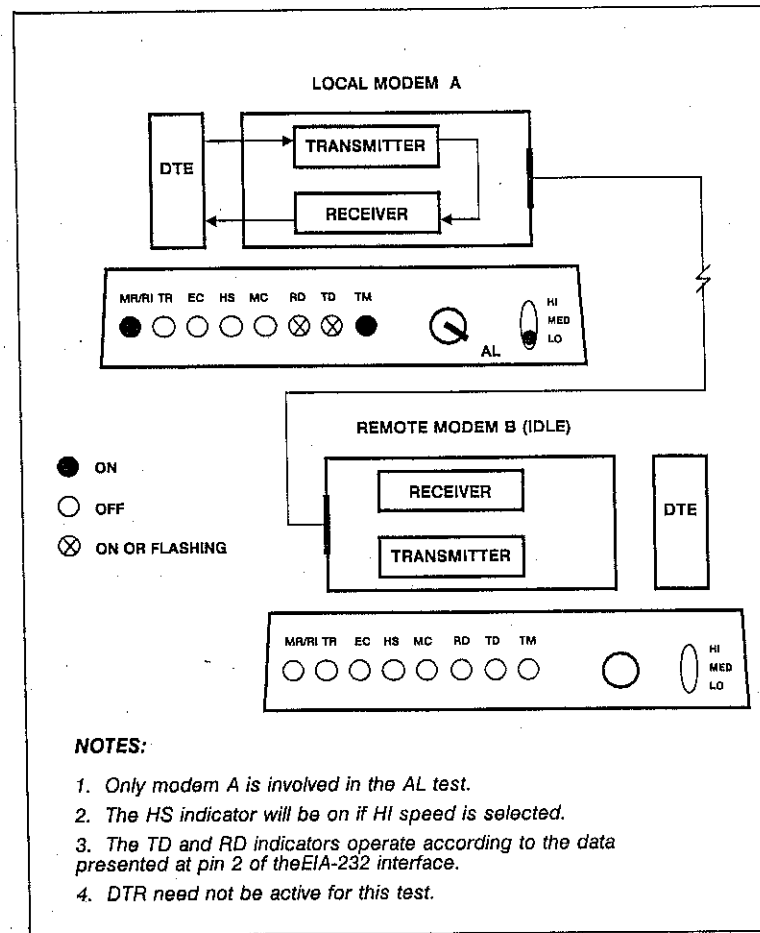
Figure 6-2
Analog Loopback (AL)

To start the self test, put the selector in the SAL position. The modem checks its internal circuits by generating a test pattern, transmitting it to the receiver, and checking for errors. During the test, the modem is isolated from its terminal equipment, phone line, and the other modem. If the MC indicator flashes, the modem is faulty.

Test the local DTE and cable with the end-to-end self test (Figure 6-3). With the selector in the AL position, type a test message. If no message appears on the screen, the terminal equipment or cable is at fault.

To see if the data cable is defective, replace it with a properly configured cable known to have sound electrical continuity. If the cable checks out okay but the problem remains, the DTE is defective.

If all the local equipment tests okay, see "Testing the Remote Modem and Telephone Line.

Testing the Remote Modem and Telephone Lines

Both modems and connecting phone line are tested with the end-to-end self test (ST) (Figure 6-3) provided a connection is established.

If a connection is not established, dial the other party and have them run the SAL and AL tests at that end. This will show if either the remote modem, its DTE, or data cable is the problem.

After a connection is established, both must select the ST position.

LOCAL MODEM A

REMOTE MODEM B

● ON
○ OFF
⊗ ON OR FLASHING
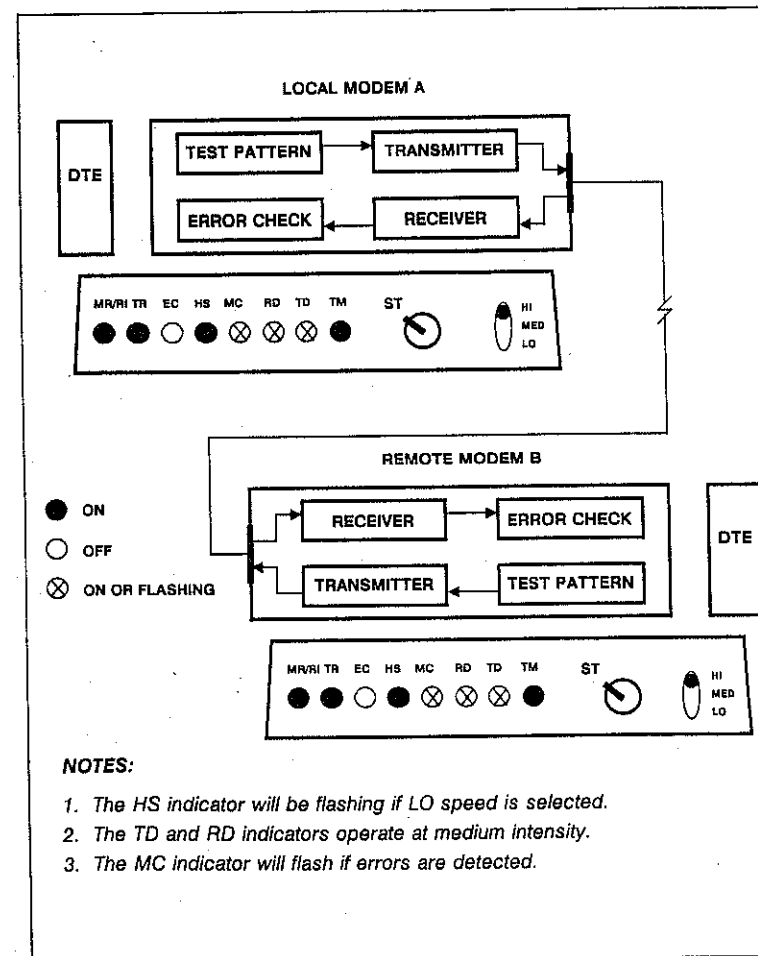
NOTES:

1. The HS indicator will be flashing if LO speed is selected.
2. The TD and RD indicators operate at medium intensity.
3. The MC indicator will flash if errors are detected.

Figure 6-3
End-to-End Self Test (ST)

The local modem will generate and transmit a test pattern to the remote modem. The remote modem will verify the received pattern is correct, then will generate its test pattern to your modem, which checks for bit errors.

If the remote modem detects errors, the problem is in the telephone line.

If the local modem indicates errors, the remote modem or the phone line is at fault. If the remote modem passes the SAL test, the phone line is the problem.

If no operator is attending the remote modem, the Self Test Remote Digital Loopback test (Figure 6-4) in either 1200 or 2400 bps operation will run the equivalent of the ST if a connection to the remote modem is established.

In this case, the local modem tells the remote modem to loop back the test pattern. If the local modem MC lamp flashes indicating bit errors, the problem can be isolated at the other end by running the SAL and AL tests to determine whether the remote modem, DTE, or data cable is at fault.

If the local modem MC indicator flashes, the test connection was denied by the remote modem. If this happens, use the tests described in Additional Tests.

NOTES:

1. The TD and RD indicators for modem A will be at an intensity lower than that for a data space condition. The test data averages 50% mark/space data.

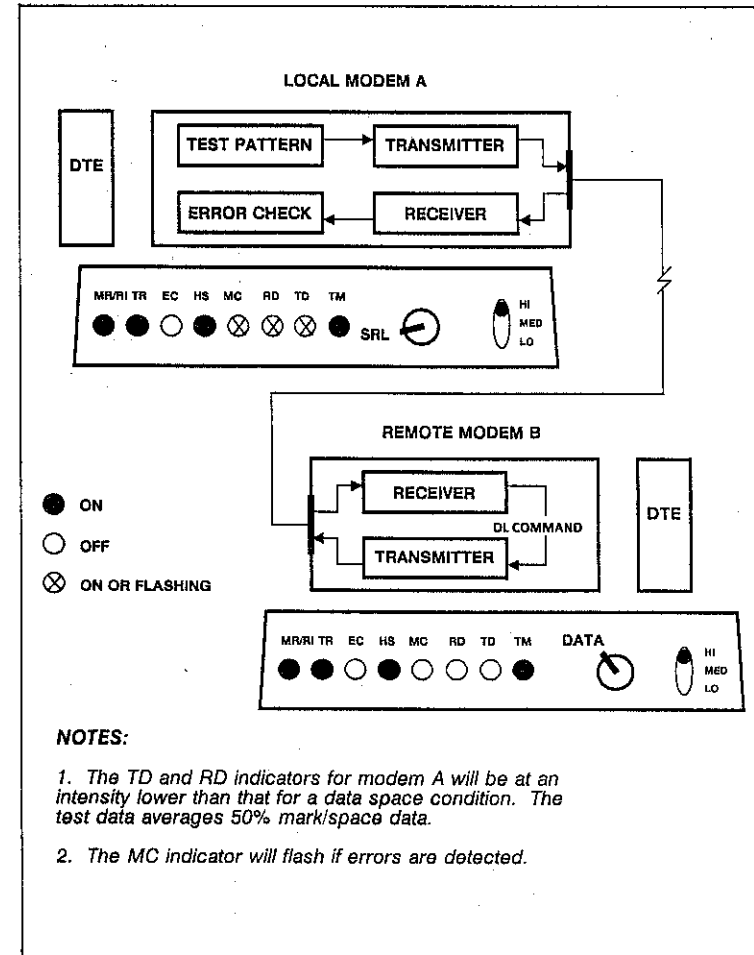2. The MC indicator will flash if errors are detected.

Figure 6-4
Self Test Remote Digital Loopback (SRL)

Additional Tests

For special cases, there are 2 additional tests; the Digital Loopback (DL) (Figure 6-5) and the Remote Digital Loopback (RL) (Figure 6-6). They are provided for V.54 compatibility and are not usually needed for problem isolation.

The remote operator can select DL to force the remote modem to loop back a test message, or select RL for the same purpose. In both cases, the DTE is involved but the remote DTE is not part of the loop.

> **NOTE**
> The modem generated test patterns of the SRL and ST tests are more effective at detecting errors than are the test messages of the DL and RL test.

Some problems may be related to the telephone line connection. Refer to Installation.
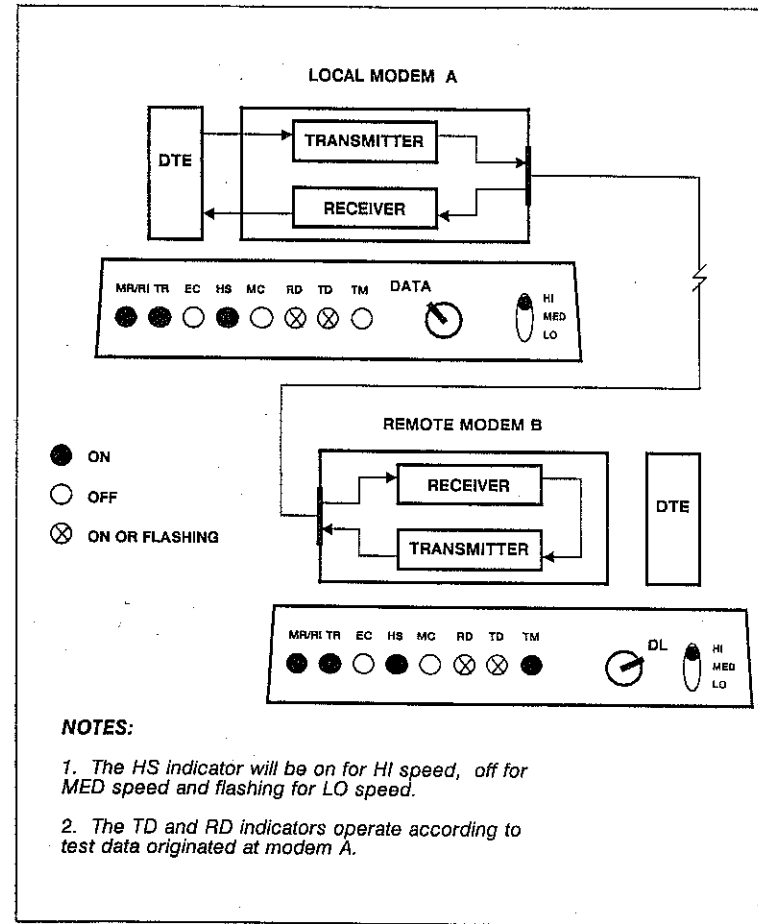

NOTES:

1. The HS indicator will be on for HI speed, off for MED speed and flashing for LO speed.

2. The TD and RD indicators operate according to test data originated at modem A.

Figure 6-5
Digital Loopback (DL)

LOCAL MODEM A

DTE

TRANSMITTER

RECEIVER

MR/RI TR EC HS MC RD TD TM

RL

HI
MED
LO

● ON

○ OFF

⊗ ON OR FLASHING

REMOTE MODEM B

RECEIVER

TRANSMITTER

DTE

MR/RI TR EC HS MC RD TD TM DATA

HI
MED
LO

NOTES:

1. The TD and RD indicators for modem A
operate according to data originated at modem A.

Figure 6-6
Remote Digital Loopback (RL)

Chapter 7
Maintenance

GENERAL

Field repair of the modem is not recommended.
If none of the lights located on the modem front
panel are lighted, a fuse may be blown. Remove
the fuse holder on the rear panel of the modem
and check the fuse. If the fuse is blown, replace
it with an equivalent type.

A modem suspected of malfunctioning can be
tested using the test features in Chapter 6. If the
modem passes all tests without indicating error,
ensure the modem option switches and jumpers
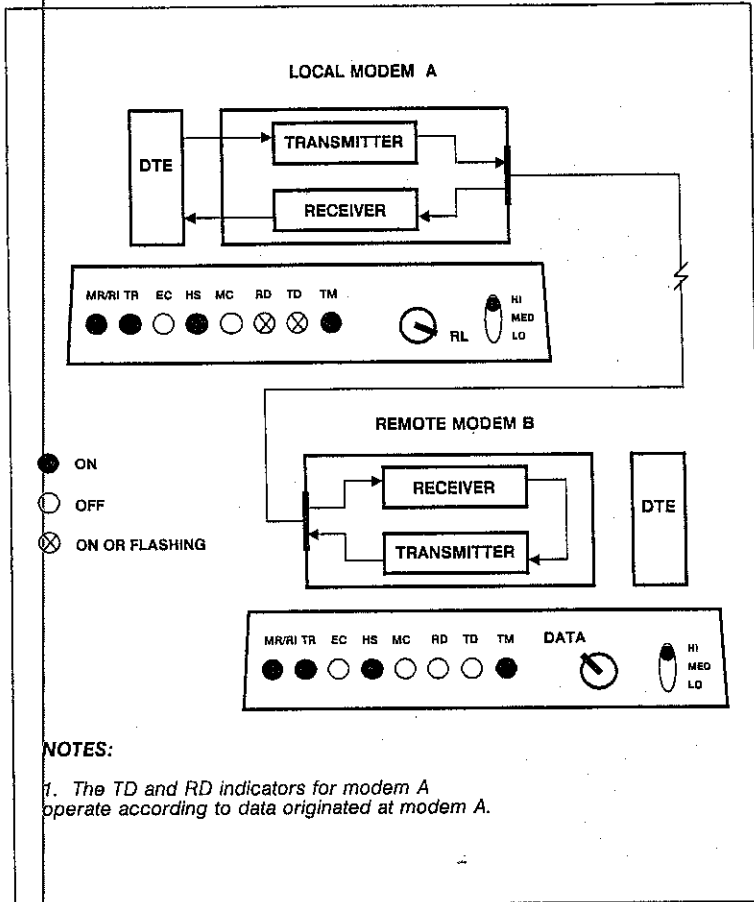are selected properly for your terminal and
application.

FCC	Registration No. AK396F-72916-MD-E REN. No. 0.4B
Operation	Full duplex 2-wire. Dial up or private lines.
Data	High speed 2400 bps (V.22 bis). 2400 bps + 1%, – 2.5% character asynchronous (10 or 11 bits, including 1 start and 1 stop bit). Medium speed 1200 bps (V.22 or Bell 212A). 1200 bps + 1%, – 2.5% character asynchronous (10 or 11 bits, including 1 start and 1 stop bit). Low speed 0-300 bps asynchronous.
Modulation	Quadrature Amplitude Modulation (QAM) at 2400 bps or Phase Shift Keying (PSK) at 1200 bps. Frequency Shift Keying (FSK) at 0-300 bps.
Operating Modes	Manual originate, autodial, manual answer, permanent autoanswer or controlled autoanswer. 2400, 1200, 0-300 asynchronous.

Transmit Carrier Frequencies (300 bps)

		Originate	Answer
Transmit:	Mark	1270 Hz ± 0.5%	2225 Hz ± 0.5%
	Space	1070 Hz ± 0.5%	2025 Hz ± 0.5%

Transmit Carrier Frequencies (1200 and 2400 bps)

	Originate	Answer
Carrier	1200 Hz ± 0.01%	2400 Hz ± 0.01%

Line Impedance	600 ohms ± 10% transformer coupled and transient protected.
Transmitter Output Level	0 to – 12 dBm programmable (external resistor), or permissive (– 9 dBm).

Receiver Dynamic Range	– 45 dB ± 4 dB (1200 and 2400 bps) – 50 dB ± 4 dB (300 bps)
Digital Interface	EIA-232C
Test Functions	Through front panel switch or through pin 25 at EIA-232C (Analog Loopback).
Data Set Compatibility	Most makes of 2400 full-duplex, Bell 212A (at 1200 bps), and Bell 103A.

AUTO DISCONNECT FUNCTIONS

Abort Disconnect	Default 30 sec. Software selectable 1 to 30 sec.
Loss of Carrier Disconnect	Switch selectable 100 ms or 1.4 sec. Software selectable 100 ms to 25.5 sec.
Long Space Disconnect Receive	Switch or software selectable for disabled or 2 sec.
Long Space Disconnect Transmit	Switch or software selectable for disabled or 4 sec.
DTR Disconnect	Switch selectable for disabled or 500 ms. Software selectable for disabled or 10 ms to 2.55 sec.
MNP Link Establishment Failure	18 sec or 6 sec when protocol fallback is enabled.
MNP Inactivity Timeout	Default disabled; Software selectable for disabled or 1 to 90 minutes.
MNP Retry Limit Exceeded	Twelve retries.

Security	Multilevel security features
	   unsecured direct access
	   password controlled direct access
	   password controlled from a callback list.

SIGNALING CHARACTERISTICS OF THE AUTOMATIC CALL UNIT

Pulse Dial	Pulse Rate
	  10 PPS ± 0.5 PPS
	  (Make + Break Period = 100 ± 5 ms)
	
	Break Interval
	  61% ± 3% of Make + Break Period
	
	Interdigit Time
	  700 ms ± 5 ms
	
	Transition Chatter
	  < 3ms duration

Dual Tone Multi-Frequency (DTMF) Dial	Timing intervals.
	  Duration of composite tone signal:
	  programmable in 100 ms ± 5 ms
	  Default is 100 ms.
	  Interdigit time: programmable 50-255 ms
	  using S-register 11. Default is 70 ms ± 5 ms

Signal Level	Single tone, low band: – 6 dBm ± 2 dB Single tone, high band: – 6 dBm ± 2 dB Composite Signal: – 3 dBm ± 2 dB

Physical Dimensions	Standalone enclosure
	  Width: 7.00 inches (17.8 cm)
	  Height: 2.25 inches (5.7 cm)
	  Depth: 9.60 inches (24.4 cm)

Weight	2 pounds, 10 oz.
Operating Temperature	0° C to 50° C
Relative Humidity	95% noncondensing

A

Technical Specifications

Power Requirements   115 Vac ± 10%; 50/60 Hz or
230 Vac ± 10%; 50/60 Hz for applicable models.

Power Consumption   8 watts nominal

AT		attention code - command prefix
A/		repeat last command
+ + +		escape sequence
		pause + + + pause
A		answer
D		dial
	T	tone dial
	P	pulse dial*
	,	long pause (2 sec or S6 value)
	W	wait for 2nd dial tone
	!	1/2 sec flash
	R	switch to answer mode after dialing
	@	wait for 5 sec silence
	;	return to command mode after dialing
	S	dial stored command line
	S%n%	dial one of multiple stored numbers
	&Z	store command line
	&Zn =	
E		local character echo off
E1		local character echo on *
H		hang up
O		go online (after escape)
Q		status displays on *
Q1		status displays off *

* factory settings

Sn?	read value in register n
Sn = v	set value in register n
V	status messages *
V1	status codes
X	connect (code 1), all speeds, no dial tone detection
X1	connect (code 1), 0-300 bps, connect 1200 (code 5), 1200 bps, or connect 2400 (code 10), 2400 bps, no dial tone detection
X2	wait for dial tone (CONNECT speeds as shown for X1)
X3	detect busy signal (connect speeds as shown for X1)
X4	wait for dial tone, detect busy signal * (connect speeds as shown for X1)
Z	reset to stored configuration with self test
&W	store current configuration
&F	restore factory configuration
	* factory settings
B	CCITT 1200
B1	Bell 212A
&L	dial line
&L1	leased line
Y	long space disconnect off
Y1	long space disconnect on
&S	DSR always on
&S1	DSR on when ready to accept data

&C	DCD always on
&C1	DCD on while carrier is present
&D	ignore DTR
&D1	DTR recalls ACU
&D2	DTR disconnects
&D3	DTR resets
I	request product code
I1	request EPROM CRC value
I2	request EPROM CRC test
&T	terminate any test
&T1	initiate analog loopback
&T3	initiate digital loopback
&T4	allows acceptance of slaved digital loopback
&T5	disallows acceptance of slaved digital loopback
&T6	initiate remote digital loopback
&T7	initiate self test analog loopback
%B	MNP break option 0
%B1	MNP break option 1
%B2	MNP break option 2
%B3	MNP break option 3
%B4	MNP break option 4
%B5	MNP break option 5
%L	ends protocol fallback list
%L1	native mode to the protocol list
%L3	MNP to the protocol list
%N	DCE DTR flow control on
%N1	DCE DTR flow control off
%N2	DCE DC1/DC2 flow control on
%N3	DCE DC1/DC3 flow control off
%N4	DCE DC2/DC4 flow control on
%N5	DCE DC2/DC4 flow control off
%N6	DCE Pin 11 flow control on
%N7	DCE Pin 11 flow control off
%N8	DCE Wang flow control on
%N9	DCE Wang flow control off

%U	extended displays off	
%U1	extended displays on	
%V	DTE CTS flow control on	
%V1	DTE CTS flow control off	
%V2	DTE DC1/DC3 flow control on	
%V3	DTE DC1/DC3 flow control off	
%V4	DTE DC2/DC4 flow control on	
%V5	DTE DC2/DC4 flow control off	
%V6	DTE pin 11 flow control on	
%V7	DTE pin 11 flow control off	
%V8	DTE Wang flow control on	
%V9	DTE Wang flow control off	
%X	transmit long space disconnect off	
%X1	transmit long space disconnect on	

Reg.	Range	Function	Factory Value
S0	0 1-255	autoanswer off autoanswer on, answer on indicated ring	0 1
S1	0-255	ring count	---
S2	0-127 128-255	escape character feature disabled	43 (" + ")
S3	0-127	end of line character	13 (CR)
S4	0-127	line feed character	10 (LF)
S5	0-127	backspace character	8 (BS)
S6	0-255 sec	pause before dialing	2
S7	1-30 sec	pause for carrier	30
S8	0-255 sec	pause for comma	2
S9	0-255 (in 0.1 sec increments)	carrier detect time	6
S10	0-255 (in 0.1 sec increments)	lost carrier detect time	1/20
S11	50-255 ms	length of pause between DTMF tones	70 ms
S12	0-255 (in 0.02 sec increment)	escape sequence pause	50 (1 sec)
S 14	---	options status	---
S16	---	system tests	0
S18	0-255 sec	test timer	0
S21	---	options status	---
S22	---	options status	---
S23	---	options status	---
S25	0-255 (in 0.01 sec increments)	DTR drop time	5
S27	---	options status	0

S-Registers

Reg.	Range	Function	Factory Value
S50	0-1	nonvolatile RAM status	---
S51	---	options status	---
S53	---	options status	---
S54	---	flow control DTE	---
S55	---	flow control DCE	---
S58	0-90	MNP inactivity timer	0
S59	0-5	MNP break control	5
S60	0-1	MNP initiate/accept	---
S61	1-8	DTE speed	---
S65	0-1	MNP line idle	1
S66	0-255 (in 0.1 sec increments)	DTMF tone length	1
S67	0-1	result code	0
S69	0-6	DCE speed	---
S70		DCE independent low speed	
S71	0-1	Security on/off	---
S72	0-255	Password/Timeout	30
S73	0-255	Callback Delay	2
S74	1-10	Callback Retry	3
S75	0-255	Callback Retry Delay	2
S77	0-255	auto protocol recognition timer	---
S91	---	DCE protocol 1st choice	---
S92	---	DCE protocol 2nd choice	---
S93	---	DCE protocol 3rd choice	---
S94	---	DCE protocol 4th choice	---
S95	---	DCE protocol 5th choice	---

S Registers, continued

Reg.	Range	Function	Factory Value
S96	---	DCE protocol 6th choice	---
S97	---	DCE protocol 7th choice	---
S98	---	DCE protocol 8th choice	---
S99	---	DCE protocol 9th choice	---

S Registers, continued

PIN FUNCTIONS

The pins are connected in the modem and do not normally need to be reconnected. However, if the operator chooses to change the pin connections, detailed information is provided in this chapter about the pin functions.

This information is not necessary for the installation or operation of the modem but is helpful for anyone wanting to change the modem setup.

The modem interfaces with the terminal or computer through a 25-pin connector on the rear panel of the modem.

TELCO and TELSET Pin Functions

The modem has an 8-pin (TELCO) jack that is used to connect the modem to the telephone line. The pin functions are as follows:

Pin 1   Not used.

Pin 2   Not used.

Pin 3   MI - comes from switch hook on exclusion key telephone. Not used in some systems.

Pin 4   R - Ring side of telephone line. Dial up or private (Red).

Pin 5   T - Tip side of telephone line. Dial up or private (Green).

Pin 6   MIC - comes from switch hook on exclusion key telephone. Not used in some systems.

Pin 7   PR - goes to data jack program resistor.

Pin 8   PC - goes to data jack program resistor (Common Return).

The 6-pin jack labeled TELSET may be connected to a standard telephone set. The pin functions are as follows:

Pin 1   Not used.

Pin 2   Not used.

Pin 3   RA - Ring side of telephone set (when telephone is used) (Red).

Pin 4   TA- Tip side of telephone set (when telephone is used) (Green).

Pin 5   Not used.

Pin 6   Not used.

MODEM DATA TERMINAL INTERFACE

The modem connector interfaces with the DTE via a 25-pin connector on the rear panel of the unit. This connector is labeled DTE and is DB-25S or equivalent. All interface functions are EIA-232C compatible.

Pin functions for the EIA-232C, 25-pin modem connector are listed in Table D-1

Pin	EIA-232C Circuit	CCITT V.24 Circuit	Function
1	AA	101	Frame Ground
2	BA	103	Transmitted Data
3	BB	104	Received Data
5	CB	106	Clear to Send
6	CC	107	Data Set Ready
7	AB	102	Signal Ground
8	CF	109	Data Carrier Detect
11			Flow Control
12	CI		Speed Indicator (DCE)
20	CD	108/2	Data Terminal Ready
22	CE	125	Ring Indicator
23	CH		External Speed Control (DTE)
25	CN	141	Analog Loopback Command

Table C-1
Pin Functions

Pin Functions

Unused pins have no electrical connection.

Pin functions describe the modem when in the data mode.

Pin 1   Frame Ground (AA). Connected to the modem case and to the ground lead on 3-wire ac power connections. Can be connected to Signal Ground (pin 7) as an option.

Pin 2   Transmitted Data (BA). Transmit data is applied to this pin from DTE. This signal is used for modem transmit data. Required voltage levels are:

Mark   – 3 to – 25V
Space   + 3 to + 25V

The DTE is required to operate with 10 or 11 bit words. When in data mode using the native 224A/D protocol, the DTE must operate at data rates of 0-300, 1200, or 2400 bps. When any other protocol is used or when in the command state, the DTE must operate at data rates of 110, 300, 450, 600, 1200, 2400, 4800, or 9600 bps.

Pin 3   Received Data (BB). Demodulated data from the modem is presented to the terminal on pin 3. Output voltage levels into a 3K ohm load are:

Mark   – 3 to – 15V
Space   + 3 to + 15V

If synchronous high speed operation is selected, received data is synchronous with the received clock output (pin 17), with data transitions occurring on the positive going edge of the clock on pin 17.

The data output is inhibited in a mark state when no valid carrier is present on the TELCO line as indicated by data carrier detect (pin 8). Activity on the receive data line is indicated by the RD LED on the front panel.

Pin 5   Clear to Send (CB). Clear to Send (CTS) is a function supplied to the terminal by the modem that indicates it is permissible to begin data transmission. CTS is always on. The output levels into 3K ohm or greater loads are:

CTS on   + 3 to + 15V
CTS off   – 3 to – 15V

Pin 6   Data Set Ready (CC). DSR is a function supplied by the modem to the terminal to indicate the modem has received data terminal ready (pin 20) and is ready to transmit data. DSR may also be active if the ACU is enabled. Output levels are:

DSR on   + 3 to + 15V
DSR off   – 3 to – 15V

The absence of DSR at the DTE interface may indicate:

● Modem power is off.
● Modem is in Digital Loopback.
● Modem is in Self Test.

Pin 7   Signal Ground (AB). Common return lead for all signals at the modem interface.

Pin 8   Data Carrier Detect (CF). DCD is furnished by the modem to the terminal to indicate a valid carrier is being received, i.e., a continuous level above the threshold level established by the Carrier Detect level option.

The carrier must persist above the required level for a certain period of time and the protocol link must be established before DCD can come true. This prevents false CF signals due to line noise. When CF is false, Received Data is clamped to a constant mark.

Pin 11   Flow Control. This lead can be an input or output. Printers typically use this lead for flow control. When the modem is attached to a printer, use this as an input to flow control the modem. When the modem is attached to a

"host," use this as an output to flow control the "host". Pin 11 must be selected as flow control. Refer to %V, %N and S54 and S55.

Pin 12   Speed Indicator (CI). Speed indication from DCE to DTE.

CI	Toggle Switch
+3 to +25V = 2400 bps	
-3 to -25V = 1200 bps/300 bps	Hi
+3 to +25V = 1200 bps/2400 bps	Med/Lo
-3 to -25V = 0-300 bps	

Pin 20   Data Terminal Ready (CD). A signal from the terminal to the modem indicating the terminal is ready to send or receive data. Data Terminal Ready must be true for Data Set Ready to be true. Required levels are:

on   +3 to +25V
off   -3 to -25V

Pin 22   Ring Indicator (CE). A signal to the terminal indicating the phone is ringing. Can be used by the terminal to raise DTR if this interrupt is taken care of by the software.

on   +3 to +15V
off   -3 to -15V

Pin 23   External Speed Control (CH). Command from DTE to DCE.

Pin 25   Analog Loopback Test (CN). The signal from the terminal to the modem. A positive level forces analog loopback.

NOTE

Options are provided that affect the operation of:

Pin 6   DSR

Pin 8   DCD

Pin 11   Flow Control

Pin 20   DTR

Pin 23   CH

Pin 25   CN