TOTAL CONTROL™

MP 8/16

Manual

About This Manual

This manual applies to the Total Control MP (Modem Pool) product MP/8 V.34

The first four chapters describe all you need to know about getting the Total Control MP unit up and running:

- *Chapter 1. Overview* describes the unit and its uses, as well as the capabilities and compatibilities of the modems.
- *Chapter 2. Set Up* details how to install the unit as a stand-alone device or install it in a rack mount system, describes the DIP switch defaults and functions, and shows how to cable the unit into a system.
- *Chapter 3. Configuring the Modems* describes how to change the configurations of the modems for different system requirements.
- *Chapter 4. Queries and Help Screens* introduces commands which display the current configuration settings of the modems, as well as commands which display the status of connections.

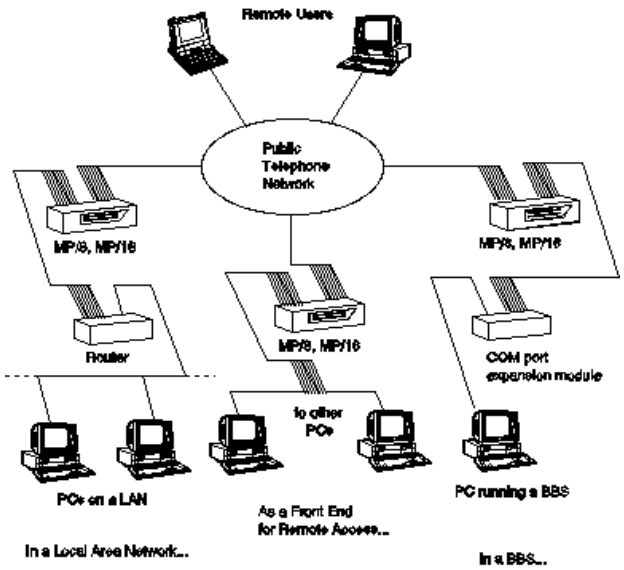
Where the first four chapters offer basic information on getting the unit running, the Appendixes give more detailed information. Much of the information in these sections would require that the modems be accessed separately through a terminal or computer in terminal mode. See *Accessing the Modems* in Chapter 3.

- *Appendix A. Link Negotiation and Error Control* talks about the protocols modems use in connecting.
- *Appendix B. Summaries and Tables* contains RS-232 pinouts for programming purposes or making customized cables for non-standard equipment. It also lists descriptions and options for S-Registers which can be used in customizing the modem configurations.
- *Appendix C. Command Summary* describes AT command set use and commands that can be used in customizing the modem configurations.
- *Appendix D. Dial Security and Remote Access* describes how to set up the modems for remote access.
- *Appendix E. Dedicated and Leased Line Operations.*
- *Appendix F. Additional Operations* discusses Fax operations and installions in an ACK/ENQ system.
- *Appendix G. Modem Testing* shows how to run Analog Loopback, Digital Loopback, and other tests on the modems to make sure they are working properly.
- *Appendix H. Software Upgrades* details downloading and running software upgrade files.
- Appendixes I, J, and K contain definitions, technical, regulatory, warranty, and service information.

A Note on Communications Software

If you're using a computer rather than a terminal, you need communications software. Many brands are available, all of which are based on the modem's AT command set. Some users prefer their communica tions software to take control of the modem, and are more comfortable with a program that makes the modem almost transparent. Others prefer a program that allows them to use the modem's AT command set some times, and their software at other times, depending on the task at hand.

Easy to install and maintain, the Total Control MP (Modem Pool) is ideal for a small network or BBS. Instead of having many modems strewn about and tangled in a web of cables and cases, you can now have everything hooked up to a single box of modems. The Total Control MP is a versatile unit that fits into numerous system setups. Here are only a few examples:



- *In a Local Area Network...* the MP can be interfaced to a terminal server or a router. Thus, it allows multiple users remote access to the network.
- *As a Front End for Remote Access...* the MP may front-end a rack of PCs running remote access operations.
- *In a BBS...* the MP can be hooked up to a computer running a BBS via a COM port expansion module. All the calls coming in to the BBS will come through a single unit.

The Unit

This section briefly describes the functions of the LEDs, the Telco jacks, and the RS-232 jacks.

Figure 1.1—The Front Panel

LEDs

Each set of modems has 9 LEDs on the front panel. The Run / Fail LED indicates whether the unit is operating. The other LEDs are numbered 1–8, each number corresponding to a modem. When the unit is first turned on, the modem lights run through the spectrum of colors as a warm up. The colors indicate the status of each modem as follows:

- *off*—idle
- *green*—online
- *orange*—dialing
- *flashing green*—testing
- *red*—critical failure

Figure 1.2—The Rear Panel

Telco Jacks

On the rear of the unit, you will find the Telco jacks, which allow access to the phone lines. These are labeled 1–8, according to the modem each corresponds to, and are used for connecting the unit phone jacks via standard RJ-11 telephone cables.

RS-232 Jacks

RS-232 jacks allow the modems to interface with computers. These are also labeled 1–8 according to the modem each corresponds to. The RJ-45 connectors on the unit meet EIA / TIA 561 standards.

Modem Features

High-Speed Connections

With the V.34 standard and the V.Fast Class modulation scheme, two modems can connect at rates up to 28.8K bps. V.32 *bis* modems connect at rates up to 14.4K bps.

Custom Configurations

You can create custom configurations to use as default settings and store them in Non-Volatile Random Access Memory (NVRAM) . Each time the unit is powered on or reset, it operates at the settings you've specified. See Chapter 3, Appendix B, and Appendix C.

Software Upgrades

U.S. Robotics high-speed modems are equipped with Flash ROM, making them software upgradable. Through the U.S. Robotics BBS, there is easy access to software which can bring your modems up to date on the latest advances in data communication technology. See Appendix H.

Fax Capability

You can use your modem with Class 1 or Class 2.0 facsimile software to exchange faxes with millions of Group III fax machines worldwide. See Appendix F.

Dial Security

With Dial Security, you will be able to prevent unauthorized access to the system with the use of Autopass, Prompting, and Dialback. See Appendix D for more information.

HELP Screens

The modem displays screens that summarize the command sets, Dial command options, and S-Register functions. See Chapter 4.

Modem Compatibility

Total Control MP modems adhere to the following modulation schemes and standards, ensuring com patibility with a wide base of installed modems.

Note: The International Telecommunication Union (ITU-T) was formerly the International Telegraph and Telephone Consul - tative Committee (CCITT).

ITU-T V.34	28.8K / 26.4K / 24K / 21.6K / 19.2K / 16.8K / 14.4K / 12K / 9600 / 7200 / 4800 / 2400 bps (V.34 only)
V.FC	28.8K / 26.4K / 24K / 21.6K / 19.2K / 16.8K / 14.4K bps (V.34 only)
V.32 terbo	21.6K / 19.2K / 16.8K / 14.4K / 12K / 9600 / 7200 / 4800 bps
ITU-T V.32 *bis*	14.4K / 12K / 9600 / 7200 / 4800 bps
ITU-T V.32	9600 / 4800 bps
ITU-T V.22 *bis*	2400 bps
Bell 212A	1200 bps (also V.22)
ITU-T V.23	1200 bps with 75 bp s back channel (some U.K. and European phone systems)
ITU-T V.25	Answer sequence for calls originating outside the U.S. and Canada
Bell 103	300 bps (ITU-T V.21 optional)
ITU-T V.42	LAPM error control, 1200 bps and higher
ITU-T V.42 *bis*	Data compression, 1200 bps and higher
MNP	Levels 2, 3, and 4 error control, level 5 data compression, 1200 bps and higher
ITU-T V.54	Analog, digital, and remote digital loopback testing

Fax Standards

Total Control MP modems provide Group III compatibility when combined with Class 1 or Class 2.0 fax software. In addition, the modem adheres to the following standards.

TIA / EIA-578	Service Class 1 Asynchronous Facsimile DCE Control Standard
TIA / EIA-592	Service Class 2.0 Asynchronous Facsimile DCE Control Standard
ITU-T V.17	14.4K / 12K bps
ITU-T V.29	9600 / 7200 bps
ITU-T V.27 *ter*	4800 / 2400 bps
ITU-T V.21	300 bps

Other Compatibility Features

Other compatibility features include the following stan dards and certification:

- Can b e used with any computer or terminal that is com - patible with the RS-232 standard interface.
- Can be used with any computer or terminal that uses ASCII, the standard character code supported by most equipment manufacturers.
- Is fully FCC- and IC-certified for the uses described in this manual.

The Total Control MP is very simple to set up. Once it is set up, it is ready to run. There are three easy steps:

- ➢ *Installing the Unit as a Stand-Alone or in a Rack*
- ➢ *Setting the DIP Switches*
- ➢ *Cabling*

Components

The package contains the following items:

- the Total Control MP/8 unit.
- this manual
- a power cable
- eight telephone cables
- rack mounting flanges and screws
- rubber feet

You will also need a Phillips screwdriver.

Cable Kits—optional. The unit also requires RS-232 cables in order to interface with a network or individual terminals. There are kits available from U.S. Robotics which have all the cables and adapters necessary. See *Cable Kits* in Appendix B for more details. Ask your distributor for ordering information.

Note: If the phone lines are leased lines, refer to Appendix E. If the unit is installed in a Hewlett Packard system using *Ack/Enq* protocol, refer to Appendix F.

Installing the Unit as a Stand-Alone or In a Rack

The Total Control MP is designed to be used as either a stand-alone unit or in a rackmount system. If you wish to use the MP as a stand-alone unit, see the section *Using the MP as a Stand-Alone Unit*. If the MP is going to be used in a rack mount system, see the section *Installing the Unit in a Rack*.

Important—Optimal Operating Conditions:

1) Do not block the fan on the right side of the unit.
2) Keep the unit in a dry place at room temperature.
3) If using the unit as a stand-alone, keep it on a flat surface. This will leave room above and below or adequate ventilation.
4) When installing more than one chassis in an equipment rack, leave room above and below them for adequate ventilation.

Using the MP as a Stand-Alone Unit

To use the MP as a stand-alone unit, you must first stick the rubber feet included with the package onto the recesses on the four corners of the bottom of the unit.

You may skip the rest of this section and go to *Setting the DIP Switches*.

Installing the Unit in a Rack

1. Attach the flanges, provided with the unit, to the sides of the unit, and screw them on tightly. See Figure 2.1.

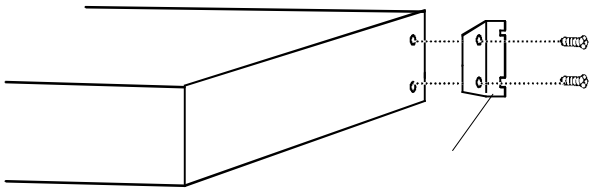


Figure 2.1—Attaching the Flanges

2. *Installing the unit in the rack.* Most racks come with the necessary screws and nuts / anchors to install rackmount devices.

   a. First, gather four screws and enough nuts / anchors for the screws.

   b. Then, holding the unit in the rack and supporting it from underneath with one hand, insert all four screws partially into the front vertical rails of the equipment rack and place the nuts / anchors on the ends of the screws inside the rack. Beginning with the two **bottom** screws, tighten all four until the unit is secure. See Figure 2.2.

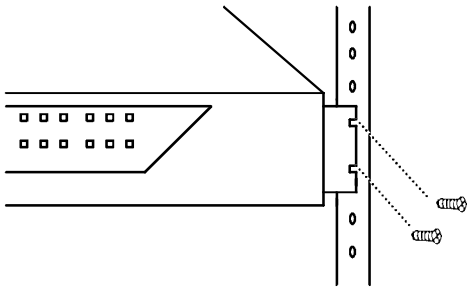


Figure 2.2—Rackmount Installation

Setting the DIP Switches

The DIP switches, located on the rear panel between the RS-232 and Telco ports, are for adapting the modem to your equipment and system requirements. Each set of DIP switches controls 8 modems.

Figure 2.3 shows the DIP switches in their factory default settings, which reflect typical system requirements such as: Auto Answer enabled, no result codes, no Data Terminal Ready or Carrier Detect override. See Table 2.1 for switch options to decide if the factory settings need to be changed.

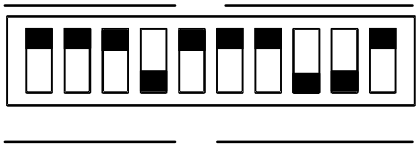


Figure 2.3—DIP Switch Factory Settings

Table 2.1—DIP Switch Functions

Switch	Factory Setting	Function
1	OFF	Data Terminal Ready Operations OFF Normal DTR operations: computer must provide DTR signal for modem to accept commands; dropping DTR terminates a call ON DTR always ON (Override)
2	OFF	Verbal / Numeric Result Codes OFF Verbal (word) results ON Numeric results

Switch	Factory Setting	Function
3	OFF	Result Code Display OFF Result Codes suppressed ON Result Codes displayed
4	ON	Command Mode Local Echo OFF Keyboard commands displayed ON Echo suppressed
5	OFF	Auto Answer OFF Modem answers on first ring ON Auto answer disabled
6	OFF	Carrier Detect Operations OFF Normal CD operations. Courier sends CD signal when it connects with another modem, drops CD on disconnect ON CD always ON (Override)
7	OFF	Auxiliary, DIP Switch 3 ON OFF Result codes in Originate and Answer mode ON Result codes in Answer mode disabled
8	ON	AT Command Set Recognition OFF Command recognition disabled (Dumb mode) ON Enabled—command set recognized (Smart mode)
9	ON	Escape Code (+++) Response OFF Modem hangs up and returns to Comm and mode ON Modem maintains connection, returns to Command mode
10	OFF	Power-on / Reset Load Configuration Defaults OFF Load from nonvolatile memory (NVRAM) ON Load factory settings from read only memory (ROM)

Cabling

There are two cabling tasks to get the unit running. First, the unit needs to be interfaced to a terminal or network via RJ-45 cables. These are available in a cable kit from U.S. Robotics. Then, the modems must be hooked in to the telephone lines via RJ-11 cables, supplied with the unit.

To cable the unit:

1. Make sure that the unit's power switch on the rear panel is OFF. See Figure 2.4.

Figure 2.4—Rear Panel

2. *Connect the modems to telephone lines.* For each modem, plug one end of an RJ-11 telephone cable into a Telco jack on the rear panel of the unit. Plug the other end into a Telco jack.

   Note: Do not confuse the RJ-11 and RJ-45 cables. They look alike, but RJ-45 cables have more pins than RJ-11 cables: RJ-11 cables have 4 pins where RJ-45 cables have 8 pins.

3. *Connect the modems to terminals.* The final step is to connect the RS232 jacks to the computer or terminal equipment.

   a. Connect one end of an RJ-45 cable into each of the RS-232 jacks on rear panel of the unit.

   b. *Adapters*—since the terminal's RS-232 jack probably does not fit with RJ-45 cables, this connection requires an adapter. Depending on a syatem's cabling needs, there are cable kits available with either RJ-45 to DB-25 or RJ-45 to DB-9 adapters. Use these to plug the cable into the terminals or network.

4. Plug the power cable into the power jack at the back of the unit. Plug the cable into a standard 115-volt AC wall socket.

5. Power on the unit. The Run/Fail LED should emit a green light. If it does not indicate that the power is on, make sure the power cable is attached tightly and the power switch is on.

Total Control MP modems are factory configured to run under hardware flow control. Once the unit is set up, nothing else needs to be done—the unit is all ready to operate. However, the modems can be configured for specialized systems or situations.

The modems use a superset of the standard AT command set for dial-up modems. The commands control configuration options as well as modem operations such as diagnostic testing. Typically, you'll need to directly command the modems only for initial configuration, and to write that to Non-Volatile Random Access Memory (NVRAM) with the commands. After that, the modems will perform without operator intervention.

This chapter covers:

- *ROM Templates*
  - *Default—Hardware Flow Control Template*
  - *Low Performance Template*
  - *Software Flow Control Template*
- *Accessing the Modems*
- *Changing the Default Settings*
- *Custom Settings in NVRAM*
- *Using S-Registers*

Templates

Read Only Memory (ROM) templates in the MP modems contain settings for configuration commands and S-Registers that control the way the modems operate. By tailoring any one or more of these, the modems can be programmed to meet specific communications needs.

Default—Hardware Flow Control Template—&F1

When the Total Control MP is first turned on, the modems automatically load the hardware flow control template into active RAM from Non-Volatile Random Access Memory (NVRAM). The Hardware Flow Control template, though stored in ROM, is also stored in NVRAM as the current settings. Unless a modem is programmed for another template, it will operate under this configuration.

In this configuration, the modems are set to operate with hardware flow control, a fixed serial port rate using the highest-level result codes.

The modem drops the Clear to Send (CTS) signal it has been sending to the computer or terminal when the modem's buffer nears 90 percent capacity. It starts sending CTS again when the buffer is about half full.

Table 3.1 on the opposite page shows the configuration command settings under the hardware flow control template.

Recommended Uses

This template is the most compatible and is recommended for all systems and software that support Request to Send and Clear to Send hardware signaling, and a fixed serial port rate to provide flow control. It offers the greatest efficiency and reliability. If your system requires software flow control, your best bet is to use the Software Flow Control template described next.

If your system supports hardware flow control, you may wish to review the descriptions of the other templates, or go directly to *Accessing the Modems* later in this chapter.

Table 3.1—&F1 Hardware Flow Control Default Template

Options	Setting	Description
Handshake option	B0	ITU-T answer sequence
Error control	&M4	Normal/error control
Data compression	&K1	Enabled
Transmit data hardware	&H1	Hardware flow control
Rec'd data hardware flow control	&R2	Enabled
Rec'd data software flow control	&I0	Disabled
Serial port rate select	&B1	Serial port rate fixed higher than connect rate
Link rate select	&N0	Variable
Result code subset	X7	Extended—all code s
Protocol response codes	&A3	Full protocol codes
Tone/Pulse dialing	P	Pulse dial
Online local echo	F1	Disabled
Remote Digital Loopback (RDL)	&T5	Deny RDL
Normal/Leased	&L0	Normal phone line
Data Set Ready operations	&S0	Override enabled
Break handling	&Y1	Clear buffer, send immediately
Stored telephone number	&Z0–9=0	Blank
Pulse dial make/break ratio	&P0	U.S./Canada
Guard tone	&G0	U.S./Canada
Word length*	8	
Parity*	0	None
DTE rate* (Kbps)	19.2	–

* Detected by the modem from the AT prefix of the &W com mand that writes your defaults to NVRAM. Set your software to the desired word length, parity, and serial port rate defaults before sending the modem the **AT . . . &W** string.

Software Flow Control Template—&F2

This template is the same as &F1, except &F2 uses software flow control.

Table 3.2 on the opposite page lists the configuration command settings of the software flow control template. Settings different from the default template are noted in bold.

The modem sends the computer or terminal the standard ASCII Transmit OFF (XOFF) character, <Ctrl>-S, when its buffer nears 90 percent capacity. The modem sends the ASCII Transmit ON character, <Ctrl>-Q, when the buffer is about half full. ASCII definitions are as follows:

XON	<Ctrl>-Q	(ASCII 17 Decimal, 11 Hex)
XOFF	<Ctrl>-S	(ASCII 19 Decimal, 13 Hex)

Use of software flow control may prove satisfactory if you're only transferring text files. However, if you're transferring non-text (binary) files, or using an Xmodem-type protocol, there is a risk that the XON/XOFF characters will be confused with control characters in the files or protocol. You may wish to disable flow control entirely (&R1, &I0). In addition, set the modem to &B0 and &N0, so that the serial port and connection rates are equal.

Recommended Uses

For use with software and hardware that doesn't support hardware flow control.

Table 3.2—&F2 Software Flow Control Template

Options	Setting	Description
Handshake option	B0	ITU-T answer sequen ce
Normal/error control	&M4	Normal/error control
Data compression	&K1	Enabled
Transmit data flow control	**&H2**	**Software flow control**
Rec'd data hardware flow control	**&R1**	**Disabled**
Rec'd data software flow control	**&I2**	**Enabled**
Serial port rate select	&B1	Serial port rate fixed higher than connect rate
Link rate select	&N0	Variable
Result code subset	X7	Extended. Includes all codes
Protocol response codes	&A3	Full protocol codes
Tone/Pulse dialing	P	Pulse dial
Online local echo	F1	Disabled
Remote Digital Loopback	&T5	Deny RDL
Normal/Leased	&L0	Normal phone line
Data Set Ready operations	&S0	Override enabled
Break handling	&Y1	Clear buffer, send immediately
Stored telephone number	&Z0–9=0	Blank
Pulse dial make/break ratio	&P0	U.S./Canada
Guard tone	&G0	U.S./Canada
Word length*	8	
Parity*	0	None
DTE rate* (Kbps)	19.2	–

* Detected by the modem from the AT prefix of the &W com mand that writes your defaults to NVRAM. Set your software to the desired word length, parity, and serial port rate defaults before sending the modem the **AT . . . &W** string.

No Flow Control Template—&F0

This template does not include features such as a fixed serial port rate or hardware flow control. Table 3.4 on the opposite page lists all the configuration settings with differences from the default template noted in bold.

Recommended Uses

This is good for low-performance situations. It offers compatibility with non-typical computers, older equipment, or software that cannot handle flow control and other features.

Note: If DIP switch 10 is ON when the modem is powered on, or you load factory template 0 (&F0), the following settings take effect.

Table 3.3—&F0 No Flow Control LowPerformanceTemplate

Options	Setting	Description
Handshake option	B0	ITU-T answer sequence
Normal/error control	&M4	Normal/error control
Data compression	&K1	Enabled
Transmit data flow control	**&H0**	**Disabled**
Rec'd data hardware flow control	**&R1**	**Disabled**
Rec'd data software flow control	&I0	Disabled
Serial port rate select	**&B0**	**Detect from AT command: variable rate**
Link rate select	&N0	Variable
Result code subset	**X1**	**Basic**
Error-control response codes	**&A1**	**Enabled**
Tone/Pulse dialing	P	Pulse dial
Online local echo	F1	Disabled
Remote Digital Loopback (RDL)	&T5	Deny RDL
Normal/Leased	&L0	Normal phone line
Data Set Ready operations	&S0	Override enabled
Break handling	&Y1	Clear buffer, send immediately
Stored telephone number	&Z0–9=0	Blank
Pulse dial make/break ratio	&P0	U.S./Canada
Guard tone	&G0	U.S./Canada
Word length*	**7**	
Parity*	**1**	**Even**
DTE rate* (bps)	**9600**	**–**

* Detected by the modem from the AT prefix of the &W com mand that writes your defaults to NVRAM. Set your software to the desired word length, parity, and serial port rate defaults before sending the modem the AT . . . &W string.

Accessing the Modems

In order to perform the operations in this manual, the modems must be accessed one at a time. To access a modem:

1. *Flip DIP switch 3 ON and DIP switch 4 OFF.* This will cause the modem to display Result codes, so you can see what its settings are and to echo AT commands, so you can see what you type.
2. Connect a PC or laptop serial port to the modem's RS-232 port.
3. Load a standard modem communications program (terminal emulator) on the computer.
4. Set the serial port rate to 19.2K, 38.4K, or 57.6K bps with the following data format: 8 data bits, no parity, and 1 stop bit.
5. Test the connection by typing **AT <Enter>**. If the modem responds **OK**, the connection is fine.

You are now ready to perform any of the configuring or testing operations in this manual.

Changing the Default Template

Once you have decided which template will best fit the situation, the modem can be programmed so that it loads that template on booting up. For example, say that &F2, software flow control, is the most desirable template. Once you have accessed the modem you would:

1. Load template &F2 into active RAM.
2. Save the template to Non-Volatile Random Access Memory (NVRAM).

   Both steps 1 and 2 can be done with the following command string:

   AT &F2 &W <Enter>

   The **AT** command alerts the modem that other commands follow.

The **&F2** command tells the modem to load ROM template 2, Software Flow Control, as the active settings. This command can be used to call up the other templates as well—simply replace the **2** with a **0** for the No Flow Control template, or a **1** for the Hardware Flow Control template.

The **&W** command stores the current settings to NVRAM. This command may also be used to store any on-the-fly changes into NVRAM. See below, *Custom Configurations.*

Once the new template has been saved to NVRAM, as long as DIP switch 10 is OFF (factory setting), the modem will load the NVRAM settings upon booting up.

Custom Configurations

If none of the ROM templates are exactly suitable for a system, they can be customized to fit whatever communications needs you may have.

To custom configure a modem:

1. Change all the configurations commands and S-Registers to fit your requirements. For example, to set the modem for V.42 *bis* data compression and pulse dialing, type:

   AT &K3 P &W <Enter>

   The **&W** command stores these commands as the new current settings in NVRAM. **&W** can be used with any of the commands in the templates to add new changes to the settings stored in NVRAM.

2. Make sure that DIP switch 10 is OFF so the modem will load the NVRAM settings upon booting up.

Using S-Registers

The S-Registers are used to set various timing parameters, redefine selected ASCII characters, and other configuration options. They remain the same in all the ROM templates, but can be reconfigured for special purposes. A detailed summary of the S-Register functions is in Appendix B. Table 3.4 on the next page lists all the S-Register options that are stored in NVRAM. For a detailed description, see Appendix B.

These commands can be used in configuring S-Registers:

S*r*=*n* **Set S-Register value**: *r* is any S-Register; *n* must be a decimal number between 0 and 255. For example:

ATS0=2 <Enter>

This example would set S-Register 0, or number of rings the modem listens for before answering, to two rings.

S*r*.*b*=*n* **Set bit-mapped register value**: *r* is the bit-mapped register; . *b* is the bit; *n* is 0 (off) or 1 (on). For example:

ATS13.0=1 <Enter>

This example tells the modem to reset when the Data Transmission Ready (DTR) signal drops.

S*r*? **List current value of register*r***. For example:

ATS0?

This register query asks the modem the number of rings before it answers. A typical response would be:

2
OK

This answer shows that the modem listens for two rings before answering, while **OK** shows that the modem is ready for another command.

Table 3.4—S-Registers Stored in NVRAM

NVRAM S-Register Options		Factory Setting
S0	Sets number of rings for Auto Answer*	1
S1	Counts number of rings	0
S2	Escape code character	43
S3	Carriage Return character	13
S4	Line Feed character	10
S5	Backspace character	8
S6	Dial wait-time, sec.	2
S7	Carrier wait-time, sec.	60
S8	Dial pause, sec.	2
S9	Carrier Detect time, 1/10th sec.	6
S10	Carrier loss wait-time, 1/10 th sec.	7
S11	Tone duration, spacing, msec.	70
S12	Escape code guard time, 1/50th sec.	50
S13	Bit-mapped functions**	0
S15	Bit-mapped functions**	0
S19	Inactivity/hang up timer	0
S21	Break length, 1/100th msec.	10
S22	XON character	17
S23	XOFF character	19
S24	Pulsed DSR duration, 2/100th sec.	150
S25	DTR recognition time	5
S26	RTS/CTS delay time, 1/100th sec.	1
S27	Bit-mapped functions**	0
S28	V.32 handshake time, 1/10th sec.	8
S29	V.21 handshake time, 1/10th sec.	20
S33	Bit-mapped functions **	0
S34	Bit-mapped functions**	0
S38	Disconnect wait time, sec.	0
S41	Allowable remote login attempts	0
S42	Remote Access ASCII character	126
S43	Remote guard time, 1/50th sec.	200
S44	Re-establish leased-line connect, sec.	15
S51	Bit-mapped functions**	0
S53	Bit-mapped functions**	0
S54	Bit-mapped functions**	0
S55	Bit-mapped functions**	0
S56	Bit-mapped functions**	0
S57	Bit-mapped functions**	0
S58	Bit-mapped functions**	0

* DIP switch 5 must be OFF (default). May not be less than 1; ava ilable for programming a higher value where required.

** Bit-mapped registers have up to eight functions. See descriptions later in this appendix.

User Inquiries

The Inquiry command has 11 options. The most commonly used options display the following information:

ATI3	Call duration
ATI4	Current settings
ATI5	NVRAM settings
ATI6	Link diagnostics summary

I0 The modem returns a 4-digit product code. If you have a problem and call U.S. Robotics' Technical Support Depart - ment, you may be asked for this product code.

I1 The modem performs a checksum of its read-only memory (ROM) and returns the result to the screen. This function is used only in factory testing. The modem should always read the same number.

I2 The modem perfo rms a test of its random access memory (RAM) and returns either the OK (0) or ERROR (4) result code, followed by OK when the test is completed. You may want to use this command as a checkpoint if the modem appears to be malfunctioning.

I3 The modem returns the duration of the last call if set to K0. It displays the actual time if set to K1. See the description of the K *n* command in Appendix C.

I4 The modem displays its current configuration. See figure 4.1.

```
ati4
USRobotics Courier V.32bis V.34 Fax Settings...

  B0  C1  E1  F1  Q0  V1  X7
  BAUD=57600  PARITY=N  WORDLEN=8
  DIAL=PULSE  ON HOOK   TIMER

  &A3  &B1  &C1  &D2  &G0  &H1  &I0  &K1  &L0  &M4  &N0
  &P0  &R2  &S0   &T4   &X0  &Y4

  S00=000  S01=000  S02=043  S03=013  S04=010  S05=008   06=002  S07=060
  S08=002  S09=006  S10=007  S11=070  S12=050  S13=000  S14=000  S15=000
  S16=000  S17=000  S18=000  S19=000  S20=000  S21=010  S22=017  S23=019
  S24=150  S25=005  S26=001  S27=000  S28=008  S29=020  S30=000  S31=000
  S32=009  S33=000  S34=000  S35=000  S36=000  S37=000  S38=000  S39=000
  S40=000  S41=000  S42=126  S43=200  S44=015  S45=000  S46=000  S47=000
  S48=000  S49=000  S50=000  S51=000  S52=000  S53=000  S54=000  S55=000
  S56=000  S57=000  S58=000

  LAST DIALED #:

OK
```

Figure 4.1—Sample ATI4 Screen

I5 The modem displays the configuration stored in NVRAM, as in the following example.

```
ati5
USRobotics Courier V.32bis V.34 Fax NVRAM Settings...

  DIAL=PULSE  B0  F1  X7
  BAUD=57600  PARITY=N  WORDLEN=8

  &A3  &B1  &G0  &H1  &I0  &K1  &L0  &M4  &N0
  &P0  &R2  &S0  &T4  &X0  &Y1

  S00=001  S02=043  S03=013  S04=010  S05=008  S06=002  S07=060  S08=002
  S09=006  S10=007  S11=040  S12=050  S13=000  S15=000  S19=000  S21=010
  S22=017  S23=019  S24=150  S25=005  S26=001  S27=000  S28=008  S29=020
  S31=000  S32=009  S33=000  S34=000  S35=000  S36=000  S37=000  S38=000
  S39=000  S40=000  S41=000  S42=126  S43=200  S44=015  S46=255  S47=000
  S48=000  S49=016  S50=100  S51=000  S53=000  S54=000  S55=000  S56=000
  S57=000  S58=000
                STORED PHONE NUMBERS
0:                          1:
2:                          3:
4:                          5:
6:                          7:
8:                          9:
     STORED COMMAND =

OK
```

Figure 4.2—Sample NVRAM Settings Screen

I6 During a connection, the modem monitors and stores information about link operations. When the call is ended, you can request a diagnostic summary as in the following example. The duration of the last call or real time is displayed depending on the K *n* setting.

```
ati6
USRobotics Courier V.32bis V.34 Fax Link Diagnostics...

Chars sent              0       Chars Received          0
Chars lost              0
Octets sent             0       Octets Received         0
Blocks sent             0       Blocks Received         0
Blocks resent           0

Retrains Requested      0       Retrains Granted        0
Line Reversals          0       Blers                   0
Link Timeouts           0       Link Naks               0

Data Compression        NONE
Equalization            Long
Fallback                Disabled
Last Call               00:00:00

Disconnect Reason is Keypress Abort
OK
```

Figure 4.3—Sample Link Diagnostics Screen (ATI6)

For calls under data compression, the number of characters sent may be less than the number of octets sent due to buffering operations.

Most terms used in the display are self-explanatory except for the following:

***Octets*:** Compressed data units. If the number of octets is greater than the number of characters sent, the modems probably used MNP5 compression on an already compressed file and the result was expanded data.

***Blers*:** Errors in data and protocol blocks. If there were many block errors, your receiver may have experienced problems on the line.

Blocks Resent: These represent blocks the remote modem resent due to the previous category, *Blers*.

Link Timeouts: Protocol detection problems: communications were severed momentarily, and the modems probably recovered. This does not indicate the retry timeout.

Link Naks: Negative acknowledgments (one or more blocks).

Data Compression: Indicates the type of data compres sion negotiated for the call (V42BIS or MNP5) or NONE. A V42BIS response includes the size of the dictionary and the maximum string length used, for example, 2048/32. See Appendix A for more information.

Equalization Long: Status of S15 bit 0; long if bit 0=0.

Fallback: Enabled/Disabled: indicates whether or not the modems negotiated online fallback during the connection sequence.

Protocol: Indicates the error control protocol negotiated (LAPM, HST, MNP, NONE).

Speed: The last rates at which the receiver/transmitter were operating before disconnecting.

Disconnect Reason: Possible reasons the modem hung up are as follows:

A Rootless Tree: The modem received an invalid V.42 *bis* (compression) frame.

Break Timeout: Incompatible processing of a Break signal occurred.

DISC: The remote modem sent a V.42 Disconnect frame.

DTR dropped: The computer or terminal dropped the Data Terminal Ready signal, terminating the call.

Escape code: The operator sent the modem the +++ escape code.

Extra Stepup: The modem received an invalid V.42 *bis* (compression) frame.

GSTN (General Switch Telephone Network) Clear Down: The connection was non-ARQ and DTR was dropped from one side of the connection, or the DISC frame was corrupted due to noise.

Illegal Command Code: The modem received an invalid V.42 *bis* (compression) frame.

Inactivity timeout: The modem detected no activity on the line for the duration specified in Register S19 (default is 0, timer disabled).

Invalid Codeword: The modem received an invalid V.42 *bis* (compression) frame.

Invalid speed: The modem is set to &N1 or higher, for a fixed link rate, and the remote modem is not operating at the same rate.

LD received: The remote modem sent an MNP error control Link Disconnect request.

Loop loss disconnect: The modem detected a loss of current on the loop connecting it with the tele phone company central office. This usually occurs because the remote modem has hung up; the cen tral office drops current momentarily when there is a discon nect at the other end of a call. Unless Register S38 is set higher than zero, the modem immediately hangs up at loop loss.

Loss of carrier: The modem detected loss of the remote modem's carrier and waited the duration specified in Register S10 (default is 0.7 seconds).

MNP incompatibility: The modem is set to &M5 and the remote modem does not have MNP capability, or there was an MNP negotiation procedure error.

***Retransmit limit*:** The modems reached the maximum of twelve attempts to transfer a data frame without error.

SABME Timeout (Set Asynchronous Balance Mode Extended): The modems failed this part of V.42 link negotiation.

***Unable to Retrain*:** After several attempts, disturb ances on the phone line prevented the mo dems from retraining, and they could no longer transmit or receive data.

***XID Timeout*:** The modems failed to negotiate the V.42 Detection (XID Exchange) phase.

Dial Security Disconnect Reason: Possible reasons the answering modem may have hung up during a Dial Security session are as follows:

Security Abort: The modem hung up because it received an invalid password three times.

Prompting Not Enabled: The modem hung up because the originating modem did not send an autopass password and prompting wasn't enabled.

No Prompting in Sync: The originating modem did not send an autopass password and the answering modem cannot prompt for a password in any synchronous mode.

Non-ARQ Mode: The modem hung up because the originating modem was set for error control and the answering modem was set for non-error control.

Mode Incompatible: The modem hung up because both modems were not set to the same error control setting.

No Prompting in Non-ARQ: Prompting was enabled, but the modem hung up because the originating modem was set for error control and the answering modem was set for non-error control. The answering modem cannot prompt when it is set for non-error control.

I7 The modem returns a product configuration. If you have a problem and call U.S. Robotics' Technical Support staff, you may be asked to read this screen.

I8 Not used

I9 Not used

I10 View Dial Security Account status. For security administrators only, unless local security is disabled, S53=0 or S53.2=0.

```
ati10
USRobotics Courier V.32bis V.34 Fax

                                DIAL SECURITY STATUS

     DIAL SECURITY ENABLED:[N]                  LOCAL SECURITY ENABLED:[N]
     PROMPTING ENABLED:[N]                      FORCED AUTOPASS:[N]
     LOCAL ACCESS PASSWORD:[NO PSW]             AUTOPASS PASSWORD:[NO PSW]

ACCOUNT  PSW          PHONE #                   ACCT/E   DIAL/B  NEW_#   PHONE #
  #0   [NO PSW]                                 [N]      [N]     [N]
  #1   [NO PSW]                                 [N]      [N]     [N]
  #2   [NO PSW]                                 [N]      [N]     [N]
  #3   [NO PSW]                                 [N]      [N]     [N]
  #4   [NO PSW]                                 [N]      [N]     [N]
  #5   [NO PSW]                                 [N]      [N]     [N]
  #6   [NO PSW]                                 [N]      [N]     [N]
  #7   [NO PSW]                                 [N]      [N]     [N]
  #8   [NO PSW]                                 [N]      [N]     [N]
  #9   [NO PSW]                                 [N]      [N]     [N]
OK
```

Figure 4.4—Sample Dial Security Account Status Screen (ATI10)

I11 Connection report used for debugging purposes. A U.S. Robotics Technical Support representative may ask you for information provided on this screen.

S-Register Query (Sr?)

This command allows you to view the contents of a particular S-Register, as in the following example that requests the contents of Register S0 ("On what ring will the modem answer?"):

ATS0? <Enter>

Help Screens

MP modems provide five Help screens: summaries of the basic AT command set, extended ampersand (&) command set, Dial command options, S-Register functions, and percent (%) command set.

Stop/Restart Display

The following command stops the display. Hold down the Control key and type "S":

<Ctrl>-S

To restart the display, use the same command or press any key.

Cancel Display

Either of the following commands cancels the display.

<Ctrl>-C

<Ctrl>-K

At AT$, MP modems display a screen that shows a partial summary of the command set. A second screen, activated by pressing any key, shows the remaining commands. The first screen is shown in Figure 4.5.

```
at$
HELP,  Command Quick Reference (CTRL-S to Stop, CTRL-C to Cancel)

&$    HELP, Ampersand Commands          Kn    n=0  Call Duration Mode
%$    HELP, Percent Commands                  n=1  Real Time Clock Mode
A/    Repeat Last Command               On    n=0  Return Online
A>    Continuously Repeat Command             n=1  Return Online & Retrain
AT    Command Mod e Prefix                    n=2  Return Online & Speed Shift
A     Answer Call                       P     Pulse Dial
Bn    n=0  CCITT originate mode         Qn    n=0  Result Codes Sent
      n=1  Reserved                           n=1  Quiet (No Result Codes)
Cn    n=0  Transmitter Off                    n=2  Verbose/Quiet On Answer
      n=1  Transmitter On               Sr=n  Sets Register "r" to "n"
Dn    Dial a Telephone Number           Sr?   Query Register "r"
      n=0..9#*TPR,;"W@!()-              S$    HELP, S Registers
DL    Dial Last Phone Number            T     Tone Dial
DSn   Dial Stored Phone Number          Vn    n=0  Numeric Responses
D$    HELP, Dial Commands                     n=1  Verbal Responses
En    n=0  No Command Echo              Xn    n=0  Basic Result Codes
      n=1  Echo Command Chars                 n=1  Extended Result Codes
Fn    n=0  Online Echo                        n=2-7  Advanced Result Codes
      n=1  No Online  Echo              Z     Software Reset
Strike a key when ready . .
```

Figure 4.5—Sample Basic Commands HELP Screen (AT$)

At AT&$, the modems display a screen that shows a partial summary of the extended ampersand command set. A second screen, activated by pressing any key, shows the remaining command set. The first screen is shown in Figure 4.6.

```
at&$
HELP, Ampersand Commands (CTRL-S to Stop, CTRL-C to Cancel)

&An   n=0  Disable /ARQ Re sult Codes        &Pn   n=0  N.American Pulse Dial
      n=1  Enable /ARQ Result Codes                 n=1  UK Pulse Dial
      n=2  Enable /Modulation Codes           &Rn   n=0  CTS Follows RTS
      n=3  Enable /Extra Result Codes               n=1  Ignore RTS
&Bn   n=0  Floating DTE Speed                       n=2  RX to DTE/RTS high
      n=1  Fixed DTE Speed                    &Sn   n=0  DSR Always On
      n=2  DTE Speed Fix ed When ARQ                n=1  Modem Controls DSR
&Cn   n=0  CD Always On                             n=2  Pulse DSR, CTS=CD
      n=1  Modem Controls CD                        n=3  Pulse DSR
&Dn   n=0  Ignore DTR                               n=4  DSR=DCD
      n=1  On-Line Command Mode               &Tn   n=0  End Test
      n=2  DTE Controls DTR                         n=1  Analog Loopback (ALB)
&Fn   n=0  Load Factory Configuration               n=3  Digital Loopback (DLB)
      n=1  Hardware Flow Control Cnfg.              n=4  Grant Remote DLB
      n=2  Software Flow Control Cnfg.              n=5  Deny Remote DLB
      n=3  HST/Cellular w/ HW FC Cnfg.              n=6  Remote Digital Loopback
&Gn   n=0  No Guard Tone                            n=7  Remote DLB
      n=1  550 Hz Guard Tone                        n=8  ALB With Self Test
      n=2  1800 Hz Guard Tone               &W    Store Configuration
Strike any key when ready . . .
```

Figure 4.6—Sample Ampersand Commands HELP Screen (AT&$)

At ATD$, the modems display this Dial command summary:

```
atd$
HELP, Dial Commands (CTRL-S to Stop, CTRL-C to Cancel)

0-9   Digits to Dial
*     Auxiliary Tone Dial Digit
#     Auxiliary Tone Dial Digit
T     Tone Dialing
P     Pulse Dialing
R     Call an Originate Only Modem
,     Pause (Wait for S8 Time)
;     Remain in Command Mode After Dialing
"     Used to Dial Alpha Phone #'s
W     Wait for 2nd Dial Tone (X3-X7)
@     Wait for an Answer (X3-X7)
!     Flash Switch Hook

OK
```

Figure 4.7—Sample Dial Command HELP Screen (ATD$)

At ATS$, the modems display a screen that shows a partial summary of the S-Register functions. More screens, activated by pressing any key, show the remaining registers. The first screen can be seen in Figure 4.8.

```
ats$
HELP, S Register Functions (CTRL-S to Stop, CTRL-C to Cancel)

S0    Ring to Answer On                    S36 Reserved
S1    Counts # of Rings                    S37 Reserved
S2    Escape Code Char                     S38 Disconnect Wait Time (sec)
S3    Carriage Return Char                 S39 Reserved
S4    Line Feed Char                       S40 Reserved
S5    Backspace Char                       S41# of Allowed Login Attempts
S6    Wait Time/Dial Tone (sec)            S42 Remote Escape Code Char
S7    Wait Time/Carrier (sec)              S43 Remote Escape Code Time (1/5   0sec)
S8    Comma Time (sec)                     S44 Leased Line Delay Timer (sec)
S9    Carrier Detect Time (1/10sec)        S47 Reserved
S10   Carrier Loss Time (1/10sec)          S48 Reserved
S11   Dial Tone Spacing (msec)            S51 Bit Mapped
S12   Escape Code Time (1/50sec)                 1 = MNP/V.42 Disabled in V.22
S13   Bit Mapped                                 2 = MNP/V.42 Disabled in V.22bis
        1 = Reset On DTR Loss                    4 = MNP/V.42 Disabled in V.32
        2 = Do Originate in Auto Answer          8 = Reserve  d
        4 = No Pause Before Result Codes         16 = Reserved
        8 = Do DS0 On DTR                        32 = Reserved
        16 = Do DS0 On Reset                     64 = Reserved
Strike a key when ready . . .
```

Figure 4.8—Sample S-Register HELP Screen (ATS$)

At AT%$, the modems display a screen that shows a partial summary of the percent command functions. A second screen, activated by pressing any key, shows the remaining registers. The first screen is seen in Figure 4.9.

```
at%$
HELP, Percent Commands (CTRL-S to Stop, CTRL-C to Cancel)

%An=    Security Account Information          %En=    Erase Account Information
        Command Structure                             n=1  Erase Local Access Psw
%An=    PW,ACCT E,DIAL B,NEW#,PH#                     n=2  Erase Autopass Psw
        n = (0-9)                                     n=3  Erase Accounts PSW
        PW = Password                         n=4  Erase Accounts Phone #
        ACCT E = Account Enable                       n=5  Erase Accounts S tatus
        DIAL B = Dial Back Enable             %Fn     Remote DTE Data Format
        NEW# = New Dial Back #                        n=0  8, No parity
        PH# = Dial Back Phone #                       n=1  7, Mark parity
%Bn      Remote DTE Data Rate                         n=2  7, Odd parity
        n=0   110  bps                                n=3  7, Even parity
        n=1   300  bps                        %L=PWn  Security Local Access Psw
        n=2   600  bps                                PWn = (0-9)
        n=3  1200  bps                        %Pn=s   Store Remote Access Pswd
        n=4  2400  bps                                n=0  Query Access Only
        n=5  4800  bps                                n=1  Full Configuration
        n=6  9600  bps                        %Pn?    Query Remote Access Pswd
        n=7 19200  bps                                n=0  Query Access Only
        n=8 38400  bps                                n=1  Full Configuration
Strike a key when ready . . .
```

Figure 4.9—Sample Percent HELP Screen (AT%$)

This appendix includes information on how U.S. Robotics modems negotiate with remote modems for the rate and other characteristics of each connection. In addition, you'll find information on error control as well some statistics and guidelines on using the modem for the best throughput.

The following text includes the term *ARQ*, which means Automatic Repeat Request. ARQ is a method used in many error control protocols to ensure that any data that has been corrupted in transit is retransmitted. We use the term in our document ation to designate a connection under error control.

Note: High-speed calls are highly vulnerable to errors unless the data is protected by error control. The V. protocol opera - tions described on the following pages take place even if one of the modems is not set for error control, thereby prohibiting error control for the call. If your modem connects with a modem at high speed but without error control, and if you are not using an error control protocol for your call, you may lose data.

Link Negotiation

V.34 Handshaking

A Total Control MP modem defaults to V.34 and tries for the highest possible speed when it attempts to connect with another modem, 28.8K bps. The entire V.34 range comprises 28.8K, 26.4K, 24K, 21.6K, 19.2K, 16.8K, 14.4K, 9600, 7200, 4800, and 2400 bps. If the remote modem is not V.34 capable, a connection is made using the highest compatible modulation scheme (V.FC, V.32 *terbo*, V.32 *bis*, and so on, down to as low as Bell 103, or 300 bps).

If the remote modem has V.34 capability, the two modems use a line probing technique to determine the highest speed possible under current line conditions, and complete the connection. If the remote modem does not have V.34 capability, a calling Total Control MP modem listens to the other modem's answer tones to identify what standard rate the remote modem is operating at, and adjusts to that rate. An answering Total Control MP modem sends out a series of answer tone signals until both modems can negotiate the best connection rate.

V. Fast Class (V.FC) Handshaking

Total Control MP modems detect a V.Fast Class modem and try for the highest possible speed when attempting to connect. The entire V.FC range comprises 28.8K, 26.4K, 24K, 21.6K, 19.2K, 16.8K, and 14.4K bps. If the remote modem is not V.FC capable, a connection is made using the highest compatible modulation scheme (V.32 *terbo*, V.32 *bis*, and so on, down to as low as Bell 103, or 300 bps).

Earlier, lower-speed V. protocols do not employ line probing. Instead they use predefined answer tones to specify, or identify, speed capabilities. These protocols define the following *maximum* speeds.

- V.32 *terbo*: 19.2K bps, with an additional MP-to-MP speed of 21.6K bps.
- V.32 *bis*: 14.4K bps.
- V.32: 9600 bps.
- V.22 *bis*: 2400 bps
- V.22: 1200 bps.

ASL (Adaptive Speed Leveling—used in V.32 *terbo* and V.32 *bis* modes) is a strategy that allows the modems' receivers and transmitters to act independently of each other. We have always featured a shift up/shift down feature with error-correcting modems that allows them to slow down if there are problems with the phone line in order to avoid data errors, and then speed up again. But the independence of the receiving and transmitting channels means that one channel or the other may slow down and then speed up without affecting the data flow on the other. The result is more efficient line operation.

Note: While many modems on the market now use the more efficient speeds, there may be a problem in answering older, "dumb" V.32 modems at 9600 bps. Register S28 is used to modify the duration of the extra tones used in V.32 negotiations, in the rare instance that this may be necessary. See *S-Registers* in Appendix B.

Error Control

Error control is available for calls at 1200 bps and above. It can be disabled, although high speed calls (above 2400 bps) should always be under error control. The operations defined in an error control protocol include the following:

- Establishment of compatibility
- Data frame formatting
- Error detection through Cyclic Redundancy Checking (CRC)
- Retransmission of corrupt data frames

Total Control MP modems are set at the factory to &M4 causing them to try for an error control connection and, if that isn't possible, to proceed with the call in Normal mode. The modem first tries for a V.42 connection, then an MNP connection. The following information is based on the modem's setting of &M4.

V.42 Handshaking

This international standard includes a two-stage hand shaking process:

- A **Detection phase** that is based on an exchange of predefined characters.
- **LAPM (Link Access Procedures for Modems) Negotiation.** In this phase, the modems identify their capabilities concerning maximum data block size and the number of outstanding data blocks allowed before an acknowledgment is required.

MNP Handshaking

This protocol is supported by the ITU-T V.42 Recommenda tion. It was originally developed by Microcom, Inc. and is now in the public domain.

MNP is based on special protocol frames. If V.42 negotiation fails and the remote modem doesn't recognize an MNP Link Request, error control isn't possible.

Data Compression

If the modems successfully establish a V.42 connection, they also negotiate for V.42 *bis* data compression. If they successfully establish an MNP connection, they negotiate for MNP5 data compression. The type of compression for a call, if any, is reported in the ATI6 display and in the CONNECT message if an MP modem is enabled to show result codes.

Modems using V.42 *bis* compression negotiate the fol lowing options and report them in the ATI6 display.

- Dictionary size: that is, the amount of memory available for compression table entries. (Entries are codes devised for redundant data. The data is packed into shorter data units and unpacked by the receiving modem.)

  Possible sizes are as follows:

Bits	Entries
9	512
10	1024
11	2048

  U.S. Robotics modems use an 11-bit, or 2048-entry dictionary, but drop down if the remote modem uses a 9- or 10- bit dic tionary.

- Maximum string length of each entry. As the dic tionary fills, the modem deletes the oldest unused strings.

V.42 *bis* compression is more efficient than MNP5 com pression in part because it dynamically deletes entries that are no longer used. In addition, it works better with files that are already compressed. These include .ZIP files down loaded from many Bulletin Boards and 8-bit binary files, which seem to the modem to be compressed.

MNP5 compression should not be used with such files because it adds data to them which lessens throughput. (The additional data is stripped when the file is decom pressed by the remote modem.) When transfer ring such files, it's best to set the modem to &K3: this allows V.42 *bis* compression to work ynamically with the com pressed data but disables MNP5.

Flow Control

Flow control of data from the computer is required under error control for two reasons:

1. The transmitting modem buffers a copy of each frame it transmits to the remote end until it is acknowledged by the receiving modem.
2. If errors are encountered, retransmis sion activity can cause a steady stream of data from the computer to overflow the buffer.

Throughput Guidelines

The following guidelines should help to make the most of the modem's advanced performance features. In many instances, experimentation and experience will indicate what works best for your applications.

1. Optimal throughput is attained under the following conditions:
   - The communications software allows fixing the serial port rate higher than the connection rate by setting the soft ware to 115.2K, 57.6K, or 38.4K bps and setting the modem to &B1.

     If the software automatically switches serial port rates to follow the connection rate, the modem's serial port rate must also be set to follow the connection rate for each call, &B0, and then throughput will be limited.

     Installations with specialized software may want to enable a fixed serial port rate for ARQ calls and a variable serial port rate for non-ARQ calls. See the &B2 command in Appendix C.
   - The call is under data compression.
   - The data is comprised of text files rather than binary files such as .EXE or .COM files. See the table at the end of this appendix.
2. MNP5 compression is disabled fo r files that are already compressed, and 8-bit binary files that appear to the modem

to be already compressed. MNP5 is disabled by setting the modem to &K3.

3. The file transfer is not slowed down by a file-transfer protocol. Many non-text files require a file transfer protocol, but the results vary. For example, certain public domain file transfer protocols have the following effects:

   Kermit — Newer versions support packets up to 9K and a sliding window design to elimi nate turn-around delay. With earlier versions how ever, throughput may be severely reduced due to short block lengths (possibly under 128 bytes) and acknowledg ment turnaround time.

   Xmodem — Throughput may be reduced if your version uses short block lengths (128 bytes). Some versions use larger blocks (1K blocks). Throughput is also reduced by overhead (error control protocol information).

   Ymodem — There is an improvement over Xmodem due to larger block lengths (1K bytes), but throughput is still reduced by the protocol's error control overhead.

   The above protocols further reduce throughput when an error control connection is established. The accuracy of the data is checked both by the file trans fer protocol and the modem. To avoid redun dancy, use the above protocols only for non-ARQ connections.

   We recommend that the latest version of Zmodem be used on on error-controlled connections only with hardware flow control. There is minimal overhead and throughput is nearly unequaled by any other protocol. Zmodem should also be used for non-ARQ connections. Leave the modem at its &M4 and &K1 settings for both error control and data com pression. Ymodem-G is another good choice, but never without both the local and remote modems using error control: if Ymodem-G detects an error, it aborts the transfer. Do not use either protocol with software flow control (XON/XOFF signaling).

Typical Throughput

The maximum connection rate between two V.34 modems is 28.8K bps. Occasionally, connections occur at 26.4K, 24K, and 21.6K bps because line quality differs from location to location. Line conditions and data rate affect throughput. Also remember your serial port rate must match or exceed your connection rate. If you set your serial port rate at 19.2K bps, the V.34 modem will only connect at or below 19.2K bps.

The tables on the next page indicate the typical throughput, in characters per second (cps) that can be expected under the following conditions:

- Connection (link) rates of 14.4K, 21.6K, and 28.8K bps, respectively
- Serial port rates set at 57.6K bps for the 14.4K bps connection and 115.2K bps for the 21.6K and 28.8K bps connections
- Modem set to &B1 (fixed serial port rate)
- V.42 *bis* compression negotiated for the call and the default size 11-bit, 2048-entry dictionary
- Straight data (not already compressed, no file-transfer protocol)
- Transmission from a fast (486) computer

Note: .ZIP files that are already compressed or files that appear to the modem to be compressed yield lower throughput. We recommend setting the modem to &K3 when transferring these files to allow V.42 *bis*, but to disable MNP5.

14.4K bps

File Type	Typical throughput (cps)
Text file	3400
.ZIP files	1600
Database files	4600
Graphic files	2900

26.4K bps

File Type	Typical throughput (cps)
Text file	5100
.ZIP files	2400
Database files	7200
Graphic files	4300

28.8K bps

File Type	Typical throughput (cps)
Text file	6800
.ZIP files	3200
Database files	9600
Graphic files	5800

Front Panel LED Definitions

Colors	LEDs	
	Run/Fail	*Modems 1-8*
Off	off	idle
Green	power on	online
Orange	—	dialing
Flashing green	—	testing
Red	critical failure	critical failure
Flashing orange/green	—	running SDL

The RS-232 Interface

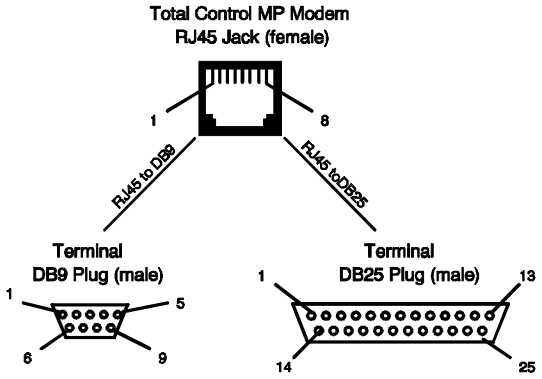
The RS-232 interface is a stan dard developed by the Electronic Industries Association (EIA) defining signals and voltages in exchanging data between the DCE and DTE. Data is transmitted between the devices via a cable with 25-pin, 9-pin, 8-pin or custom-built connectors. The MP's RS-232 ports require RJ-45 connectors.

Cable Kits

There are three Cable Kits available from U.S. Robotics which have all the cables needed to set up the unit.

- *DB-25 Kit*—This kit contains 8 RJ-45 to RJ-45 cables and 8 RJ-45 to DB-25 adapters. For use with terminals requiring DB-25 jacks.
- *DB-9 Kit*—This kit contains 8 RJ-45 to RJ-45 cables and 8 RJ-45 to DB-9 adapters. For use with terminals requiring DB-9 jacks.
- *Cisco Kit*—This kit contains one 8-to-1 cable for Cisco Systems 2500 Series Access Products.

RS-232 Pinout Conversions



Modem (RJ-45)	Signal	Terminal (DB-9)
1	Ring Indicate	9
2	DCE	1
3	DTR	4
4	SGND	5
5	RX	2
6	TX	3
7	CTS	8
8	RTS	7

Modem (RJ-45)	Signal	Terminal (DB-25)
1	Ring Indicate	22
2	DCE	8
3	DTR	20
4	SGND	7
5	RX	3
6	TX	2
7	CTS	5
8	RTS	4

Figure B.1—RS-232 Pinout Conversions

Circuit	RJ-45 Pin Number	Description
125	1	Ring Indicator (RI)
109	2	Data Carrier Detect (DCD).
108/2	3	Data Terminal Ready (DTR).
102	4	Signal Ground (SGND).
104	5	Received Data (RX).
103	6	Transmitted Data (TX).
106	7	Clear to Send (CTS).
105	8	Request to Send (RTS).

Table B.1—RS-232 Interface Pin Definitions

Figure B.1 on the opposite page shows the paths that the RS-232 signals take in converting from RJ-45 pins to DB-9 and DB-25 pins. These are the most common RS-232 pin assignments. If you need to make custom cables, see *Minimum Requirements*.

Make sure the RS-232 cable is shielded. Cables are normally six feet long, but longer lengths are possible. If you encounter problems with signal degradation, try a shorter cable.

If you decide to build your own cable, use a low-capacitance cable. To further minimize the capacitance, connect only those functions (pins) that your application requires.

Minimum Requirements

Some computer/terminal equipment supports only a few of the RS-232 signal functions set in the MP. The minimum required for the modem to operate are as follows:

RJ-45 Pin	Function
1	Ring Indicate
6	Transmitted Data
5	Received Data
4 or 5	Signal Ground
3	Data Terminal Ready

Figure B.2—Minimum RS-232 Signal Requirements

S-Register Summary

Usage

The default values are those users typically require. Change the settings of an S-Register with the ATS*r*=*n* command, where *r* is the register and *n* is a decimal value from 0-255:

ATS13=8 <Enter>

The modem does not perform a value-range check. Some values may not work with some equipment, and you'll have to readjust the settings.

Some registers are bit-mapped (bits 0 –7). For example, turning on bit 0 of S13 causes the modem to reset each time the computer or terminal drops its Data Terminal Ready (DTR) signal. Turning on bit 3 of S13 causes the modem on receipt of DTR, to auto dial of the number stored at position 0 in NVRAM.

To turn on one or more bits in any bit-mapped register, use the total the values of the bits you want to turn on.

Alternatively, identify the bits to be turned on with the following format: S *r*.*b*=1, where *r* is the register and .*b* is the bit.

To display the contents of a register, use ATS*r*? as in this example:

ATS19? <Enter>

Register	Default	Function
S0	See DIP Switch 5	Sets the number of rings on which to answer when in Auto Answer mode. S0=0 disables Auto Answer, the same as DIP switch 5 ON. S0=1 enables Auto Answer and the modem answers on the first ring.
S1	0	Counts and stores the number of rings from an incoming call.
S2	43	Stores the ASCII decimal code for the escape code character. Default character is "+". A value of 128 –255 disables the escape code.
S3	13	Stores the ASCII decimal code for the Carriage Return character. Valid range is 0–127.
S4	10	Stores the ASCII decimal code for the Line Feed character. Valid range is 0 –127.
S5	8	Stores the ASCII decimal code for the Backspace character. Values of 128 –255 disable the Backspace key's delete function.
S6	2	Sets the number of seconds the modem waits before dialing. If set to X2, X4, X6, or X7, the modem dials as soon as it detects a dial tone (fast dials). If there is no dial tone, the modem observes the S6 timeout.
S7	60	Sets the number of seconds the modem waits for a carrier. May be set for much longer duration if, for example, the modem is originating an international connection.

Register	Default	Function
S8	2	Sets the duration, in seconds, for the pause (,) option in the Dial command and the pause between command re-execu tions (> and A> commands).
S9	6	Sets the required duration, in tenths of a second, of the remote modem's carrier signal before recognition by the MP modem.
S10	7	Sets the duration, in tenths of a second, that the modem waits after loss of carrier before hanging up. This guard time allows the modem to distinguish between a line hit or other disturbance that momentarily breaks the connection, from a true discon nect (hanging up) by the remote modem.
S11	70	Sets the duration and spacing, in milliseconds, of dialed tones.
S12	50	Sets the duration, in fiftieths of a second, of the guard time fo r the escape code (+++) sequence.

Register	Default	Function
S13	0	Bit-mapped register. Select the bit(s) you want on and set S13 to the total of the values in the Value column. For example, ATS13=20 enables bit 2 (value = 4) and bit 4 (value = 16). Or use ATS *r.b*=0 (OFF) or 1 (ON). For example, ATS13.0=1 .3=1 turns on bits 0 and 3. To turn a bit off, set that bit to zero, as in ATS13.3=0.

Bit	Value	Result
0	1	Reset when DTR drops
1	2	Reverse normal Auto Answer operation: on incoming RING, enter Originate Mode and look for Answer tone
2	4	Disable 250 msec. pause before result code display
3	8	On DTR signal, Auto Dial the number stored in NVRAM at position 0
4	16	At power on/reset, Auto Dial number stored in NVRAM at position 0
5	32	Reserved.
6	64	Disable MNP Level 3 (used for testing Level 2)
7	128	Custom applications

Register	Default	Function
S14	0	Bit-mapped register.

Bit	Value	Result
0	1	Disconnect on escape code
1–7	–	Reserved

Register	Default	Function
S15	0	Bit-mapped register. To set the register, see the instructions for S13.

Bit	Value	Result
0	1	Reserved.
1	2	Disable online fallback
2	4	Reserved.
3	8	Reset non-ARQ mode Transmit buffer from 1.5K bytes to 128
4	16	Disable MNP Level 4; retransmitting the larger Level 4 data blocks may be a problem if you expect a great number of errors during a call
5	32	Set backspace key to delete
6	64	Some earlier 2400 bps MNP modems, not made by U.S. Robotics or Microcom, were not fully compatible with the MNP protocol. If you have difficulty making a successful 2400 bps MNP connection with a remote MNP modem, it may be because of this incompatibility. Set S15 to 64 and try again to make the connection.
7	128	Custom applications only

Register	Default	Function
S16	0	Bit-mapped test register. To set the register, see the instructions for S13. For information on testing, see Appendix H. **Bit Value Result** 0 1 Analog Loopback 1 2 Dial test 2 4 Test pattern 3 8 Remote Digita l Loopback 4 16 Reserved 5 32 Reserved 6 64 Reserved
S17	0	Reserved.
S18	0	Test timer for software-initiated loopback testing (& T*n)*, disabled when S18 is set to 0. See Appendix H. Used to set the duration of testing, in seconds, before the modem automatically times out and terminates the test.
S19	0	Sets the duration, in minutes, for the Inactivity Timer. The timer activates when there is no data activity on the phone line and at the timeout, the modem hangs up. S19=0 disables the timer.
S20	0	Reserved.
S21	10	Sets, in 10-millisecond units, the length of Breaks sent from the modem to the computer or terminal. Applies to ARQ mode only.
S22	17	Stores the ASCII decimal code for the XON character.
S23	19	Stores the ASCII decimal code for the XOFF character.

Register	Default	Function
S24	150	Sets the duration, in 20-millisecond units, between pulsed DSR signals when the modem is set to &S2 or &S3. The default is 3 seconds.
S25	5	Sets DTR recognition time in 10 millisecond units.
S26	1	Reserved.
S27	0	Bit-mapped register. To set the register, see the instructions for S13.

Bit	Value	Result
0	1	Enable ITU-T V.21 modulation at 300 bps for overseas calls. In V.21 mode, the modem answers both Bell 103 and V.21 calls, but only originates V.21 calls.
1	2	Enable unencoded (non-trellis-coded) modulation in V.32 mode; this option is part of the ITU-T V.32 recommendation, but is rarely used.
2	4	Reserved.
3	8	Disable 2100 Hz answer tone to allow two V.42 modems to connect more quickly.
4	16	See next page.
5	32	See next page.
6	64	Reserved.

Register	Default	Function		
		7	128	Unusual software incompati - bility. Some software may not accept certain result codes. This setting disables the codes and displays the 9600 code instead. The call's actual rate can be viewed on the ATI6 screen.
		Error control handshaking options: select the total values of bits 4 and 5.		
		Bit 4	**Bit 5**	**Result**
		0	0	Complete handshaking sequence: V.42 Detection, LAPM error control, MNP
		16	0	Disable MNP
		0	32	Disable V.42 Detection and LAPM
		16	32	Disable Detection phase if you know that the remote modem does LAPM, but not the Detection phase.
S28	8	Sets the duration, in tenths of a second, of the extra 3000/600 Hz answer tones sent during V.32 hand shaking. This gives V.32 modems additional time to connect in V.32 mode before timing out. If there is difficulty answering older, manually operated V.32 modems for example, modems that require a button to be pushed in order to dial, try lengthening the duration of the extra tones.		

Register	Default	Function
		Setting S28 to zero eliminates the extra tones, resulting in a faster connect time if, for example, the modem is set to use V.21 modulation (300 bps) or V.23 modulation (1200 bps).
S29	20	Sets the duration, in tenths of a second, of the answer tones sent during V.21 hand-shaking. Default = 20 (2 seconds). This gives V.21 modems additional time to connect in V.21 mode before timing out.
S30–S32	0	Reserved.
S33	0	Setting this register to 1 (S33=1) enables a reduced packet size.
S34	0	Bit-mapped register. See instructions for S13.

Bit	Value	Result
0	1	Disable V.32 *bis*. Used for troubleshooting.
1	2	Disable the modem's enhanced, proprietary V.32 *bis* modulation. Used for troubleshooting.
2	4	Disable the faster retrains that occur during proprietary V.32 terbo modulation. Used for troubleshooting.
3	8	Enable V.23. Required for some British connections.
4	16	Change MR LED to DSR.
5	32	Reserved.
6	64	Disable the remote access busy message.
7	128	Disable V.32 *terbo*.

S35–S37	0	Reserved.

Register	Default	Function
S38	0	Sets the duration, in seconds, before a forced hang-up and clearing of the Transmit buffer, when DTR drops during an ARQ call. This is provided to allow time for a remote modem to acknowledge receipt of all transmitted data. Default = 0: the modem immediately hangs up when DTR drops. If the modem receives the ATH command, it ignores S38 and immediately hangs up.
S39–S40	0	Reserved.
S41	0	Sets the number of allowable remote access login attempts, thus enabling or disabling remote access. The default setting of zero allows no remote login attempts, thus disabling remote access. A value of 1 or greater enables remote access. If the number of unsuccessful login attempts exceeds the limit set by this register, the modem returns online and any further login attempts during the remainder of that connection are refused.
S42	126	Stores the ASCII decimal code for the remote access escape character. The default character is a tilde (~).
S43	200	Sets the duration, in fiftieths of a second, of the guard time for the remote access (~~~~) sequence.
S44	15	Sets the duration, in seconds, of the delay between when the modem senses loss of carrier and when it attempts to re-establish a leased-line connection.
S45–S50	0	Reserved.

Register	Default	Function		
S51	0	Bit-mapped register. See instructions for S13.		
		Bit	**Value**	**Result**
		0	1	Disable MNP / V.42 for V.22 (1200 bps)
		1	2	Disable MNP / V.42 for V.22 *bis* (2400 bps)
		2	4	Disable MNP / V.42 for V.32 / V.32 *bis* / V.32 terbo / V.FC,V.34 (9600 / 14,400 / 19,200 / 21,600 bps).
		3–6	—	Reserved
		7	128	Reserved.
S52				Reserved.

Register	Default	Function
S53	0	Bit-mapped register. Select the Dial Security features you want enabled by setting S53 to the total of the values in the Value column in the table below. For example, S53=3 enables Dial Security with prompting. S53=5 enables Dial Security and local-access password protection. Or use ATS *r.b*=0 (OFF) or 1 (ON). For example, ATS53.0=1, .2=1 turns on bits 0 and 2. To turn a bit off, set that bit to zero as in ATS53.2=0.

Bit	Value	Result
0	1	Dial security enabled
1	2	Prompting enabled
2	4	Local-access password protection enabled

Note: In addition, enabling local access password protection disables the & Z*n*=*s* command which stores up to ten phone numbers because stored phone numbers occupy the same space in NVRAM as the dialback numbers for Dial Security accounts.

S54 64 Symbol rate bit-mapped register used primarily by U.S. Robotics Technical Support for debugging purposes.

Bit	Value	Result
0	1	Disable 2400 symbol rate
1	2	Disable 2743 symbol rate
2	4	Disable 2800 symbol rate
3	8	Disable 3000 symbol rate
4	16	Disable 3200 symbol rate
5	32	Disable 3429 symbol rate
6	64	Disable Call Indicate (CI)
7	128	Disable V.8

Register	Default	Function
S55	0	Trellis code bit-mapped register used primarily by U.S. Robotics Technical Support for debugging purposes.

Bit	Value	Result
0	1	Disable 8S-2D mapping
1	2	Disable 16S-4D mapping
2	4	Disable 32S-2D mapping
3	8	Disable 64S-4D mapping

Register	Default	Function
S56	0	Bit-mapped register primarily used by U.S. Robotics Technical Support for debugging purposes.

Bit	Value	Result
0	1	Disable non-linear coding
1	2	Disable TX level deviation
2	4	Disable pre-emphasis
3	8	Disable precoding
4	16	Disable shaping
5	—	Reserved
6	64	Disable V.34
7	128	Disable V.FC

Register	Default	Function
S57	0	Reserved for German operations.
S58	0	Reserved.

AT Command Set Format

The AT Command set allows you to configure your modem. Use the following guidelines:

- Your communications software must be running and, if you are using a computer, it must be in Terminal mode.
- Type commands in either upper or lower case, not a combination (AT or at— *not* At).
- All commands except A/, A> and +++ are preceded by the AT (*attention*) prefix and are executed with the Enter/Carriage Return key (<Enter>).
- Command length = 60 characters maximum. The modem doesn't count the AT prefix, Carriage Return character, or spaces. It counts (but doesn't act on) punctuation such as hyphens and parentheses.
- A missing numeric parameter is assumed to be zero, as in the command to hang up: ATH <Enter> is the equivalent of ATH0 <Enter>.

Example (spaces are not required, but are added here for readability):

AT &K3 X2 DT O71 312 1234 <Enter>

AT	Attention—tells modem that a command follows.
&K3	Disable MNP5 data compression.
X2	Use the X2 result code subset.
DT	Dial the following number using tone dialing.
<Enter>	Execute the commands.

+++ **Escape code operations.** Once the modem is online to another system, the only command it recognizes is an *escape code* of three typed pluses, which forces the modem back to Command mode. Do the following when issuing the command:

- Wait one second after sending the last item of data
- Type: +++
- Wait one second before typing any data

Do not type the AT prefix or a Carriage Return. The guard time of one second before and after the code prevents the modem from misinterpreting the occurrence of +++ in the transmitted data stream.

If necessary, the character used in the escape code or the dura - tion of the guard time can be changed by resetting Register S2 or S12. See the *S-Register Summary* in Appendix B.

In response to +++ the modem returns to Command mode. However, it keeps the line open or hangs up, depending on the setting of DIP switch 9:

DIP Switch 9	Response to +++
OFF	Modem goes on hook (hangs up), sends NO CARRIER result code (factory setting)
ON	Modem maintains connection (Online-Command mode), sends OK result code

The factory setting (OFF) forces an automatic disconnect when you issue +++.

Set DIP switch 9 ON if you want the modem to respond to +++ by entering Online-Command mode, enabling it to execute commands and return online. (See the O command later in this appendix.)

> If you know the modem you are calling is frequently busy, include the Repeat command in the Dial string, as follows:

AT > DT 1234567 <Enter> or
AT DT 1234567 > <Enter>

The modem enters Repeat mode, dials the number, waits 60 seconds for a carrier (default), and hangs up. Then after a two-second pause, it redials.

The cycle continues until the modems connect or the modem reaches a maximum of 10 attempts.

A **Force Answer** mode when the modem hasn't received an incoming call.

A/ **Re-execute the last issued command.** A/ doesn't take the AT prefix or a Carriage Return, and can be used to redial.

A> **Repeat continuously.** This command combines both the A/ and > commands. The modem enters Repeat mode and redials the Dial string in the command buffer.

AT **Attention** command prefix. Use AT alone to test for the OK result code. AT must prefix all commands except A/, A> and +++.

Any key **Terminate the current dialing operation** resulting from an issued Dial command; terminate Repeat mode (> or A>).

B*n* **Handshake options** for international calls above 1200 bps. Default = B0

- B0 ITU-T (formerly CCITT) answer sequence. Default. This is required to answer all V.32-type calls as well as calls from overseas.
- B1 Bell answer tone. This setting should only be used if the modem is not required to answer V.32-type calls.

C*n* **Transmitter** enabled / disabled.
Default = C1

- C0 Transmitter disabled; receive-only condition.
- C1 Transmitter enabled.

D*n* **Dial the specified phone number**; also execute Dial options.

Note: With the exception of the Dial options, the modem ignores any commands issued after D in the same command string.

D **Dial the number that follows and enter Originate mode.** Optional parameters:

P **Pulse dial** (Default).

T **Tone dial** (rotary phone).

, **(Comma) Pause for 2 seconds before continuing to dial.**

; **Return to Command mode after dialing.**

" **Dial the letters that follow** (in an alphabetical phone number).

! **Transfer a call** (flash the switch-hook). This command applies to modems in installations where other modems share the phone line. The modem flashes the switch-hook (goes off hook 0.5 seconds, on hook for 0.5 seconds and off hook again) to dial the specified extension.

W **Wait for a second dial tone before dialing.**

@ **Wait for an answer** (with X3 or higher). The @ command can be used in the Dial string to tell the modem to detect at least one ring, wait for five seconds of silence at the other end of the call, and then continue to execute the Dial string.

/ **Pause for 125 milliseconds.**

R **Reverse frequencies.** This command allows calls to an originate-only modem. It reverses the modem's originate/answer frequencies, forcing the modem to dial out at the answer frequency.

DL **Dial the last-dialed number.** The modem stores each Dial command until it receives the next Dial command. Use DL instead of A/, described on the next page, if you wish to send the modem non-Dial commands before dialing again.

DS*n* **Dial the number stored in NVRAM** at position *n*, where *n* = 0–9.

E*n* **Command Mode Local echo.** Enables / disables the display of your typed commands.

The modems are shipped with DIP switch 4 ON, disabling local echo. The E *n* command controls the local echo for a current session, independently of the switch setting.

E0 Command mode echo enabled. The modem does not display keyboard commands.

E1 Command mode echo disabled.

F*n* **Online local echo.** This command causes the modem to display a copy of the data it is transmitting to another system. Default = F1.

F0 Online echo ON. Sometimes called *half duplex*. As the modem transmits data to a remote system, it also sends a copy of the data to the screen.

F1 Online echo OFF. Sometimes called *full duplex.*

H*n* **On/off hook control.**

H0 Hang up (go on hook).

H1 Go off hook.

I*n* **Inquiry.** This command calls up screens which display the modem's status and settings.

I0 Display product code

I1 Display results from ROM checksum

I2 Display results from RAM test

I3 Display the duration of the last call

I4 Display current modem settings

I5 Display NVRAM settings

I6 Display Dial diagnostics summary of the last call

I7 Display product configuration information

I8 Reserved

I9 Reserved

I10 Display dial security account status information

I11 Display connection report

K*n* **Modem clock operation:** Call-duration or Real-time mode. Displayed with ATI3 and ATI6 commands.
Default = K0.

K0 Display current call-duration if online. Display last call-duration if offline.

K1 Return actual time at ATI3. Clock is set using ATI3=HH:MM:SS K1.

O*n* **Return Online.** If DIP switch 9 is ON (upon detection of the escape code the modem maintains the connection), you can issue commands and then toggle the modem back online with the O *n* command.
Default = O0.

There are two ways to return online.

ATO0 Return online.

ATO1 Return online and retrain. Use to have the modem re-synchronize if there were errors in a non-ARQ data transfer.

Q*n* **Result codes.** The modems are shipped with DIP switch 3 OFF, to disable result codes. Use the Q *n* command to control the display for a current session, independently of the switch setting.

Q0 Result codes displayed.

Q1 Result codes suppressed (quiet).

Q2 Result codes suppressed in Answer mode.

S*r*=*n* **Set S-Register value:** *r* is any S-Register; *n* must be a decimal number between 0 and 255.

S*r*.*b*=*n* **Set bit-mapped registers:** *r* is the bit-mapped register; . *b* is the bit; *n* is 0 (off) or 1 (on).

S*r*? **Query contents of S-Register.** Variable *r* is the register to be checked.

V*n* **Display result codes in words or numbers**(Verbal / Numeric mode).
Default = 1

V0 Numeric mode.

V1 Verbal mode.

X*n* **Result code set options.** Use the following table.

	Setting							
Result Codes	**X0**	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**
0 / OK	•	•	•	•	•	•	•	•
1 / CONNECT	•	•	•	•	•	•	•	•
2 / RING	•	•	•	•	•	•	•	•
3 / NO CARRIER	•	•	•	•	•	•	•	•
4 / ERROR	•	•	•	•	•	•	•	•
5 / CONNECT 1200		•	•	•	•	•	•	•
6 / NO DIAL TONE			•		•		•	•
7 / BUSY				•	•	•	•	•
8 / NO ANSWER				•	•	•	•	•
9 / RESERVED								
10 / CONNECT 2400		•	•	•	•	•	•	•
11 / RINGING						•	•	•
13 / CONNECT 9600		•	•	•	•	•	•	•
18 / CONNECT 4800		•	•	•	•	•	•	•
20 / CONNECT 7200		•	•	•	•	•	•	•
21 / CONNECT 12000		•	•	•	•	•	•	•
25 / CONNECT 14400		•	•	•	•	•	•	•
43 / CONNECT 16800		•	•	•	•	•	•	•
85 / CONNECT 19200		•	•	•	•	•	•	•
91 / CONNECT 21600		•	•	•	•	•	•	•
99 / CONNECT 24000		•	•	•	•	•	•	•
103 / CONNECT 26400		•	•	•	•	•	•	•
107 / CONNECT 28800		•	•	•	•	•	•	•
Functions								
Adaptive Dialing			•	•	•	•	•	•
Wait for 2nd Dial Tone (W)				•	•	•	•	•
Wait for Answer (@)				•	•	•	•	•
Fast Dial			•		•		•	•

Result Code	Meaning
0/OK	Command has been executed.
1/CONNECT	Connection with another modem; if set to X0, connection may be between 300 and 28.8 bps; if X1 or higher, connection is at 300 bps.
2/RING	Incoming ring detected.
3/NO CARRIER	Carrier detect has failed or carrier has been dropped due to disconnect.
4/ERROR	Command is invalid.
5/CONNECT 1200	Connection with another modem at 1200 bps.
6/NO DIAL TONE	Dial tone not detected during the normal 2 seconds, set in Register S6.
7/BUSY	Busy signal detect; modem hangs up.
8/NO ANSWER	After waiting 5 seconds for an answer, modem hangs up; returned instead of NO CARRIER when the @ option is used.
10/CONNECT 2400	Connection with another modem at 2400 bps.
11/RINGING	The modem has dialed; remote phone line is ringing.
12/VOICE	Voice answer at remote site; modem hangs up.
13/CONNECT 9600	Connection at reported rate. Same meaning for results of 4800 (18), 7200 (20), 12K (21), 14.4K (25), 16.8K (43), 19.2K (85), 21.6K (91), 24K (99), 26.4K (103), or 28.8K (107)
Adaptive Dialing	The modem attempts to use tone dialing and, if that doesn't work, reverts to rotary dialing.
Wait for Another Dial Tone (W)	The modem continues dialing as soon as it detects another dial tone. See the dial options earlier in this chapter.
Wait for an Answer (@)	The modem continues dialing when it detects 5 seconds of silence on the line. See the dial options earlier in this chapter.
Fast Dial	The modem dials immediately on dial-tone detect, instead of waiting the normal 2 seconds set in Register S6.

Z **Reset to NVRAM settings** when DIP switch 10 is OFF (factory setting). If DIP switch 10 is OFF, the modem resets to the &F0 configuration template, with no flow control.

Ampersand (&) Command Set

&A*n* **Enable/disable additional result code subsets.** See the X *n* command earlier in this chapter.
Default = &A3.

Note: *ARQ* (Automatic Repeat Request) is used in this manual to denote calls under error control.

&A0 ARQ result codes are disabled. This setting does not affect an error control connection; the modem returns the standard CONNECT messages if result codes are enabled.

&A1 ARQ result codes are enabled, indicating that a connection is under error control. Message 14 is displayed if the modem is set to X0 and the connection is at any rate from 1200 to 28.8K bps. The remaining results indicate the connection rate and require a setting of X1 or higher.

14 / CONNECT / ARQ
15 / CONNECT 1200 / ARQ
16 / CONNECT 2400 / ARQ
17 / CONNECT 9600 / ARQ
19 / CONNECT 4800 / ARQ
22 / CONNECT 12000 / ARQ
24 / CONNECT 7200 / ARQ
26 / CONNECT 14400 / ARQ
47 / CONNECT 16800 / ARQ
88 / CONNECT 19200 / ARQ
94 / CONNECT 21600 / ARQ
100 / CONNECT 24000 / ARQ
104 / CONNECT 26400 / ARQ
108 / CONNECT 28800 / ARQ

&A2 Additional VFC, V34, or V32 modulation indicator. If your software cannot handle the added modulation information, select &A1 or &A0.

33/CONNECT 9600/V32
38/CONNECT 4800/V32
40/CONNECT 7200/V32
41/CONNECT 12000/V32
45/CONNECT 14400/V32
83/CONNECT 16800/V32
87/CONNECT 19200/V32
93/CONNECT 21600/V32
97/CONNECT 21600/VFC
101/CONNECT 24000/VFC
105/CONNECT 26400/VFC
109/CONNECT 28800/VFC
139/CONNECT 14400/VFC
143/CONNECT 16800/VFC
147/CONNECT 19200/VFC
111/CONNECT 21600/V34
113/CONNECT 24000/V34
115/CONNECT 26400/V34
117/CONNECT 28800/V34
120/CONNECT 2400/V34
124/CONNECT 4800/V34
128/CONNECT 7200/V34
132/CONNECT 9600/V34
136/CONNECT 12000/V34
140/CONNECT 14400/V34
144/CONNECT 16800/V34
148/CONNECT 19200/V34

37/CONNECT 9600/ARQ/V32
39/CONNECT 4800/ARQ/V32
44/CONNECT 7200/ARQ/V32
42/CONNECT 12000/ARQ/V32
46/CONNECT 14400/ARQ/V32
84/CONNECT 16800/ARQ/V32
90/CONNECT 19200/ARQ/V32
96/CONNECT 21600/ARQ/V32
98/CONNECT 21600/ARQ/VFC
102/CONNECT 24000/ ARQ/VFC
106/CONNECT 26400/ARQ/VFC
110/CONNECT 28800/ARQ/VFC
141/CONNECT 14400/ARQ/VFC
145/CONNECT 16800/ARQ/VFC
149/CONNECT 19200/ARQ/VFC
112/CONNECT 21600/ARQ/V34
114/CONNECT 24000/ARQ/V34
116/CONNECT 26400/ARQ/V34
118/CONNECT 28800/ARQ/V34
122/CONNECT 2400/ARQ/V34
126/CONNECT 4800/ARQ/V34
130/CONNECT 7200/ARQ/V34
134/CONNECT 9600/ARQ/V34
138/CONNECT 12000/ARQ/V34
142/CONNECT 14400/ARQ/V34
146/CONNECT 16800/ARQ/V34
150/CONNECT 19200/ARQ/V34

&A3 Additional error control indicator (LAPM, MNP, or NONE) and data compression type (V42BIS or MNP5). Default. When the call is not under one of those protocols (and ARQ is not included in the result code), the modem reports NONE, for no protocol.

If the modems are using data compression, the type of compression, V42BIS or MNP5, is added to the result code. In the first of the following examples, the modems negoti ated error control for the call (ARQ), used VFC modulation, are using the LAPM error control protocol, and are using V.42 *bis* compression.

CONNECT 28800/ARQ/VFC/LAPM/V42BIS [or MNP/MNP5]
CONNECT 19200/ARQ/V32/LAPM/V42BIS [or MNP/MNP5]
CONNECT 14400/ARQ/V32/LAPM/V42BIS [or MNP/MNP5]
CONNECT 2400/NONE

Note: Although these codes will return numeric identifiers, they are the same numeric identifiers used for &A2 result codes. If the modem is in Numeric mode (V0) and set to &A3, you will not be able to differentiate between &A2 and &A3 result codes. &A3 result codes may not be compatible with some software.

&B*n* **Serial port rate.** This command controls the rate at which the computer communicates to the modem.
Default = &B1

&B0 Variable rates.

&B1 Fixed rate. The modem always communicates with the computer at the rate at which you have set the terminal or software, regardless of the connection rate.

This setting is not affected by the &N setting. However, the serial port rate *must be equal to or higher than* the &N*n* rate.

&B2 Fixed for ARQ calls/Variable for non-ARQ calls. Answer mode only. When the modem goes off hook and connects in ARQ mode, it shifts its serial port rate up to a user-specified rate, for example, 38.4K bps. If the connection is not under error control, the modem behaves as if it were set to &B0 and switches its serial port rate to match the connection rate of each call.

&C*n* **Carrier Detect operations.** At power-on and reset, the modem operates according to the setting of DIP switch 6. This command is not stored in nonvolatile memory as a power-on/reset default.

&C0 CD override, CD always ON.

&C1 Normal CD operations. The modem sends a CD signal when it connects with another modem and drops the CD when it disconnects.

&D*n* **Data Terminal Ready (DTR) operations.** At power-on and reset, the modem operates according to the setting of DIP switch 1. This command is not stored in non volatile memory as a power-on/reset default.

&D0 DTR override. The modem operates as though the DTR is always ON.

&D1 Advance usage: If issued before connecting with another modem, the modem can enter online command mode during a call by toggling DTR. &D1 functions similarly to the escape code (+++), except that this setting is independent of DIP switch 9.

If DIP switch 1 is ON (DTR override) when you issue the &D1 command, the DTR override is automatically turned off. However, if you change the setting of DIP switch 1 *after* issuing &D1, the DIP switch setting takes precedence.

Return online with the O *n* command, or hang up with the H*n* command.

&D2 Normal DTR operations. The terminal or computer must send a DTR signal for the modem to accept commands. Dropping DTR terminates a call.

&F*n* **Load command setting template from ROM.** The modem is shipped with three configurations (templates), &F0 –&F2, stored in permanent memory (ROM). Appendix B includes configuration listings for each template. Any one of the templates may be loaded into current memory (AT &F *n*) or written to nonvolatile memory and reset default (AT &F *n* &W). Note, however, that &F0 is always loaded into memory if DIP switch 10 is ON.
Default = &F1.

&F0 Load No Flow Control template settings

&F1 Load Hardware Flow Control template settings

&F2 Load Software Flow Control template settings

&G*n* **Guard Tone.** This setting applies only to overseas calls at 2400 or 1200 bps. British phone switching systems require the modem to send an 1800 Hz guard tone after it sends an answer tone. Some other European phone networks require a 550 Hz guard tone. Guard tones are not used in the United States or Canada.
Default = &G0

&G0 No guard tone. This is used in the U.S. and in Canada.

&G1 This sets a 550 Hz guard tone, and is used in some European countries.

&G2 This sets an 1800 Hz guard tone, and is used in the U.K. and some Commonwealth countries. &G2 requires the B0 setting.

&H*n* **Transmit data flow control** is for data transmitted to the modem by its attached com puter or terminal. The modem monitors its buffer as data comes from the computer or modem. If the buffer approaches 90 percent capacity, the modem signals the computer or terminal to stop transmitting. When the modem has sent enough data over the link to half empty the buffer, it signals the computer or terminal to resume transmitting.
Default = &H1

&H0 Transmit Data flow control disabled.

&H1 Hardware flow control. Requires that your computer or terminal and software support Clear to Send (CTS) at the RS-232 interface.

&H2 Software flow control. Requires that your software support XON / XOFF signaling.

&H3 Use both hardware and software flow control. If you are unsure about what your equipment supports, select this option.

&I*n* **Received data software flow control.**
Default = &I1

&I0 Disables XON / XOFF flow control of received data.

&I1 The modem acts on your typed XON/XOFF commands, Ctrl-S or Ctrl-Q, and passes them to the remote computer.

&I2 The modem acts on your XON/XOFF commands, but removes them from the data stream instead of passing them to the remote computer. This is the recommended setting for ARQ mode.

&I3 Hewlett Packard —Host mode. Applies only to modems attached to an HP mainframe that uses the ENQ/ACK protocol. Use in ARQ mode only. See Appendix G.

&I4 Hewlett Packard —Terminal mode. Applies only to modems attached to terminals in an HP system that uses the ENQ/ACK protocol. Use in ARQ mode only. See Appendix G.

&I5 This setting is designed to enable flow control on the phone link when the connection is not under error control. For this to work for you, the remote modem must have &I5 capability.

&K*n* **Data compression.**
Default = &K1

&K0 Data compression disabled.

&K1 Auto enable/disable. The modem enables compression if the serial port rate is fixed, &B1, and disables compression if the serial port rate follows the connection rate, &B0, because compression offers no throughput advantage when the serial port and connection rates are equal. Compression may even degrade throughput.

&K2 Data compression enabled. Use this setting to keep the modem from disabling compression.

&K3 Selective data compression. The modem negotiates only for V.42 *bis* compression, and disables MNP Level 5 (MNP5) compression. Use this setting to transfer 8-bit binary files, .ZIP files, and other files that are already compressed.

&Ln **Normal/Leased phone line.**
Default = &L0

&L0 Normal phone line.

&L1 Leased line; enables modem to reconnect if disconnected.

&M*n* **Enable ARQ (error control) protocols.** Both the host modem and the remote modem must use the same protocol.
Default = &M4

&M0 Normal mode, no error control. Due to the nature of phone line channels, this is never recom mended for calls above 2400 bps.

&M1 Reserved.

&M2 Reserved.

&M3 Reserved.

&M4 Normal / ARQ mode. If an ARQ connection isn't made, the modem operates in Normal mode, as though it were set to &M0.

&M5 The modem enters ARQ asynchronous mode. The modem hangs up if an ARQ connection cannot be made.

&M6 Reserved.

&M7 Reserved.

&N*n* **Connection rate variable or fixed.**
Default = &N0

&N0 Variable rates. The host modem negotiates with the remote modem for the highest possible connection rate, depend ing on the capabilities of the remote modem. This is the recommended setting.

&N1-&N14 Fixed rate. The modem only connects if the remote modem is operating at the same rate. If not, the modem hangs up. If you wish, you can filter out calls at other than a specific rate, for security or other reasons, by fixing the connection rate.

The connection rate must always be lower than, or equal to, the serial port rate, never higher.

The options are as follows.

&N1	300 bps	&N9	16.8K bps (terbo,
&N2	1200 bps		V.FC, and V.34 only)
&N3	2400 bps	&N10	19.2K bps (terbo, V.FC,
&N4	4800 bps		and V.34 only)
&N5	7200 bps	&N11	21.6K bps (ter bo, V.FC,
&N6	9600 bps		and V.34 only)
&N7	12K bps	&N12	24K bps (V.FC and V.34 only)
&N8	14.4K bps	&N13	26.4K bps (V.FC and V.34 only)
		&N14	28.8K bps (V.FC and V.34 only)

&P*n* **Pulse dial make/break ratio.** This command sets the ratio of the off-hook / on-hook (make / break) interval for pulse dialing. The default sets the modem for use in North America. The ratio must be changed if the modem is used in the United Kingdom and some Common wealth countries.
Default = &P0

&P0 Make / break ratio, U.S. / Canada: 3 9% / 61%.

&P1 Make / break ratio, United Kingdom, some Commonwealth countries: 33% / 67%.

&R*n* **Received data hardware (RTS) flow control.**
Default = &R2

&R0 Delay Clear to Send Response after Request to Send signal (RTS / CTS delay).

&R1 The modem ignores RTS. This setting is required if your computer or terminal or software does not support RTS.

&R2 Hardware flow control of received data enabled. The modem sends data to the computer or terminal only on receipt of the RTS signal.

&S*n* **Data Set Ready (DSR).** The modem sends the computer or terminal a Data Set Ready (DSR) signal via the RS-232 interface.

&S0 DSR is always ON (override).

&S1 In Originate mode, the modem sends the DSR after it dials, when it detects the remote modem's answer tone. In Answer mode, the modem sends the DSR after it sends an answer tone.

&S2 This option is for specialized equipment such as automatic callback units. On loss of carrier, the modem sends a pulsed DSR signal with Clear to Send (CTS) following Carrier Detect (CD).

&S3 This is the same as &S2, but without the CTS following CD.

&S4 The modem sends the computer a DSR signal at the same time as it sends the Carrier Detect (CD).

&S5 CTS follows CD, with DSR normal.

&T*n* **Modem testing.**

&T0 End test

&T1 Initiate Analog Loopback (AL) testing

&T2 Reserved

&T3 Initiate Local Digital Loopback (LDL) testing

&T4 Reserved.

&T5 Reserved.

&T6 Reserved.

&T7 Reserved.

&T8 Initiate AL with self test and error detection

&W **Write the current to NVRAM.**

&Y*n* **Break handling.** This command allows you to send a break to abort data transfer without disconnecting from the phone link. Default = &Y1

&Y0 Destructive, don't send Break.

&Y1 Destructive, expedited.

&Y2 Nondestructive, expedited.

&Y3 Nondestructive, unexpedited; modem sends Break in sequence with data received from computer or terminal.

&Z*n*=*s* **Store a phone number in NVRAM.** This command stores up to ten numbers, where *n* is the position 0–9 in nonvolatile memory, and *s* is the phone number string. The number-string may be up to 36 characters long, including any Dial command options.

AT &Z2=555-6789 <Enter>

Do not include modem settings in the &Z*n* string. If the call requires a special setting, insert it in the command string before the DS*n* command. In the following example, &M0 (no error control) is inserted before the Dial command:

AT&M0 DS2 <Enter>

Note: The &Z*n*=*s* command functions differently when Dial Security is enabled. See Appendix D for more information.

&Z*n*? **Display the phone number stored in NVRAM** at position *n* (*n* = 0–9).

Percent Command Set

%A*n* **Create and configure security accounts.** See Appendix D.

%B*n* **Remotely configure the modem's serial port rate.** See Appendix D.

%B0	110 bps	%B6	9600 bps
%B1	300 bps	%B7	19,200 bps
%B2	600 bps	%B8	38,400 bps
%B3	1200 bps	%B9	57,600 bps
%B4	2400 bps	%B10	115,200 bps
%B5	4800 bps		

%C*n* **Remote configuration control.** See Appendix D.
Default = %C0

%C0 Defer configuration. This is the default. Configuration changes are deferred until the call is ended; they take effect for ensuing connections. You do not need to enter this command; it is the default unless you enter %C1 or %C2.

%C1 Restore configuration. Use this command to cancel any configuration changes made during remote access, and restore the original configuration. However, commands that have been written to NVRAM (with &W) will not be restored to their previous settings. Additionally, if you have forced immediate config uration changes (with %C2), those changes cannot be reversed with %C1.

%C2 Execute configuration. Use this command to force configuration changes to take effect immediately, during the current connection. We recommend against forcing immediate configuration changes unless absolutely necessary, as this can result in an unreliable connection or even a loss of connection.

%E=*n* **Make security system edits.** See Appendix D.

%E=1 Erase local access password.

%E=2 Erase autopass password.

%E=3 Erase passwords in accounts 0–9.

%E=4 Erase phone numbers in accounts 0 –9.

%E=5 Disable Account, Dialback, and New Number fields in accounts 0 –9 disabled.

%F*n* **Remotely configure data format.** See Appendix D.

%F0 No parity, 8 data bits.

%F1 Mark parity, 7 data bits.

%F2 Odd parity, 7 data bits.

%F3 Even parity, 7 data bits.

%L= **Assign an account password as the local access password.** See Appendix D.

%P*n*= **Disables password security** (*n*=0 or 1) when no character follows the equal sign. See Appendix D.

%P*n*=*s* **Specify the following password string (*s*) for viewing privileges only** (*n* = 0) or view and configuration privileges (*n* = 1). See Appendix D.

%P*n*? **Display password *n*.** See Appendix D.

%S=*n* **Obtain access to security accounts without disabling security.** See Appendix D.

%T **Tone recognition.** Enables the modem, when off hook, to detect the tone frequencies of dialing modems. %T is meant primarily for use with network applications, but may also be integrated into certain software programs. For example, %T could be used in a security program to identify incoming tone security codes.

To enable %T, type ATH1 <Enter> to force the modem off hook. Then type AT%T <Enter>.

%V=PW*n* **Assign Autopass password.** Assign the password in account *n* in your modem's security as your autopass password. See Appendix D.

Remote Access and Dial Security can be set up and accessed using the AT command set while in terminal mode. To access the modems, see *Accessing the Modems* in Chapter 3.

Dial Security is designed to protect networks and data centers from unauthorized access.

Note: If used in conjunction with software providing these features, the procedures in this section are not necessary. The kind of security provided by a MP modem is different from other kinds of dial security where software is used by the computer to control user access. The MP Dial Security is set up in the modem's firmware, so access is controlled from modem to modem.

Warning:
If you want to set up Security on your modem, you must complete the steps below ***in the order listed:***

1. Set up your own security account:
   - Set up your local access password
   - Enable local access password protection
2. Set up remote user accounts.

3. Enable Dial Security.

You must set up your local access security information ***before*** enabling Dial Security and allowing remote calls, as outlined under *Set Up Your Security Account* in what follows.

Be sure to remember your local access password; if you enable security and forget your local access password, you risk being locked out of your system.

Dial Security

Dial Security allows you to configure up to 10 Security accounts for each modem. Each security account is stored in nonvolatile memory (NVRAM) and may be set up in one of three ways:

- ➢ Automatic password access
- ➢ Prompted password access
- ➢ Password with Dialback protection

Autopass

Autopass is the term we use for the basic implementation of Dial Security in the MP modems. It is in effect whenever Dial Security is enabled.

To use autopass alone, the following requirements must be met:

- Both host and remote modems must be U.S. Robotics modems with Dial Security enabled.
- The connection must be under V.42 error control (both modems must be set to &M4 or &M5).

When the remote modem is set for Dial Security, it automatically includes an autopass password (configured by the remote user to be compatible with the host modem's security) in its V.42 error control request. The host modem checks all the enabled passwords in its security accounts for a match.

If the remote user has set up the modem with an invalid password, the host modem returns an INVALID PASSWORD message and hangs up.

If the remote user failed to enable Dial Security on the remote modem, the host modem will not accept the call unless prompting (below) is enabled on the host modem.

Prompting

While the use of autopass (above) is restricted to U.S. Robotics Dial Security modems, prompting allows secured connections with any remote modem whose user has been assigned an allowed password. When prompting is enabled, and the host modem doesn't receive an autopass password, it prompts the remote user for a password. The host modem checks the received password against each of its active Security accounts.

If the password is valid, a secure connection is completed.

If the password is invalid, the host modem prompts twice more before disconnecting.

If there are no password attempts at the remote end, the host modem times out after 60 seconds and disconnects.

Note: There is no prompting capability in synchronous mode.

Prompting is more flexible than autopass because it:

- doesn't require a remote modem to have U.S. Robotics Dial Security.
- doesn't require a V.42 connection, so remote modems without V.42 error control capabilities can connect.

Optional Dialback

Dialback offers an additional layer of security. When the host modem receives a valid password that matches an account and Dialback is enabled, the host first disconnects. The remote user receives a NO CARRIER message. Then the host modem dials back the remote modem.

Typically, the Dialback number is stored in the Security account's phone number field. However, if the security account has been set up to allow a new number, the host prompts the remote user for the new number before hanging up, and then dials back.

In order to use dialback, Dial security and prompting must be enabled.

What the Host Modem Operator Needs to Do

Complete the steps below ***in the order listed:***

1. Set up your own Security account.
2. Set up Security accounts for your remote users.
3. Enable Dial Security.
4. Maintain Security accounts.

Set Up Your Security Account

Security accounts are set up via an AT command line structure, rather than a screen format.

1. Set up your Security account using one of 10 accounts (numbered 0 –9). Each account has five possible fields, as shown in the following table.

Password Enabled	Account Enabled	Dialback Enabled	Allow New Number	Dialback Number
8 chars. max. ASCII 32-127 case sensitive*	YES / NO	YES / NO	YES / NO	up to 37 characters (0–9)
BILL	Y	Y	N	1-419-555-5 555

* If "BILL" is the password, "Bill" is an invalid entry.

Use the %A *n*= command and format (below) to set up accounts, where *n* is the account number, 0 –9. The fields in the above table are entered after the equal sign, each separated by a comma, as in the following example for account 0 with the password BILL.

> **Warning:** Do not insert spaces between commas or between fields and commas. Spaces will invalidate the command.

AT%A0=BILL,Y,Y,N,1-419-555-5555 <Enter>

This examp le instructs the modem to store the configuration for account 0: password (BILL), account enabled (Y), dialback enabled (Y), allow a new number (N), and the dialback phone number.

Note: The %A *n*= command is automatically written to NVRAM and does not require an &W.

Some accounts may have fewer security options. The following example sets the password (Judy) and enables account 1 without any dialback options.

AT%A1=Judy,Y,,, <Enter>

Each security function can be configured or modified independently. If a field is to remain as is, just insert a comma, as shown in the following command. It allows the remote user to supply a new Dialback number different from the one stored in the original account record.

AT%A0=,,,Y, <Enter>

2. Set up your local access password. This password protects the Security accounts from unauthorized users. When this protection is enabled, you cannot view, modify, or tamper with the Security accounts unless you enter the correct local access password. The local access password must be chosen and protection must be enabled ***before*** Dial Security is enabled.

   In the following example, the local access password is the same as the password in account 0.

   AT%L=PW0 <Enter>

Set Up Accounts for Remote users

Once your account is configured and password protection has been enabled, you can set up the remote user accounts. Use the %A*n*= command (using the same guidelines you used to set up the system administrator's account in Step 1 of the previous section) to set up remote user accounts.

Once security accounts have been enabled, you are responsible for communicating valid password information to your remote users.

Enable Dial Security

Once you have completed the previous steps, you are ready to enable Dial Security.

When you enable Dial Security, you must choose either autopass or prompting as the security method. You must know what types of modems remote users are using and set the Dial Security parameters accordingly. Autopass is limited to U.S. Robotics modems with Dial Security, but prompting is not.

1. Register S53 is the bit-mapped register used to enable Dial Security. The &W command must be used to save Register S53 settings to NVRAM. Otherwise, when the computer is

powered off and on again, or the modem is reset using ATZ, it will default to S53=0, Dial Security disabled.

To enable Dial Security with autopass and local access password protection, but without prompting, type the following command:

AT S53.0=1 .2=1 &W <Enter>

The following command enables Dial Security with autopass, prompting, and local access password protection.

AT S53.0=1 .1=1 .2=1 &W <Enter>

Note: Enabling local access password protection disables the &Z *n=s* command that stores up to ten phone numbers. Stored phone numbers occupy the same space in NVRAM as the dialback numbers for Dial Security accounts, and cannot be used when Dial Security is enabled.

If the local access password is not protected, the &Z *n=s* command overwrites the corresponding Dial Security dialback number. For example, the following command overwrites the dialback number for account 5:

AT &Z5 = 555-8976 <Enter>

However, if the local access password is protected, and a user tries to use the &Z *n=s* command, an ACCESS DENIED message is displayed.

Warning: Be sure DIP switch 10 is OFF so the modem will load the settings stored in NVRAM. If someone sets DIP switch 10 ON, the low performance template settings (&F0) are loaded, and Dial Security is disabled. If this should happen, reset DIP switch 10 to OFF, power off the modem and power it back on, or reset the modem by typing ATZ <Enter> so that the proper settings take effect.

Maintain Security Accounts

Once the local access password is set and protected, the system administrator is the only one who can access account information. To modify or change account information, use the %S= and %E = commands described next.

Account Access (%S)

Once Dial Security is enabled, you can access accounts by entering the local access password using the %S= command, which allows access to the accounts by disabling local security.

AT%S=(*your local access password*) <Enter>

Note: The modem echoes the local access password, which is case sensitive. The system will accept an invalid password entry, but will lock you out from the modem's security commands. For example, if the password is Bob, but you enter BOB, an OK is displayed. However, if you try to type a security command (for example, ATI10 <Enter> to view accounts), an ACCESS DENIED message is displayed.

Account Status

Once access has been granted, you can view account information by typing the I10 option of the Inquiry (I) command:

ATI10 <Enter>

Remote users may only use this command during a remote access session if local access security is disabled.

Erasing Account Information (%E)

Use the %E= *n* command to make system edits.

%E=1	Erase local access password.
%E=2	Erase autopass password.
%E=3	Erase passwords in accounts 0–9.
%E=4	Erase phone numbers in accounts 0 –9.
%E=5	Disable Account, Dialbac k, and New Number fields in accounts 0 –9.

To edit or overwrite an individual account, or an individual account field, use the %A *n*= command described in *Set Up Your Security Account*, earlier in this appendix.

Remote Configuration

Dial Security accounts may be configured remotely. See *Configuring Dial Security Remotely* at the end of this appendix.

What the Remote Caller Needs To Do

When remote users want to call in to your modem (assuming you have enabled Dial Security), they must contact you to obtain a valid password. They must also find out if they must set the remote modem for auto answer (necessary if your modem uses Dialback as a security method).

1. If the host modem security is set up, get a password from the host modem operator. Passwords are case-sensitive, so be sure to copy it down correctly.

   If the host modem security is set up for prompting and the host operator enables dialback for your account, skip to Step 3.

2. *For remote users with MP or Courier modems only*. Set up security on your modem, including an account that uses the password the host asked you to use. Refer to *Set up Your Security Account*, earlier in this appendix, for instructions.

   Then assign the password as your autopass password. Enter the following command, where *n* is the number of the account you set up):

   AT %V=PWn <Enter>

   You can check to see that you've correctly set up your autopass password by typing the following command:

   AT I10 <Enter>

   Your autopass password appears in the right-hand column below FORCED AUTOPASS.

Once the autopass password is set, enable your modem's Dial Security with the following command:

ATS53.0=1 &W <Enter>

3. If Dialback is enabled at the host site, set your modem to answer the host modem when it disconnects and dials back.

   To set the modem to answer the Dialback call, set DIP switch 5 OFF and reset the modem (ATZ <Enter>).

   Alternatively, type the following command:

   AT S0=1 <Enter>

4. Call the host modem.

5. When the call is completed, if you want to disable auto answer, do one of the following:

   - Set DIP switch 5 ON and reset the modem (ATZ<Enter>).
   - Type the following command:

     AT S0=0 <Enter>

Remote Access Operations

You can set a MP modem so that someone at a remote location can configure your modem.

This might be helpful if you have problems making a connection with another modem. For example, if you have trouble connecting with a bulletin board, you can allow the bulletin board operator to dial in to your modem and view its configuration settings. If neces sary, the bulletin board operator can send the modem a configu ration string that will make it compatible with the bulletin board.

Another use might be for Dial Security administration when the system administrator is unable to be at the host modem site. It might be urgent, for example, to disable an account.

At the Host modem

There are two tasks required to set up remote access:

1. Set up password security.
2. Enable remote access.

Set Up Password Security

You can designate two passwords for remote access security, each allowing a different level of access to the remote user. You can assign one password that allows viewing privileges only, whereby the host modem's configuration can be remotely viewed but not changed. You can assign another password that allows both remote viewing and configuration privileges.

Remote access passwords can be up to eight alphanumeric characters long, and are not case-sensitive.

%Pn Use the %Pn command to assign remote privileges.

%P0 Viewing privileges only

%P1 Viewing and configuration privileges

To assign a password that allows viewing privileges only, use the command format below:

AT%P0=[password] <Enter>

To assign a password that allows viewing and configuration privileges, use the command format below:

AT%P1=[password] <Enter>

Disabling Password Security

If you want to disable an assigned password (and thereby dis - able remote access security), use the following command format:

AT%P0= <Enter>

or

AT%P1= <Enter>

Warning: If you disable the %P1 password, a remote user does not need to enter a password for configuration access.

Enable Remote Access

Set Register S41 for a value of 1 or greater. S41 is used to set the number of allowable login attempts, as explained later. A setting of zero allows no login attempts, and thus disables remote access.

AT S41=1 <Enter>

At the Remote Modem Site

Remote configuration can be performed at any time during an asynchronous connection. The user performing remote configu - ration can use any modem; it does not have to be a U.S. Robotics model.

1. Make sure the host modem has been set for remote configuration, as described earlier. Then establish a connection. It does not matter which modem originates the call.
2. After a connection has been established, send the following escape sequence:

   Pause four seconds,

   type four tildes: **~~~~**

   and

   pause another four seconds.

   Note: You can change the escape sequence character with Register S42. The pause duration (guard time) can be modified with Register S43. (These values are set at the host modem.)
3. When the modem begins its login sequence, the caller will see a display similar to the following:

   U.S Robotics Remote Session

   Serial Number 000000A000000001
4. At this point, if password security is active, the caller is prompted for the password.

Password (Ctrl-C to cancel)?.....

As described earlier in *Password Security*, entering the password assigned by the %P0 command allows viewing privileges only. Entering the password assigned by the %P1 command allows viewing and configuration privileges. Note that there is a 3-minute time limit for entering the password.

As mentioned earlier, if the number of unsuccessful login attempts exceeds the set limit, the modem returns online and refuses any further login attempts during the remainder of that connection.

When a password is accepted, a MP modem indicates that it has entered Remote Access mode and the remote prompt appears on the remote caller's screen.

Access Granted

Remote->

5. If password security is not active (no passwords have been set or both passwords are disabled), the modem automatically enters Remote Access mode and the remote prompt appears on the remote caller's screen.

   Remote->

6. Once the remote access session has been established, keep in mind that there is a 3 minute inactivity timer. If the modem detects no activity for 3 minutes, it aborts the remote access session and resumes a normal online connection.

Aborting the Request for Remote Access

If you want to abort the remote access login before you have entered the password, return online by pressing <Ctrl>-C or typing ATO <Enter>.

Remote Viewing and Configuration

Once you've gained remote access, you can communicate with the host modem as if you are entering commands at its attached computer. Depending on your access privileges, you can use the regular AT commands.

If you have view privileges only (with %P0), you can use any of the view (Inquiry) commands described in Chapter 4.

If you have view and configure privileges (set with %P1), you can use any of the modem commands, except those com mands that cannot be used while online, such as the Dial com mand. You can also use the remote configuration commands explained later.

When you make remote configuration changes, the remote prompt is altered to indicate that changes have been made. The prompt will change from:

Remote->
to
Remote+>

If you restore the original configuration (with %C1, explained next), the original prompt is also restored (back to Remote->), indicating that the original configuration is intact.

By default, configuration changes do not take effect until the connection is terminated (see %C *n*). However, the new configu - ration is immediately reflected on the information screens (ATI *n*).

Remote Configuration Commands

Here are the commands only used during remote access.

%B*n* Configure the modem's serial port rate.

%B0	110 bps	%B6	9600 bps
%B1	300 bps	%B7	19,200 bps
%B2	600 bps	%B8	38,400 bps
%B3	1200 bps	%B9	57,600 bps
%B4	2400 bps	%B10	115,200 bps
%B5	4800 bps		

%C*n* Configuration control.
Default = %C0

%C0 Defer configuration. Configuration changes are deferred until the call is ended; they take effect for ensuing connections.

%C1 Restore configuration. Use this command to cancel any configuration changes made during remote access, and restore the original configuration. However, commands that have been written to NVRAM (with &W) will not be restored to their previous settings. Additionally, if you have forced immediate config uration changes (with %C2), those changes cannot be reversed with %C1.

%C2 Execute configuration. Use this command to force configuration changes to take effect immediately, during the current connection. We recommend against forcing immediate configuration changes unless absolutely necessary, as this can result in an unreliable connection or even a loss of con nection.

%F*n* Configure data format.

%F0 No parity, 8 data bits.

%F1 Mark parity, 7 data bits.

%F2 Odd parity, 7 data bits.

%F3 Even parity, 7 data bits.

Password Commands

%P*n*= Disables password security (*n*=0 or 1) when no character follows the equal sign.

%P*n*=*s* Specify the following password string (*s*) for viewing
privileges only (*n* = 0) or view and configuration privileges (*n* = 1).

%P*n*? Display password *n*.

Command Format

When typing commands during the remote access session, no delay between command strings is necessary. For example, you can type the following commands without pausing after each one:

- a password: ABCDEF <Enter>
- a configuration string: AT&H1&R2&W <Enter>
- and a request for an information screen: ATI5 <Enter>

The maximum number of characters between carriage returns is 40.

Ending a Remote Access Session

One of four commands ends a remote access session.

- <Ctrl>-C aborts the login procedure.
- ATZ resets the modem and terminates the connection.
- ATH terminates the connection.
- ATO ends the remote access session, but the modems remain online.

Configuring Dial Security Through Remote Access

The system administrator can configure host modem security account information with a modem at a remote site using the procedures described below.

Note: Before remote configuration is possible, the local modem's remote access must be enabled, and a remote access password that allows viewing and configuration privileges must be assigned. For convenience, you may want to use your local access password as your remote access password.

Dialing In From the Remote Site

1. From the remote site, connect to the host modem using Dial Security. Once a connection is made, follow the instructions for beginning a remote access session as described earlier in this appendix.
2. When remote access has been granted, use the %S= command to access the Dial Security accounts.
3. If you wish, you can view account information by typing the following Inquiry (I) command:

   AT I10 <Enter>

4. Make any configuration changes and execute them immediately by typing the following command:

   AT %C2 <Enter>

5. To end the remote session and reactivate local access security on the host modem, reset the modem by typing:

   ATZ <Enter>

> **Warning:** If you do not use the ATZ command to end a remote access session, local access security will remain disabled at the host modem site and anyone dialing in to your modem for remote access will have access to the I10 screen and all Security accounts.

The following operations apply in installations where the modem's phone line is not part of a public-access switched telephone network. Instead, the modem is connected to a special user-installed telephone line or a line that is leased from the telephone company. These lines are often referred to as *dedicated* (to a pair of modems) or *private* lines.

In both types of installation there is a continuous point-to-point connection between two modems. No dialing of phone numbers is required. The modems may be in either Smart or Dumb mode (determined by the position of DIP switch 8).

The User-Installed or Leased Telephone Line

User-installed lines are most commonly two-wire lines, similar to the two-wire lines that connect residential phones to the public switched network.

If you are leasing a line from the telephone company, request a two-wire line, the type of line the modem is designed to work with. If the telephone company only makes a four-wire line available, you'll need a four-wire to two-wire converter at each end of the connection. If the phone company does not install the con verters, you will have to supply them.

For optimal operations, we recommend that the physical length of these lines not exceed five miles.

Setting the Modem

If a Total Control MP modem is set to &L1, as described in what follows, and the remote AT-compatible modem has a comparable setting, they auto matically connect when they are powered on. They also reconnect, without any operator inter - vention, if a disturbance on the line is severe enough to break the connection.

Set the modem as follows:

1. Set your terminal or communications software to the rate at which you want the modems to communicate. For example, use a terminal / software setting of 19.2K bps and, if both modems have the capability, they will connect at 14.4K bps. The following instructions assume that you are familiar with the guidelines on using the &B and &H (Appendix C) and the &W command (Appendix C).

2. Send the modem the following command:

   AT &B1 &S2 &H1 &L1 &W <Enter>

   &B1 fixes the modem's computer interface rate at the same serial port rate you selected when setting up your communications software. &S2 causes the modem to send a Clear to Send (CTS) signal *only* after it sends the Carrier Detect (CD) signal, that is, only after it connects with the remote modem. (See the note that fol lows.) &H1 enables hardware (CTS) flow control.

   &L1 forces the modems off hook at power on and enables them to re-establish the connection should it be broken. &W writes the settings to nonvolatile memory (NVRAM) as power-on defaults.

   Note: We recommend using the &S2 setting to delay CTS until after the connection is made, as a precaution. If the modems are in the process of connecting or reconnecting, the modem interprets any keyboard data entry, including an accidental key stroke, as a *key-press abort,* and hangs up. Delaying CTS until after carrier detection prevents this from happening, for example, if you are typing data to the remote modem when the modems momentarily disconnect and begin to reconnect. However, you have to set the modem for hardware flow control, &H1.

If your software or machine does not support Clear to Send (CTS), don't include &S2 and &H1 in the command string as suggested above. Follow the Transmit Data flow control (&H) guidelines in Appendix C. But keep in mind that if the modems fail to connect or reconnect, the reason could be a key-press abort.

3. Set the modem to load NVRAM settings at power-on, DIP switch 10 OFF. It does not matter if the modem is in Dumb or Smart mode (DIP switch 8).

4. Decide which modem is to be the calling modem and which the answering modem. Set the answering modem to Auto Answer, DIP switch 5 OFF, and the calling modem to Auto Answer suppressed, DIP switch 5 ON.

5. Power off and power on the modems. This initiates the new DIP switch settings and loads the power-on defaults, including &L1. The modems go off hook and establish the connection.

Note: If the modems cannot restore the connection and you could not set the modem to &S2, the reason could be a key-press abort. If the problem persists, however, you may need to call your telephone company to have them check your line.

Note: In order to perform these procedures, you must access each modem individually through its RS-232 port. See *Accessing the Modems* in Chapter 3.

Fax Operations

Fax operations require facsimile-compatible software that can send or receive Group III faxes. Follow the instructions in your fax software manual.

The modem's normal operating mode is Data mode. If your fax software is typical, it automatically switches the modem to Fax mode when you run the program, and resets the modem to Data mode when you exit the program.

If you have a problem, however, and think the modem may be in the wrong mode, you can use one of the following AT commands to manually switch the modem:

AT+FCLASS=0(Switch to Data mode)**<Enter>**
AT+FCLASS=1(Switch to Class 1 Fax mode)**<Enter>**
AT+FCLASS=2.0(Switch to Class 2.0 Fax mode)**<Enter>**

If you are not sure whether the modem is in Data or Fax mode, type the following command:

AT+FCLASS? <Enter>

The modem returns a value of 0 to indicate Data mode, 1 to indicate Class 1 Fax mode, or 2.0 to indicate Class 2.0 Fax mode.

Note: Whenever the fax modem is reset using the ATZ command, by toggling the DTR signal, or by turning the power off and on, the modem will be set to Data mode.

Fax Mode Flow Control Setting

Many facsimile software products use software flow control when the modem is in Fax mode. Throughout our documentation, we recommend that you use hardware flow control for Data mode (factory setting). However, to allow compatibility with software products that use software flow control by default, U.S. Robotics fax modems now automatically change to software flow control when entering Fax mode.

FCC Notice

FCC part 68, rules regarding fax operation, has been amended as follows:

> Telephone facsimile machines—identification of the sender of the message: It shall be unlawful for any person within the United States to use a computer or other electronic device to send any message via a telephone facsimile machine unless such a message clearly contains, in a margin at the top or bottom of each transmitted page or on the first page of the transmission, the date and time it is sent and an identification of the business, other entity, or individual sending the message and the telephone number of the sending machine or of such business, other entity, or individual. Telephone facsimile machines manufactured on and after December 20, 1992 must clearly mark such identifying information on each transmitted page.

Notes to Programmers

Lists of supported Class 1 fax commands and optional Class 2.0 commands are in Appendix K.

If you want to know more about the supported Class 1 fax commands, refer to the standard for the Service Class 1 fax protocol.

ANSI / EIA / TIA-578-1990 (EIA-578)
Asynchronous Facsimile DCE Control Standard
November, 1990 Approved: October 22, 1990

For more information on Class 2.0, refer to the standard for the Service Class 2.0 fax protocol.

ANSI / EIA / TIA-592-1993 (EIA-592)
Asynchronous Facsimile DCE Control Standard
May, 1993

You can obtain copies of these standards by contacting Global Engineering Documents, at 1-800-854-7179.

Call Detection

Total Control MP High-Speed modems support Call Detection, which is a method of reporting whether an incoming call is Data, Fax Class 1, or Fax Class 2.0. It is especially useful for Bulletin Board systems, as it automates recognition of different calls from multiple users.

Call Detection is an optional Service Class 2.0 feature, and is also implemented by U.S. Robotics for Fax Class 1 applications.

To obtain a copy of the technical specification of U.S. Robotics' implementation of Call Detection for Fax Class 1, call our BBS at (708) 982-5092 and download the file CALLSEL.TXT.

For information on implementing Fax Class 2.0 Call Detection, see the standard listed above. For a list of the optional Fax Class 2.0 commands supported by U.S. Robotics, see Appendix K.

Hewlett Packard Installations

During error control connections, the Total Control MP modem recognizes the ASCII ENQ/ACK characters exchanged between many Hewlett Packard host computers and their terminals. The HP host sends the terminal an ENQ character at predefined intervals, and sends no more data until the terminal responds with an ACK character.

MP modems manage this ENQ/ACK protocol so that communication is speeded up, thereby enabling HP terminals to achieve high speeds on dial-up lines. Special flow control settings, using the &I command, are required for HP users. These settings apply to ARQ connections only and to MP modems set to either B0 or B1. Disregard other flow control commands.

Set the modem to Host mode if it is attached to the host computer, or to Terminal mode if it is attached to a terminal, as follows:

Host mode	**AT&I3 <Enter>**
Terminal mode	**AT&I4 <Enter>**

Testing is available with the &T command or Register S16. All loopback testing conforms to ITU-T Recommendation V.54. Earlier U.S. Robotics high speed modems, however, did not perform the &T test repertoire.

In order to perform the following tests, the modems must be accessed (see *Accessing the Modems* in Chapter 3). Only one test can be performed at a given time. If you send a test command while the modem is in test mode, you'll receive an ERROR message.

The LED for the modem being tested will flash green while it is testing.

Testing With &T

The tests supported through the &T command include analog loopback, digital loopback and remote digital loopback. Users can key in their own data during testing, or use the modem's internal test pattern and error detector.

In all cases, disable error control before testing. If the modem is detecting errors and retransmitting the affected data, your results will be invalid.

Ending a Test¾ &T0, S18

Issuing the &T0 command terminates a test. Alternatively, set Register S18 to a specified number of seconds, for example, S18=10. When the 10 seconds are up, the modem automati cally ends the test and returns to Command mode. If the test was Analog Loopback, the &T0 command hangs up the modem. If the test was Digital or Remote Digital Loopback, issue an ATH command to hang up the modem, or an ATZ command to hang up the modem and reset it to its defaults.

Note: If you use the S18 test timer, but in the pro cess of testing you issue an ATZ command, S18 resets to zero and the timer is disabled. You cannot store a value for S18 in nonvolatile memory; its power-on and reset default is always zero.

Analog Loopback—&T1, &T8

This test checks the operation of the modem's transmit ter and receiver. Data flow is shown in Figure H-1.

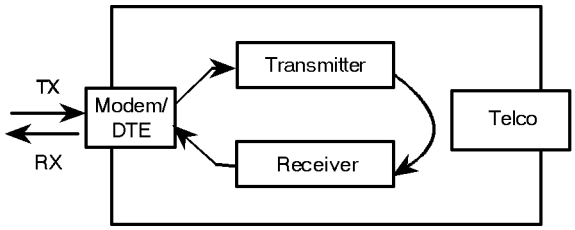


Figure H-1—Data Flow During Analog Loopback

There are two analog loop back options. The first, &T1, involves your typing data that you can verify at your screen.

The second option, &T8, is an internal self-test that does not involve the keyboard or screen. It isolates the modem from the computer interface to give you a more specific result.

&T1

1. The modem must be in Command mode. If you wish, set Register S18 as a test timer, as explained earlier.
2. Send the modem the following command:

   AT &M0 &T1 <Enter>

   The modem disables error control, enters analog loopback (AL) mode, and sends a CONNECT message. The MR status light flashes.
3. Type recognizable data so that you can verify it when it is looped back to the screen.
4. End the test. If you set S18, the modem automati cally stops the test at the timeout, exits AL mode and responds OK.

   If you didn't set Register S18, wait one second and type +++ to bring the modem back to Command mode. If DIP switch 9 is OFF, the modem also hangs up and ends the test.

   If DIP switch 9 is ON, type AT&T0 to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If the modem sends an ERROR message, you have issued an invalid command.
5. If there were no errors, reset the modem to &M4, for error control, unless you've issued the ATZ reset command.

   Note: If the modem is in online-command mode, that is, still connected to a remote modem, and you send it an &T1 or &T8 command, it drops the call, enters AL mode, sends a CONNECT result and waits for loopback characters.

&T8

This AL option causes the modem to send an internal test pattern to its transmitter and loop it back to the receiver. An internal error detector counts any errors and, when the test is ended, sends the number of errors or 000 (no errors) to the screen.

Since you don't type anything during this test, and the modem does not send anything to the screen, this option verifies only

the modem. If there are no errors but your problem continues, it may be at the comput er interface.

1. The modem must be in Command mode. If you wish, set Register S18 as a test timer, as explained earlier.

2. Send the modem the following command:

   AT &M0 &T8 <Enter>

   The modem disables error control and enters AL mode. The Modem LED glows green. The modem sends its internal test pattern to the trans mitter, and loops the pattern back to the receiver. You will not see any data on your screen.

3. End the test. If you set S18, the modem automati cally stops the test at the timeout. If you didn't set Register S18, type AT&T0 to end the test. Or use ATH or the command that resets the modem, ATZ. Both of the latter end the test and hang up the modem.

   The modem hangs up and returns a three-digit code, followed by OK. A code of 000 indicates no errors were found. A code of 255 indicates 255 or more errors. An ERROR message indicates that you issued an invalid command.

4. If there were no errors, reset the modem to &M4 for error control unless you issued the ATZ command.

Digital Loopback¾&T3

If your modem has passed the AL test, this test can help you locate a problem with a remote modem or the tele phone channel. Figure H-2 shows the data flow during DL testing.

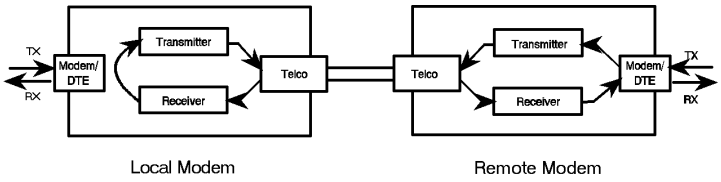


Figure H-2—Data Flow During Digital Loopback

Note: This test requires the modem to establish a connection and return to online-command mode in response to the +++ escape code. DIP switch 9 must be set ON so that the modem does not hang up on receipt of the escape code. After you change the switch, issue ATZ to the modem to initiate the new setting.

1. Set the modem to &M0, to disable error control. Establish a connection with the remote modem.
2. Bring the modem back to Command mode with the +++ escape code. Then send it the AT&T3 com mand. The modem enters DL mode and the Modem LED glows green.
3. The remote user should type a short message. It will be looped back by your modem's trans mitter for verification on the remote screen. You will not see the message or any other data.
4. When the remote user has completed the test, issue the AT&T0 command to end the test, or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK.
5. Reset DIP switch 9 OFF if you normally use the factory default. Reset the modem to &M4 unless you used the reset command, ATZ.

&T4, &T5

The &T4 option causes the modem to grant a remote modem's request for a Remote Digital Loop back test.

The &T5 option cancels &T4, and the modem fails to recognize such a request. This is the default so that your modem isn't subject to another user calling and tying up your modem without your permission.

Remote Digital Loopback—&T6, &T7

This test, like the local digital loopback test, verifies the condition of both modems and the phone link. Data flow is shown in Figure H-3.

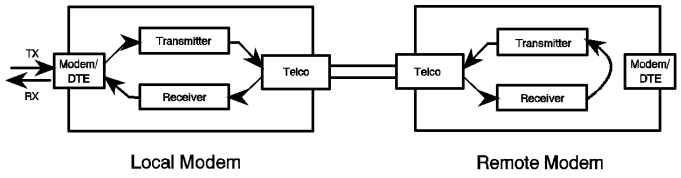


Figure H-3—Data Flow During Remote Digital Loopback

The request for and granting of Remote Digi tal Loopback testing requires that both modems use ITU-T V.22 stan dard signaling. *The test must be performed at 2400 bps or lower.* If the remote modem does not have the capability or is not set to respond (&T4), you will get an ERROR result code.

As with Analog Loopback, there are two Remote Digi tal Loopback options. If you select &T6, you send keyboard data to the modem and verify it when it is returned over the phone lines and to your screen. If you select &T7, the modem sends its internal test pattern and returns an error count to your screen.

Note: Both test options require the modem to establish a connection and return to online-command mode in response to the +++ escape code. DIP switch 9 must be set ON so that the modem does not hang up on receipt of the escape code. If necessary, set the switch ON and then issue the ATZ command to the modem to initiate the new switch setting.

&T6

1. Set the software to 2400 bps or lower. Set the modem to &M0. If you wish, set the S18 timer.

   Establish a connection with the remote modem. If you haven't already done so, arrange with the remote user to cooperate with your testing and, if necessary, set the remote modem to acknowledge the RDL request. For example, older U.S. Robotics high speed modems need to be set to S16=8.

2. Bring the Modem back to Command mode with the +++ escape code. Send it the AT&T6 command. The modem enters RDL mode and the Modem LED glows green.

3. Type a short message. It will be looped back to your modem by the remote modem and to your screen for verification. (The remote user will not see your data.)

4. End the test. If you set Register S18 the modem automatically ends the test when the test timeout is reached. If you didn't set S18, type AT&T0 to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK.

   Data errors indicate a problem with the remote modem or the phone link. If you have not performed analog loopback testing with your modem, the problem may also lie with your modem.

5. Reset DIP switch 9 OFF unless you normally set that switch ON, and issue ATZ to the modem to initiate the new setting. Reset the modem to &M4 unless you used the reset command, ATZ.

&T7

This test option causes the modem to send an internal test pattern through the Remote Digital Loopback. An internal error detector counts any errors and, when the test is ended, sends the number of errors or 000 (no errors) to the screen.

You don't need to type anything during this test. The modem sends only its final error count to your screen.

1. Set the software to 2400 bps or lower . Set the modem to &M0. If you wish, set the S18 timer.

   Establish a connec tion with the remote modem. If you haven't already done so, arrange with the remote user to cooperate with your testing and, if necessary, set the remote modem to acknowl edge the RDL request. For example, older U.S. Robotics high speed modems need to be set to S16=8.

2. Bring the modem back to Command mode with the +++ escape code. Then send it the AT&T7 com mand. The modem enters RDL mode and the Modem LED glows green.

   The modem sends its internal test pat tern to the remote modem, which loops it back to your modem. You will not see the data on your screen.

3. End the test. If you set S18, the modem automati cally stops the test when the timer times out. If you didn't set Register S18, type AT&T0 to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If you issue an invalid command, the modem sends an ERROR message.

   When you terminate the test, the modem returns a three-digit code, followed by OK. A code of 000 indicates no errors were found. A code of 255 indicates 255 or more errors.

   If you've performed an Analog Loopback and know your modem is working properly, errors indicate a problem with either the phone connection or the remote modem.

4. Reset DIP switch 9 OFF unless you normally operate with it ON. Issue an ATZ command to initiate the new switch setting. Reset the modem to &M4 unless you've sent it the ATZ reset command.

Testing With Register S16

Register S16 is a bit-mapped register with the following bit functions:

Bit	Value	Function
0	1	Analog Loopback (AL)
1	2	Dial Test
2	4	Test Pattern
3	8	Remote Digital Loopback (RDL)

Note: Earlier U.S. Robotics modems require bit 3 to be enabled in order to grant RDL to a remote modem. The modem now requires its default &T4 setting instead. To perform RDL with a U.S. Robotics modem that does not use the &T test repertoire, that modem should be set to S16=8 before it can grant RDL testing.

Analog Loopback (AL)—S16=1D

As with the &T AL test, do not attempt this test under error control. MP modems should be tested at 2400 bps or lower, to avoid asymmetrical modulation at higher speeds.

1. To initiate testing, type AT&M0S16=1D. The modem disables error control, enters AL mode and sends a CONNECT result code. The Modem LED glows green.
2. Type data to the modem for the modem to transmit, loop to its receiver, and output to the screen. An alternative is to use the *Test Pattern*, described later.
3. End the test by not typing anything for one second, then typing three pluses (+++), and waiting another second. This forces the modem back to Command mode. If DIP switch 9 is OFF, the modem exits AL mode and returns to Command mode. If DIP switch 9 is ON, the modem maintains the con

nection when it receives the +++ escape code. Issue the ATH command to end AL mode.

4. Reset the modem to Data mode, S16=0, and error control (&M4), or issue the ATZ (reset) command.

Dial Test¾ S16=2

The Dial Test is used for factory testing the frequencies of tone values. When S-Register 16 is set to 2 and a single tone is dialed (e.g., ATD7 <Enter>), the modem continues to transmit that tone until you type another Carriage Return.

Test Pattern¾ S16=4

The test pattern can be used instead of your typed data during Analog Loopback (AL) or Remote Digital Loop back (RDL), using &T commands or S16. The test pattern is available at all speeds. At 300 bps, the modem's serial port rate must be fixed (&B1) and the link rate fixed at 300 bps (&N1). At rates over 9600 bps, just set the modem for a fixed serial port rate (&B1).

To use the test pattern during AL testing with S16, type the follow ing command. The test pattern is sent through the loopback.

AT&M0S16=5D

To use the test pattern during RDL testing with S16, type the following command:

AT&M0S16=12

To use the test pattern with the &T AL or RDL tests, insert the test pattern command, S16=4, before issuing the test command. The first of the following commands initiates AL, the second RDL:

ATS16=4&T1
ATS16=4&T6

The test pattern alone (ATS16=4) is used for testing equipment and the phone line. When S16 is set to 4, the modem transmits the test pattern upon connec tion with a remote modem.

Ending Testing with the Test Pattern

Pressing any character key cancels all test pattern tests and hangs up the modem. If you used Register S16, be sure to reset Register S16 to Data mode when you reset the modem to its error control defaults, for example, ATZ or AT&M4S16=0.

Remote Digital Loopback—S16=8

Responding Modem

The responding modem must be ready to act on the modem's RDL request. U.S. Robotics high-speed modems should be set to &T4. If they do not have &T testing capability, they should be set to S16=8.

Initiating Modem

1. If DIP switch 9 is OFF, set it ON so that it does not hang up on receipt of the +++ escape code. Issue an ATZ command to initiate the new switch setting.
2. Set the software to 2400 or 1200 bps. The ITU-T-specified RDL signals are defined only for connections at 2400 or 1200 bps.
3. Disable error control by setting the modem to &M0. Then establish a connection with the remote modem.
4. Bring the modem back to Command mode by sending it the escape code: one second of no data, three pluses (+++), and another second of no data.
5. When the OK result code appears, send the mode m the following command:

   ATS16=8 O

   The modem enters RDL mode (S16=8), the MR status light flashes, and the modem goes back online (O command). Then it transmits the ITU-T-defined RDL signals, causing the remote modem to enter RDL mode.
6. Type any data at the keyboard. (Or send the test pattern.)
7. To end the test, send the modem the +++ escape code again to bring it back to Command mode.

8. When the modem sends the OK result, reset the modem to Data mode with the following command:

   ATS16=0

   The modem signals the responding modem that RDL testing is over. Terminate the call as you nor mally would, and reset the modem to its normal error control setting, &M4 or &M5.

   Or, if you wish to resume data transmission with the remote modem, add the O command to the ATS16=0 string to return the modem online. Keep in mind, however, that error control is disabled. Because error control is negotiated during the con nection sequence, its status cannot be changed until the modem is back on hook and in Command mode.

To perform the procedures in this chapter, each modem must be accessed individually through its RS-232 port. See *Accessing the Modems* in Chapter 3.

Software Download Upgrade Programs

You can download upgrades from the USR Bulletin Board Service (BBS) to obtain maintenance fixes or new features.

We suggest you retain a copy of the most recent upgrade on disk so you can download it to your modem again, should the modem lose its code for any reason.

The software download program requires DOS version 3.0 or higher and may be run from the DOS shell under Microsoft Windows. The program must be run separately on each modem.

Call the USR BBS

1. Call the USR BBS:

   ATDT 708 982 5092 <Enter>

2. Unless you are running an ASCII-based communications program, answer YES at the graphics prompt when you connect to the BBS.
3. Press Enter with each prompt until you come to the main menu.

Download the Upgrade File

1. At the command line of the main menu, type **F** (File) and press Enter. Select area 15 (Total Control) from the file area menu The most recent zipped files will display.
2. Use the Ent er key to scroll through the file list. On the right hand side of the screen, there is a description of each software upgrade program. Select the file called **MP_*xxyy*.EXE**. In the filename, ***xxyy*** are variables indicating the version—select the file with most recent file date. Use the spacebar to flag this file for download.
3. Press Enter to go back to the main menu.
4. At the command line on the main menu, type **D** and press Enter to initiate a download.
5. Answer the download prompts according to your s ystem requirements. The file will be downloaded to the directory specified in your communications software.
6. When the file transfer is complete and you are ready to leave the BBS, type **G** (*Goodbye*) from the main menu.

Upgrade the Modem

1. Create an SDL directory on the hard drive and save the SDL files to that directory.
2. At the DOS prompt of the directory where your copy of the file has been downloaded, type **MP_*xxyy*** and press Enter. The zipped file will self-extract several files onto your hard disk.
3. Type **SDL** and press Enter.

   The .EXE file checks the code embedded in itself. If there is a problem, an error message appears and the operation is terminated. If you receive an error message, download the file again.
4. A screen appears with default COM port information.

If you want to alter the defaults, use the guidelines below.

/c=*n* Enter this command to select one of four predefined COM ports on an IBM-compatible PC. Valid entries for *n* are 1, 2, 3, and 4. The default is COM 2. If you change the COM port setting, a compatible IRQ will be displayed.

/i=*n* Enter this command to set up a custom port. It specifies which IRQ (interrupt request) the COM port will use to interrupt the processor for service. Valid entries for *n* are 2, 3, 4, 5, and 7. The default is IRQ 3.

/a=*n* Enter this command to specify a port address, where *n* is the hexadecimal address of a custom port *only*.

/b=*n* Enter this command to specify the bit rate at which the COM port will communicate with the modem. Valid entries for *n* are 9600, 19200, 38400, 57600, and 115200. The default is 57600 bps.

/q This command allows you to shut off most of the screen display as the program upgrades your modem code for batch-mode execution. You will not be prompted to accept settings.

/? This command displays a help screen.

5. A prompt asks if you want to "Download Using These Settings? (Y/N)." Type **Y** if you want to continue. Type **N** if you want to abort the operation.

   Note: This is the *only* opportunity you will have to abort the operation.

6. Once you have accepted the settings, the software download will begin. During this operation, the Modem LED will flash alternating orange/green.

7. When the operation is complete, the "Modem reports download successful" message appears.

Troubleshooting

If, while running the software download modem upgrades, your computer reports an error...

Probable Cause	Solution
...your computer may not have a 16550 UART.	Lower the serial port speed.
...your computer may run an uncommon version of DOS.	Run the program on another PC.

Cross-references in the following definitions are printed in boldface.

Analog Loopback

A modem self-test in which data from the keyboard is sent to the modem's transmitter, modulated into **analog** form, looped back to the receiver, demodulated into **digital** form, and returned to the screen for verification.

Analog Signals

Continuous, varying waveforms such as the voice tones carried over phone lines. Contrast with **digital signals**.

Answer Mode

A state in which the modem transmits at the predefined high frequency of the communications channel and receives at the low frequency. The transmit/receive frequencies are the reverse of the calling modem which is in **Originate mode**.

Application (application program)

A computer program designed to perform a specific function, such as a word processor or a spreadsheet.

ARQ

Automatic Repeat Request. A general term for error control protocols which feature error detection and automatic retransmission of defective blocks of data. See **MNP** and **V.42**.

ASCII

American Standard Code for Information Interchange. A 7-bit binary code (0's, 1's) used to represent letters, numbers, and special characters such as $, !, and /. Supported by almost every computer and terminal manufacturer.

Asymmetrical Modulation

A duplex transmission technique which splits the communications channel into one high speed channel and one slower channel. During a call under asymmetrical modulation, the modem with the greatest amount of data to transmit is allocated the high speed channel. The modem with less data is allocated the slow, or back channel (450 bps). The modems dynamically reverse the channels during a call if the volume of data transfer changes.

Asynchronous Transmission

Data transmission in which the length of time between transmitted **characters** may vary.

Because the time lapses between transmitted characters are not uniform, the receiving modem must be signaled as to when the data bits of a character begin and when they end. The addition of **Start** and **Stop bits** to each character serves this purpose.

Auto Answer

A feature in modems enabling them to answer incoming calls over the phone lines without the use of a telephone receiver.

Auto Dial

A feature in modems enabling them to dial phone numbers over the phone system without the use of a telephone transmitter.

Baud Rate

The number of discrete signal events per second occurring on a communications channel. Although not technically accurate, baud rate is commonly used to mean **bit rate**.

Binary Digit

A 0 or 1, reflecting the use of a binary numbering system (only two digits). Used because the computer recognizes either of two states, OFF or ON. Shortened form of binary digit is **bit**.

Bit Rate

The number of **binary digits**, or bits, transmitted per second (**bps**). Communications channels using telephone channel modems are established at set bit rates, commonly 300, 1200, 2400, 4800, 9600, and 14400.

BPS

The bits (**binary digits**) per second rate.

Buffer

A memory area used as temporary storage during input and output operations. An example is the modem's command buffer. Another is the Transmit Data flow control buffer used for flow control and to store copies of transmitted **frames** until they are positively acknowledged by the receiving modem.

Byte

A group of **binary digits** stored and operated upon as a unit. A byte may have a coded value equal to a character in the ASCII code (letters, numbers), or have some other value meaningful to the computer. In user documentation, the term usually refers to 8-bit units or characters. 1 kilobyte (K) is equal to 1,024 bytes or characters; 64K indicates 65,536 bytes or characters.

Call Indicate

A call originating tone defined by **ITU-T** recommendation **V.8**.

Carrier

A continuous frequency capable of being either modulated or impressed with another information-carrying signal. Carriers are generated and maintained by modems via the trans mission lines of the telephone companies.

CCITT

Formerly, an international organization that defined standards for tele graphic and telephone equipment. It has been incorporated into its parent organization, International Telecommunication Union (**ITU**). Telecommunication standards are now covered under Telecommunications Standards Sector (TSS). ITU-T replaces CCITT. For example, the Bell 212A standard for 1200 bps communication in North America was referred to as CCITT V.22. It is now referred to as ITU-T V.22.

Character

A representation, coded in **binary digits**, of a letter, number, or other symbol.

Characters Per Second

A data transfer rate generally estimated from the **bit rate** and the **character** length.

For example, at 2400 bps, 8-bit characters with **Start** and **Stop bits** (for a total of ten bits per character) will be transmitted at a rate of approximately 240 characters per second (cps). Some protocols, such as USR-HST and MNP, employ advanced tech - niques such as longer transmission **frames** and **data compression** to increase cps.

Class 1/EIA-578

An American standard used between facsimile application programs and facsimile modems for sending and receiving Class 1 faxes.

Class 2.0/EIA-592

An American standard used between facsimile application programs and facsimile modems for sending and receiving Class 2.0 faxes.

Cyclic Redundancy Checking (CRC)

An error-detection technique consisting of a cyclic algorithm performed on each block or **frame** of data by both sending and receiving modems. The sending modem inserts the results of its computation in each data block in the form of a CRC code. The receiving modem compares its results with the received CRC code and responds with either a positive or negative acknowl - edgment. In the ARQ protocol imple mented in U.S. Robotics high speed modems, the receiving modem accepts no more data until a defective block is received correctly.

Data Communications

A type of communications in which computers and terminals are able to exchange data over an electronic medium.

Data Compression

When the transmitting modem detects redundant units of data, it recodes them into shorter units of fewer bits. The receiving modem then decompresses the redundant data units before passing them to the receiving computer.

Data Compression Table

A table of values assigned for each character during a call under data compression. Default values in the table are con tinual ly altered and built during each call: the longer the table, the more efficient throughput gained.

If a destructive Break is sent during a call (see the &Y com - mand), causing the modems to reset the compression tables, you can expect diminished throughput.

Data Mode

The mode in which the fax modem is capable of sending and receiving data files. A standard modem without fax capabilities is always in Data mode.

DCE

Data Communication (or Circuit-Terminating) Equipment. In this manual, the term applies to dial-up modems that estab lish and control the data link via the telephone network.

Dedicated Line

A user-installed telephone line used to connect a specified num - ber of computers or terminals within a limited area, for example, one building. The line is a cable rather than a public-access tele phone line. The communications channel may also be referred to as nonswitched because calls do not go through telephone company switching equipment.

Default

Any setting assumed, at startup or reset, by the computer's soft - ware and attached devices, and operational until changed by the user.

Digital Loopback

A test that checks the modem's RS-232 interface and the cable that connects the terminal or computer and the modem. The modem receives data (in the form of **digital signals**) from the computer or terminal, and immediately returns the data to the screen for verification.

Digital Signals

Discrete, uniform signals. In this manual, the term refers to the **binary digits** 0 and 1.

Duplex

Indicates a communications channel capable of carrying signals in both directions. See **Half Duplex**, **Full Duplex**.

EIA

Electronic Industries Association, which defines electronic stan - dards in the U.S.

Equalization

A compensation circuit designed into modems to counteract certain distortions introduced by the telephone channel. Two types are used: fixed (compromise) equalizers and those that adapt to channel conditions. U.S. Robotics high speed modems use adaptive equalization.

Error Control

Various techniques which check the reliability of characters (**parity**) or blocks of data. V.42, MNP and HST error control protocols use error detection (**CRC**) and retransmission of errored frames (**ARQ**).

Facsimile

A method for transmitting the image on a printed page from one point to another. Commonly referred to as Fax.

Fax Mode

The mode in which the fax modem is capable of sending and receiving files in a facsimile format.

Flash ROM

A mechanism that compensates for differences in the flow of data input to and output from a modem or other device.

Flow Control

A mechanism that compensates for differences in the flow of data input to and output from a modem or other device.

Frame

A data communications term for a block of data with header and trailer information attached. The added information usu - ally includes a frame number, block size data, error-check codes, and Start/End indicators.

Front End

A device which acts as a middle -man in a communications link which coordinates calls for a network.

Full Duplex

Signal flow in both directions at the same time. In micro - computer communications, may refer to the suppression of the online **Local Echo**.

Half Duplex

Signal flow in both directions, but only one way at a time. In microcomputer communications, may refer to activation of the online **Local Echo**, which causes the modem to send a copy of the transmitted data to the screen of the sending computer.

HDLC

High Level Data Link Control. A standard protocol devel oped by the International Standards Organization for soft ware appli - cations and communicating devices operating in synchronous environments. The protocol defines oper ations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Bisync**, **Protocol**, **SDLC**.

Hz

Hertz, a frequency measurement unit used internationally to indicate one cycle per second.

ITU-T

International Telecommunication Union-Telecommunication sector. Formerly referred to as CCITT. An international organization that defines standards for tele graphic and telephone equipment. For example, the Bell 212A standard for 1200 bps communication in North America is observed internationally as ITU-T V.22. For 2400 bps com munication, most U.S. manufacturers observe V.22 *bis.*

LAPM

Link Access Procedure for Modems, an error control **protocol** incorporated in ITU-T Recommendation V.42. Like the **MNP** and **HST** protocols, LAPM uses cyclic redundancy checking (**CRC**) and retransmission of corrupted data (**ARQ**) to ensure data reliability.

Local Echo

A modem feature that enables the modem to send copies of keyboard commands and transmitted data to the screen. When the modem is in Command mode (not online to another system) the local echo is invoked through the ATE1 command. The command causes the modem to display your typed commands. When the modem is online to another system, the local echo is invoked through the ATF0 command. This command causes the modem to display the data it transmits to the remote system.

MNP

Microcom Networking Protocol, an asynchronous error control protocol developed by Microcom, Inc. and now in the public domain. The protocol ensures error-free transmission through error detection (**CRC**) and retransmission of errored frames. U.S. Robotics modems use MNP Levels 1–4 and Level 5 data compression. MNP Levels 1–4 have been incorporated into ITU-T Recommendation V.42. Compare **HST**.

Modem

A device that transmits/receives computer data through a communications channel such as radio or telephone lines. A TCMP modem is a telephone channel modem that modulates, or transforms, **digital signals** from a computer into the **analog** form that can be carried successfully on a phone line. It also demodulates signals received from the phone line back to digital signals before passing them to the receiving computer.

NVRAM (Non-Volatile Random Access Memory)

User-programmable random access memory whose data is retained when the unit is turned off. Used in Total Control Modem Pool modems to store a user-defined default configuration loaded into random access memory (**RAM**) at power on.

OFF/ON Hook

Modem operations which are the equivalent of manually lift ing a phone receiver (taking it off hook) and replacing it (going on hook).

Online Fallback

A feature that allows high speed error-control modems to mon - itor line quality and fall back to the next lower speed if line quality degrades. The modems fall forward as line qual ity improves.

Originate Mode

A state in which the modem transmits at the predefined low fre - quency of the communications channel and receives at the high frequency. The transmit / receive frequencies are the reverse of the called modem which is in **Answer mode**.

Parallel Transmission

The transfer of data characters using parallel electrical paths for each bit of the character, for example, 8 paths for 8-bit characters. Data is stored in computers in parallel form, but may be con verted to serial form for certain operations. See **Serial Transmission**.

Parity

An error-detection method that checks the validity of a transmitted character. Character checking has been surpassed by more reliable and efficient forms of block-checking, including **Xmodem**-type protocols and the **ARQ** protocol implemented in TCMP modems.

The same type of parity must be used by two communicating computers, or both may omit parity. When parity is used, a parity bit is added to each transmitted character. The bit's value is 0 or 1, to make the total number of 1's in the character even or odd, depending on which type of parity is used.

Protocol

A system of rules and procedures governing communications between two or more devices. Protocols vary, but communicating devices must follow the same protocol in order to exchange data. The format of the data, readiness to receive or send, error detection and error correction are some of the operations that may be defined in protocols.

RAM

Random Access Memory. Memory that is available for use when the modem is turned on, but that clears of all information when the power is turned off. The modem's RAM holds the current operational settings, a flow control **buffer**, and a command buffer.

Remote Access

A feature that allows a remotely-located user to view the modem's configuration screens and change the modem's configuration. Password protection is available.

Remote Echo

A copy of the data received by the remote system, returned to the sending system and displayed on the screen. Remote echoing is a function of the remote system.

ROM

Read Only Memory. Permanent memory, not user-pro - grammable. The modem's factory settings are stored in ROM and can be read (loaded) into RAM as an operational configura - tion if DIP switch S10 is ON at power on.

Router

A front-end communications device which coordinates incoming calls between PCs on a network.

Serial Transmission

The transfer of data characters one bit at a time, sequentially, using a single electrical path. See **Parallel Transmission**.

Server

A PC which acts as the center of a network. All shareware is stored on this PC.

Start/Stop Bits

The signaling bits attached to a character before the character is transmitted during **Asynchronous Transmission**.

Terminal

A device whose keyboard and display are used for sending and receiving data over a communications link. Differs from a microcomputer in that it has no internal processing capa bilities. Used to enter data into or retrieve processed data from a system or network.

Terminal Mode

An operational mode required for microcomputers to transmit data. In Terminal mode the computer acts as if it were a standard terminal such as a teletypewriter, rather than a data processor. Keyboard entries go directly to the modem, whether the entry is a modem command or data to be transmitted over the phone lines. Received data is output directly to the screen. The more popular communications software products control Terminal mode as well as enable more complex operations, including file transmission and saving received files.

Throughput

The amount of actual user data transmitted per second without the overhead of protocol information such as Start and Stop bits or frame headers and trailers. Compare **characters per second**.

Transmission Rate

Same as **Bit Rate**.

V.8

ITU-T recommendation that defines procedures for starting and ending sessions of data transmission.

V.17

An **ITU-T** standard for facsimile operations that specifies modulation at 14.4K bps, with fallback to 12K bps.

V.21—Fax

An **ITU-T** standard for facsimile operations at 300 bps. U.S. Robotics or compatible fax devices then transmit or receive at higher speeds.

V.21—Modem

An **ITU-T** standard for modem communications at 300 bps. Modems made in the U.S. or Canada follow the Bell 103 standard. However, the modem can be set to answer V.21 calls from overseas.

V.22

A **ITU-T** standard for modem communications at 1200 bps, compatible with the Bell 212A standard observed in the U.S. and Canada.

V.22 bis

An **ITU-T** standard for modem communications at 2400 bps. The standard includes an automatic link negotiation fallback to 1200 bps and compatibility with Bell 212A / V.22 modems.

V.23

An **ITU-T** standard for modem communications at 1200 bps with a 75 bps back channel. Used in the U.K.

V.25

An **ITU-T** standard for modem communications. Among other things, V.25 specifies an answer tone different from the Bell answer tone. All U.S. Robotics modems can be set with the B0 command so that they use the V.25 2100 Hz tone when answering overseas calls.

V.25 bis

An **ITU-T** standard for synchronous communications between the mainframe or host and the modem using the HDLC or character-oriented protocol. Modulation depends on the serial port rate and setting of the transmitting clock source, &X.

V.27 ter

An **ITU-T** standard for facsimile operations that specifies modulation at 4800 bps, with fallback to 2400 bps.

V.29

An **ITU-T** standard for facsimile operations that specifies modulation at 9600 bps, with fallback to 7200 bps.

V.32

An **ITU-T** standard for modem communications at 9600 bps and 4800 bps. V.32 modems fall back to 4800 bps when line quality is impaired, and fall forward again to 9600 bps when line quality improves.

V.32 bis

An **ITU-T** standard that extends the V.32 connection range: 4800, 7200, 9600, 12K and 14.4K bps. V.32 *bis* modems fall back to the next lower speed when line quality is impaired, and fall back further as necessary. They fall forward to the next higher speed when line quality improves.

V.32 terbo

Modulation scheme developed by AT&T that extends the V.32 connection range: 4800, 7200, 9600, 12K, 14.4K, 16.8K, 19.2K, and 21.6K bps. V.32 *terbo* modems fall back to the next lower speed when line quality is impaired, and fall back further as necessary. They fall forward to the next higher speed when line quality improves.

V.34

An **ITU-T** standard that allows data rates as high as 28.8K bps.

V.42

An **ITU-T** standard for modem communications that defines a two-stage process of detection for **LAPM** error control.

V.42 bis

An extension of **ITU-T** V.42 that defines a specific data com - pression scheme for use with V.42 error control.

V.54

ITU-T standard for Loopback testing.

V.Fast Class (V.FC)

Proprietary modulation scheme developed by Rockwell International for data communication speeds up to 28.8K bps.

Word Length

The number of bits in a data character without parity, start or stop bits.

Xmodem

The first of a family of error control software **protocols** used to transfer files between modems. These protocols are in the public domain and are available from many bulletin board services.

XON/XOFF

Standard **ASCII** control characters used to tell an intelligent device to stop / resume transmitting data. In most systems typing <Ctrl>-S sends the XOFF character. Some devices, including MP modems, understand <Ctrl>-Q as XON; others interpret the pressing of any key after <Ctrl>-S as XON.

Command List

D

Compatibility

Your modem uses multiple standard modulation protocols and is also compatible with many nonstandard schemes.

ITU-T V.34

28.8K, 26.4K, 24K, 21.6K, 19.2K, 16.8K, 14.4K, 12K, 9600, 7200, 4800, and 2400 bps asynchronous Trellis Coded Modulation (TCM)

V.Fast Class (V.FC)

28.8K, 26.4K, 24K, 21.6K, 19.2K, 16.8K, 14.4K bps asynchronous Trellis Coded Modulation (TCM)

V.32 terbo

21.6K, 19.2K, 16.8K, 14.4K. 12K, 9600, 7200 bps asynchronous, 19.2K, 16.8K, 14.4K. 12K, 9600, 7200 bps synchronous, Trellis Coded Modulation (TCM)

4800 bps, asynchronous, Quadrature Amplitude Modulation (QAM)

ITU-T V.32 bis

14.4K. 12K, 9600, 7200 bps, asynchronous, Trellis Coded Modulation (TCM)

4800 bps, asynchronous, Quadrature Amplitude Modulation (QAM)

Additional Compatibility Features

ITU-T V.32, 9600 bps, asynchronous, Trellis Coded Modulation (TCM); 4800 bps, asynchronous, Quadrature Amplitude Modulation (QAM)

ITU-T V.25 2100 Hz tone

ITU-T V.23, 1200 bps, asymmetrical (1200 / 75 bps), Frequency Shift Keying (FSK)

ITU-T V.22 *bis*, 2400 bps, asynchronous, Quadrature Amplitude Modulation (QAM)

ITU-T V.22, 1200 bps, asynchronous, Differential Phase Shift Keying (DPSK)

Bell 212A, 1200 bps, asynchronous, Differential Phase Shift Keying (DPSK)

Bell 103, 300 bps, asynchronous, Frequency Shift Keying (FSK)

ITU-T V.21, 300 bps, asynchronous, Frequency Shift Keying (FSK)

Error Control Standards

ITU-T V.42 error control protocol at 14.4K, 12K, 9600, 7200, 4800 bps (V.32 *bis* mode) and at 2400 / 1200 bps

Microcom Networking Protocol (MNP) error control protocol, Levels 2-4 at 14.4K, 12K, 9600, 7200, 4800 bps (V.32 *bis* mode) and at 2400 / 1200 bps

Data Compression Protocols

ITU-T V.42 *bis* data compression (all modes and speeds of 1200 bps and higher)

Microcom Networking Protocol (MNP) Level 5 data compression (all modes and speeds of 1200 bps and higher)

Fax Standards

A Total Control MP modem provides Group III-compatibility when combined with Class 1 or Class 2.0 fax software. In addition, the modem adheres to the following standards.

TIA/EIA-578	Service Class 1 Asynchronous Facsimile DCE Control Standard
TIA/EIA-592	Service Class 2.0 Asynchronous Facsimile DCE Control Standard
ITU-T V.17	14.4K/12K bps
ITU-T V.29	9600/7200 bps
ITU-T V.27 *ter*	4800/2400 bps
ITU-T V.21	300 bps

Serial Port Rates

115.2K, 57.6K, 38.4K, 19.2K, 9600, 4800, 2400, 1200, 300 bps

Phone Line Interface

RJ-11

Communications Channel

Full / half duplex on 2-wire dial-up, dedicated, or leased phone lines; demand-driven high speed channel turnaround in HST mode; symmetrical speeds in V.32 *bis* mode

Operational Modes

Asynchronous, Auto Dial / Answer, Manual Originate / Answer, Smart / Dumb mode, Auto Dial / Auto Answer, Auto Answer only, Forced Originate (MI / MIC)

Fax Modems: The above modes plus fax mode

Dialing

Dialing Rotary (pulse 0-9), Tone (DTMF 0-9, #, *), a-z when in Quote (") Mode

Data Format

Binary, serial; defaults to 8-bit word length, no parity, and 1 stop bit

Word Length	Parity (1 Bit)	Stop Bits
7	Even, Odd Mark, Space	1
7	None	2
8	None	1

Flow Control Buffer Capacity

Transmit Buffer

Error co ntrol: 3.25k bytes

Non-Error control: 1.5k bytes, 128-byte option

Receive Buffer: 2K bytes

Command Buffer Capacity

60 characters, exclusive of AT prefix, Carriage Return and spaces

Test Options

Analog loopback with test pattern
Test pattern
Dial test

Call Progress Codes

FAX
DATA
NO DIAL TONE
BUSY
NO ANSWER
RINGING

Failed Call Timeout

60-sec. default, programmable 2-255 sec.

Answer Tone Timeout

60 sec.

Fax Service Class 1 Commands

+FCLASS=n (0,1, 2.0)	Class identification and cont rol
+FTS=n (0,255)	Stop transmission and pause, 10ms.
+FRS=n (0,255)	Wait for silence, 10 ms.
+FTM=n (3,24,48,72,73,74,96,121,122,145,146)	Transmit data with carrier
+FRM=n (3,24,48,72,73,74,96,121,122,145,146)	Receive data with carrier
+FTH=n (3,24,48,72,73,74,96,121,122,145,146)	Transmit HDLC data with carrier
+FRH=n (3,24,48,72,73,74,96,121,122,145,146)	Receive HDLC data with carrier

FAX service class 2.0 commands

Class 2.0 fax commands are too numerous to be listed here. For information on Class 2.0 technical specifications, contact Global Engineering Documents, at 1-800-854-7179. The document that covers this information is:

ANSI/EIA/TIA-592-1993 (EIA-592)
Asynchronous Facsimile DCE Control Standard
May, 1993

Optional Class 2.0 FAX commands supported

U.S. Robotics implements the following optional Class 2.0 fax commands :

+FNS=0,1	Pass-through non-Standard negotiation byte string
+FCR=0,1	Capability to receive
+FAA=0,1	Adaptive Answer mode
+FCT=0-255 sec.	Phase C Timeout
+FHS=0-255	Hangup Status Code, read only
+FMS=0-3	Minimum Phase C Speed
+FBS?=500,100	Buffer size, read only

Answer Tone Detector

2200-2300 Hz

Loss of Carrier (Disconnect Timer)

0.7-sec. default, programmable 0.2-25.5 sec.

Equalization

Adaptive

Transmitter Carrier Frequencies

V.34

Originate Mode:	1800 Hz
Answer Mode:	1800 Hz
Originate Mode:	1829 Hz
Answer Mode:	1829 Hz
Originate Mode:	1867 Hz
Answer Mode:	1867 Hz
Originate Mode:	1920 Hz
Answer Mode:	1920 Hz
Originate Mode:	1959 Hz
Answer Mode:	1959 Hz
Originate Mode:	2000 Hz
Answer Mode:	2000 Hz

V.Fast Class

Originate Mode:	1800 Hz
Answer Mode:	1800 Hz
Originate Mode:	1875 Hz
Answer Mode:	1875 Hz
Originate Mode:	1920 Hz
Answer Mode:	1920 Hz

USR-V.32 *terbo* / V.32 *bis* / V.32

Originate Mode:	1800 Hz
Answer Mode:	1800 Hz

V.23

Originate Mode:	
Mark:	390 Hz
Space:	450 Hz
Answer Mode:	
Mark:	1300 Hz
Space:	2100 Hz

V.22 *bis*, V.22, Bell 212A
Originate Mode: 1200 Hz
Answe r Mode: 2400 Hz

Bell 103
Originate Mode:
Mark: 1270 Hz
Space: 1070 Hz
Answer Mode:
Mark: 2225 Hz
Space: 2025 Hz

V.21
Originate Mode:
Mark: 980 Hz
Space: 1180 Hz
Answer Mode:
Mark: 1650 Hz
Space: 1850 Hz

Receiver Carrier Frequencies

V.34
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz

Originate Mode: 1829 Hz
Answer Mode: 1829 Hz

Originate Mode: 1867 Hz
Answer Mode: 1867 Hz

Originate Mode: 1920 Hz
Answer Mode: 1920 Hz

Originate Mode: 1959 Hz
Answer Mode: 1959 Hz

Originate Mode: 2000 Hz
Answer Mode: 2000 Hz

V.Fast Class
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz

Originate Mode: 1875 Hz
Answer Mode: 1875 Hz

Originate Mode: 1920 Hz
Answer Mode: 1920 Hz

USR-V.32 *terbo* / V.32 *bis* / V.32
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz

USR-V.32 *terbo* / V.32 *bis* / V.32
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz

V.23
Originate Mode:
Mark: 1300 Hz
Space: 2100 Hz
Answer Mode:
Mark: 390 Hz
Space: 450 Hz

V.22 *bis*, V.22, Bell 212A
Originate Mode: 2400 Hz
Answer Mode: 1200 Hz

Bell 103
Originate Mode:
Mark: 2225 Hz
Space: 2025 Hz
Answer Mode:
Mark: 1270 Hz
Space: 1070 Hz

V.21
Originate Mode:
Mark: 1650 Hz
Space: 1850 Hz
Answer Mode:
Mark: 980 Hz
Space: 1180 Hz

Receive Sensitivity

- 44 dBm ± 2 dBm

Transmit Level

- 9 dBm maximum

Transmitter Frequency Tolerance

.01%

Certification

FCC Part 15, Class A EMI/RFI
FCC Part 68
UL listed
CSA approved
DOC certified

Power Consumption

AC fuse protection
Mean time before failure: 50,000 hours
Auto shutoff in overvoltage and short-circuit conditions

Power Requirements

AC PSU
Nominal 120V (90-264 VAC) @ 47-63 Hz

Operating Environment

Temperature: 0-40° C, 32-104° F
Relative Humidity: 0-95% non-condensing

Maximum Output Power

110 watts

+5V	15 A
+12V	1.9 A
-12V	1 A

Maximum Input Power

160 watts
1.3 A

Typical Input Power

8 port	47 watts	0.4 A
16 port	94 watts	0.8 A

Size

12.6 x 17.5 x 3.5 inches
32.0 x 44.5 x 8.9 centimeters

Limited Warranty

U.S. Robotics, Inc., warrants to the original consumer or other end user purchaser that this product is free from defects in materials or workmanship for a period of two years from the date of purchase. During the warranty period, and upon proof of purchase, the product will be repaired or replaced (with the same or similar model) at our option, without charge for either parts or labor. This warranty shall not apply if the product is modified, tampered with, misused, or subjected to abnormal working conditions.

REPAIR OR REPLACEMENT AS PROVIDED UNDER THIS WARRANTY IS THE EXCLUSIVE REMEDY OF THE PUR - CHASER. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE, AND U.S. ROBOTICS SHALL IN NO EVENT BE LIABLE TO PURCHASER FOR INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND OR CHARACTER.

Some states do not allow the exclusion or limitation of incidental or consequential damages or allow limitations on how long an implied warranty lasts, so the above limitations or exclusion may not apply to you. This warranty gives you specific legal rights. You may also have other rights which vary from state to state.

Should you encounter problems in operating this device, see the *Service* section in this appendix.

Service

Contact your reseller or distributor. They should be able to give you the assistance you need.

If your reseller or distributor cannot help, contact the U.S. Robotics Systems Support Department at the number listed below from 8:00 –6:00, Central Time; or by mail at 8100 North McCormick Blvd., Skokie, Illinois, 60076-2999.

For technical assistance, contact USR in any of the following ways:

Systems Support	(800) 231-8770
Internet	support@usr.com
BBS	708-982-5092
Fax on Demand	(800) 762-6163
CompuServe	GO USROBOTICS
Fax	708-982-0823
Anonymous FTP	ftp.usr.com*

*The FTP is for software downloads only.

Be sure to have the product's serial number handy when contacting us.

If it becomes necessary for the unit to be mailed to the factory for repairs, see *Factory Repairs.*

If the unit must be returned to the factory for repairs, you will be given a Return Materials Authorization (RMA) number to help us keep track of your warranty request. Once you have received your RMA number, follow the procedures on the next page. Include proof of the date of purchase.

1. Ship the unit, postage paid, in its original container. If the original container is not available, pack the unit carefully in a strong box of corrugated cardboard with plenty of packing material.
2. Be sure to include your RMA number inside the package, along with your name and address. Put your return address and your RMA number on the shipping label as well.
3. Include proof of the date of purchase in the package.
4. Ship the well-packed unit to the following address:

   Technical Support Department
   U.S. Robotics, Inc.
   8100 North McCormick Boulevard
   Skokie, Illinois 60076-2999

U.S. Robotics will repair the unit and return it to you via United Parcel Service.

Note: U.S. Robotics will not accept packages sent COD, so be sure to send the unit postage paid. Please make sure the package is insured. U.S. Robotics cannot take responsibility for items lost or damaged in the mail.

FCC Registration

- FCC68: CJEUSA-73130-FA-E

  RINGER EQUIVALENCE: 0.4B

  FCC15

Connecting to the Telephone Company

It is not necessary to notify the telephone company before installing the modem. However, the telephone company may request the telephone number(s) to which the unit is connected and the FCC information printed above.

If the modem is malfunctioning, it may affect the telephone lines. In this case, disconnect the modem until the source of the difficulty is traced. Do not use the modem on party or coin telephone lines.

Radio and Television interference

This equipment generates and uses radio frequency energy and, if not installed and used properly in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. Total Control MP high speed modems have been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation.

However, there is no guarantee that interference will not occur in a particular installation. If this device does cause interference to radio or television reception, which you can determine by monitoring reception when the modem is on and off, try to correct the problem with one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the computer with respect to the receiver.
- Relocate the computer and / or the receiver so that they are on separate branch circuits.

If necessary, consult your dealer or an experienced radio / television technician for additional suggestions. You may find the following booklet, prepared by the Federal Communications Commission, helpful:

How to Identify and Resolve Radio-TV Interference Problems
Stock No. 004-000-0345-4
U.S. Government Printing Office
Washington, DC 20402

In accordance with Part 15 of the FCC rules, any modification to or tampering with this device that causes harmful interference to others may be reason for prohibiting future operation.

For Canadian Users

The Industry Canada (formerly DOC) 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 a user's satisfaction.

Before installing this equipment, make sure you are permitted to connect it to the facilities of the local telecommunications company. You must also install the equipment using an acceptable method of connection. In some cases, you may also extend the company's inside wiring for single line individual service by means of a certified connector assembly (telephone extension cord). You should be aware, however, 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 a user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

For your own protection, make sure 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.

Warning: Do not attempt to make such connections yourself; contact the appropriate electrical inspection authority or electrician.

Modem Load Number: 5

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to the telephone loop used by the device, without overloading. The termination on a loop may consist of any combination of devices subject only to the requirement that the total of the Load Numbers of all the devices not exceed 100.

IC (Industry Canada)

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the radio interference regulations of Industry Canada (formerly Canadian Department of Communications).

Le present appareil numerique n'emet pas de bruits radio-electriques depassant les limites applicables aux appareils numeriques de la classe A prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.