

# Chapter 5

## AT Commands

### GENERAL

This chapter describes commands used to select options and to operate the modem. Some options depend on or are restricted by the mode of operation.

### COMMAND CATEGORIES

The modem offers eight major categories of command statements:

- Response
- Dial
- Answer
- Terminal Interface
- General
- Private Line
- Configuration
- Remote Configuration

Six other groups of AT commands are discussed in their respective chapters:

- Protocol
- Test
- Security
- Fax
- S-registers

### OPERATION MODES

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

- Offline Command Mode
- Online Command Mode
- Data Mode

### **Offline Command Mode**

In offline command mode (generally referred to as command mode), the modem communicates with the computer or terminal. Commands can be entered separately or in strings. There is no data communication link established in this mode.

### **Online Command Mode**

This mode is entered from the data mode after the escape command has been entered. The escape command is performed by entering the escape character (+ is the default) three times. The data communication link remains established but data transmission is suspended. The modem will now accept commands like it does in the offline command mode.

### **Data Mode**

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

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

## **SENDING COMMANDS TO THE MODEM**

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

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

## **Creating a Command Statement AT**

To create a command statement use the following steps:

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

An example of a command statement using the dial command (*D*) follows.

ATD554-1212

This statement can be read as

Attention: Dial 554-1212.

Another AT command statement example is

ATZ

This statement can be read as

Attention: execute the *Z* command.

After entering a command line the modem returns a response message indicating whether or not the command was accepted or giving the data requested by the command line.

To clear command statements from the buffer you can either

- Turn the modem off,
- Enter *AT*, or
- Use the DTR reset feature.

## **Autobaud**

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

## Guidelines for Creating Command Statements

When typing command statements, note the following:

The attention code (AT) may be upper or lower case but not a combination like aT.

- Press the Enter key to execute a command.
- The command buffer can hold 80 characters.
- Use the backspace or delete key to erase the last character.

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

## Monitor Display

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

## Command Statement Buffer

The modem temporarily stores up to 80 characters in the command buffer. If this limit is exceeded, the modem does not accept the command and sends an ERROR message. To correct this condition, retype the command using 80 characters or less.

The AT characters and punctuation used in telephone numbers do not take up space in the buffer. Also, blank characters used as spaces to help increase readability are not counted. For example, the modem reads the commands

```
ATD (212) 554-1212
ATD2125551212
ATD 212 555 1212
```

as having 11 characters each. Commands can be typed in any of these forms.

### **Backspace Key**

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

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

### **Repeating a Command *A/***

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

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

### **Numbered Commands**

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

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

In all cases, the zero (0) may be omitted so the commands *M* and *M0* are identical. For clarity, this manual uses the nonzero form of commands. The modem treats both the same but zeros count against the buffer total.

### **Group Commands**

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

For example, the command statement *ATQ0V0L3DT5551212* means

- *AT* Attention.
- *Q* Allow response messages to be sent.
- *V* Select digit code responses.
- *L3* Select high volume.
- *DT* Tone dial 555-1212.

The modem executes the AT command followed by the *Q*, *V*, *L*, *D*, and *T* commands. *ATQ0V0L3DT5551212* can be read as *ATQVL3DT5551212*. Eliminating zeros reduces the number of characters, allowing more room in the buffer.

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

## RESPONSE COMMANDS

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

### Digit / Word Selection **V**

The *V* command tells the modem which type of response message to show on the monitor. Some software requires digit response messages but words are easier to remember.

Command	Operation
V	Enables digit response messages
V1	Enables word response messages *

\* *default*

**Response Displays Q**

The *Q* command enables or disables response messages. The modem still responds to commands when the response display is inhibited.

Command	Operation
Q	Response display on*
Q1	Response display off
Q2	Response display on in originate mode only

\* default

**Negotiation Displays W**

The *W* command enables or disables negotiation response messages. These messages are verbose negotiation status displays to alert the user to the link rate, protocol, and DTE rate.

Command	Operation
W	Disables negotiation displays *
W1	Enables negotiation displays
W2	Displays DCE link rate only

\* default

**Protocol Result Codes \V**

Enable or disable protocol result codes. Table 5-1 lists these codes.

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

\* default

**Call Progress / Connect Speed Messages X**

The *X* command selects response code/message displays and dialing options such as call progress monitoring, busy signal or dial tone detection and blind dialing.

Command	Operation
X	Dial tone and busy signal detection not selected; CONNECT (code 1) response messages displayed for all speeds
X1	Dial tone and busy signal detection not selected; appropriate CONNECT response messages or codes displayed for data rate
X2	Dial tone detection only; NO DIAL TONE message or code appears if dial tone not detected within 5 sec
X3	Busy signal detection only; BUSY message or code appears if dialed number is busy
X4	Dial tone and busy signal detection; appropriate CONNECT message or code displayed *

\* *default*

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

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

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

The X3 command followed by a dial command causes the modem to go off hook, wait the amount of time set in register S6 and dial the number. If a busy signal is detected, the modem sends a BUSY message and



hangs up. If the call is completed, the appropriate CONNECT message similar to X1 will be displayed. The modem will not detect a no dial tone situation.

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

The X4 command combines all the features of X1, X2, and X3. The factory setting is X4.



**Note**

*When an X2, X3, or X4 command is in effect, an appropriate CONNECT data rate message or code is displayed as for X1. When a blind dial command (X, X1, X3) is in effect, the modem waits 2 seconds or the time set by S6 and then dials.*

**Number Code Application \*RC**

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

Command	Code Set	Number	Operation
*RC	Standard *	15 18	4800 bps 9600 bps
*RC1	Alternate	11 12	4800 bps 9600 bps

\* default



**Note**

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

### Response Number Codes / Messages

Response number codes, messages, and their corresponding meanings are listed in Table 5-1. The connect speeds indicated are the serial port rate (DTE), not the DCE speed.

**Table 5-1. Response Messages**

Code	Message	Meaning
0	OK	Command received
1	CONNECT	Connect at 300 bps while X1, X2, X3, or X4 command in effect; all rates while X command in effect
2	RING	Ring detected
3	NO CARRIER	Valid carrier not detected within period specified by register S7, or carrier lost for value of S10 or more
4	ERROR	Command not recognized or too long
5	CONNECT 1200	Connection made at 1200 bps
6	NO DIAL TONE	No dial tone detected for 5 seconds (X2 or X4 command in effect)
7	BUSY	Dialed number busy (X3 or X4 command in effect)
9	CONNECT 7200	DTE rate 7200 bps
10	CONNECT 2400	DTE rate 2400 bps
11, 15	CONNECT 4800	DTE rate 4800 bps
12, 18	CONNECT 9600	DTE rate 9600 bps
13	CONNECT 12000	DTE rate 12000 bps
14	CONNECT 19200	DTE rate 19200 bps
16	CONNECT 38400	DTE rate 38400 bps
17	CONNECT 14400	DTE rate 14400 bps
19	CONNECT 57600	DTE rate 57600 bps
20	CONNECT 0300/REL	MNP 300 bps connection
22	CONNECT 1200/REL	MNP 1200 bps connection
23	CONNECT 2400/REL	MNP 2400 bps connection
24	CONNECT 4800/REL	MNP 4800 bps connection
25	CONNECT 9600/REL	MNP 9600 bps connection

**Table 5-1. Response Messages (Continued)**

<b>Code</b>	<b>Message</b>	<b>Meaning</b>
26	CONNECT 19200/REL	MNP 19200 bps connection
27	CONNECT 38400/REL	MNP 38400 bps connection
28	CONNECT 7200/REL	MNP 7200 bps connection
29	CONNECT 12000/REL	MNP 12000 bps connection
30	CONNECT 14400/REL	MNP 14400 bps connection
31	CONNECT 57600/REL	MNP 57600 bps connection
32	CONNECT 600/REL	MNP 600 bps connection
34	CONNECT 300/LAPM	LAPM 300 bps connection
35	CONNECT 600/LAPM	LAPM 600 bps connection
36	CONNECT 1200/ LAPM	LAPM 1200 bps connection
37	CONNECT 2400/ LAPM	LAPM 2400 bps connection
38	CONNECT 4800/ LAPM	LAPM 4800 bps connection
39	CONNECT 9600/ LAPM	LAPM 9600 bps connection
40	CONNECT 14400/ LAPM	LAPM 14400 bps connection
41	CONNECT 19200/ LAPM	LAPM 19200 bps connection
42	CONNECT 38400/ LAPM	LAPM 38400 bps connection
43	CONNECT 12000/ LAPM	LAPM 12000 bps connection
44	CONNECT 7200/ LAPM	LAPM 7200 bps connection
45	CONNECT 57600/ LAPM	LAPM 57600 bps connection
50	CARRIER 300	Link rate 300 bps
51	CARRIER 1200	Link rate 1200 bps
52	CARRIER 2400	Link rate 2400 bps

**Table 5-1. Response Messages (Continued)**

<b>Code</b>	<b>Message</b>	<b>Meaning</b>
53	CARRIER 4800	Link rate 4800 bps
54	CARRIER 7200	Link rate 7200 bps
55	CARRIER 9600	Link rate 9600 bps
56	CARRIER 12000	Link rate 12000 bps
57	CARRIER 14400	Link rate 14400 bps
58	CARRIER 16800	Link rate 16800 bps
59	CARRIER 19200	Link rate 19200 bps
60	CARRIER 21600	Link rate 21600 bps
61	CARRIER 24000	Link rate 24000 bps
62	CARRIER 26400	Link rate 26400 bps
63	CARRIER 28800	Link rate 28800 bps
64	CARRIER 600	Link rate 600 bps
65	PROTOCOL NEGOTIATING	Training process complete and protocol negotiation begins
70	PROTOCOL NONE	No protocol active
71	PROTOCOL MNP LEVEL 1	MNP level 1 active
72	PROTOCOL MNP LEVEL 2	MNP level 2 active
73	PROTOCOL MNP LEVEL 3	MNP level 3 active
74	PROTOCOL MNP LEVEL 4	MNP level 4 active
75	PROTOCOL MNP LEVEL 5	MNP level 5 active
76	PROTOCOL V.42	V.42 LAPM active
77	PROTOCOL V.42BIS	V.42 bis LAPM compression active
78	CONNECT 300	DTE rate 300 bps
79	CONNECT 600	DTE rate 600 bps
80	CONNECT 16800	DTE rate 16800 bps
81	CONNECT 21600	DTE rate 21600 bps
82	CONNECT 24000	DTE rate 24000 bps

**Table 5-1. Response Messages (Continued)**

Code	Message	Meaning
83	CONNECT 26400	DTE rate 26400 bps
84	CONNECT 28800	DTE rate 28800 bps
85	CONNECT 115200	DTE rate 115200 bps
95	CONNECT 21600/ LAPM	LAPM 21600 bps connection
96	CONNECT 24000/ LAPM	LAPM 24000 bps connection
97	CONNECT 26400/ LAPM	LAPM 26400 bps connection
98	CONNECT 28800/ LAPM	LAPM 28800 bps connection
99	CONNECT 115200/ LAPM	LAPM 115200 bps connection

**DIAL COMMANDS**

Dial commands let the modem originate a call to another modem. These commands can be used with either tone or pulse dial telephone systems. Commands for call answering are included at the end of this section.

**Dialing D**

To dial a number, for example *554-1212* insert the *D* command in the dialing sequence.

*AT D 554-1212*

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

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

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

The dial modifiers are shown in Table 5-2.

**Table 5-2. Dial Modifiers**

Command	Operation
T	Tone dialing*
P	Pulse dialing
,	Insert a long pause (2 sec or value in S8)
W	Wait for 2nd dial tone
!	Flash (1/2 sec)
R	Switch to answer mode after dialing
;	Return to command mode after dialing
@	Wait for silence
S	Dial stored command line or number

\* *default*

### **Tone Dialing T**

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

AT D T 323-1111

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

### **Pulse Dialing P**

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

AT D P 554-9902

### **Insert Long Pause ,**

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

AT D P 9, 1-800-554-1000

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

### **Wait for Second Dial Tone W**

To wait for second dial tone insert a *W* in the dialing sequence.

```
AT D 9 W 323-8000
```

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

### **Hook Flash !**

To flash the switchboard, insert an exclamation mark in the dialing sequence.

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

This inserts a 0.5 second on hook condition, usually for transferring a call or similar use.

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

### **Switching to Answer Mode after Dialing R**

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

```
AT D 554-2345 R
```

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

### **Remaining in Command Mode ;**

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

```
AT D 234-5678;
```

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

This is used to retain control so that further dialing tones may be entered with the following:

AT DTn; (n= additional tones to be sent)

### **Wait for 5 Seconds of Silence @**

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

AT D 399-4700 @ 2251 ;

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

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

AT D 1400 ;

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

### **Dialing a Stored Telephone Number Sn**

To dial one of the previously stored numbers, enter *Sn* where *n* represents a stored telephone number location between 1 and 9.

AT D S9

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



#### **Note**

*DS and DS1 are the same location.*

### **Autodial Number Location \*AUn**

The *\*AUn* command selects stored number *n* (*n*=1 to 9) to be autodialed. This is the autodial number, which is used for any autodial application.

### **Voice Calls**

To make a voice call, dial the number with the telephone. To use the dial command for the call, enter the following dialing sequence.

AT D (number);



The ; modifier recalls the command mode and prevents the modem from training. The remote site must be answered by the telephone for the voice call to be successful.

### **Switching from Voice to Data**

After dialing, place the modems at both ends in data mode by pressing the TALK/DATA button. The \*DA1 command can also be used to change from talk mode to data mode.

### **ANSWERING A CALL**

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

- Manual
- AT Command
- Autoanswer

The most common is autoanswer.

#### **Manual Answer**

When the phone rings, answer by pressing the TALK/DATA button.

#### **AT Command Answer A**

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

#### **Autoanswer S0**

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

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

When *S0* is one or greater, the modem automatically answers on the selected ring and connects with the calling modem.

 **Note**

*If the modem is set to respond to DTR the DTR signal must be on for autoanswer to work.*

**TERMINAL INTERFACE COMMANDS**

The EIA-232 interface connects the modem and DTE. Terminal interface commands control the action of the modem and the terminal in response to the signals being exchanged on the interface pins. Refer to Table 2-1.

**Data Carrier Detect &C**

When using DCD to indicate a valid carrier, use the *&C1* command. Some terminals and other devices require DCD on in order to communicate with the modem; if so, use the *&C* command.

Command	Operation
&C	DCD always on*
&C1	DCD is on when the modem recognizes remote modem carrier or if enabled when protocol negotiation is complete.
&C2	DCD on except for 5 seconds after disconnect
&C3	DCD follows RTS on remote modem ( <b>simulated switched carrier V.13</b> ).

\* default

*AT&C3* is used to simulate switched carrier operation.

 **Note**

*For simulated switched carrier operation &C3 must be selected on both modems. Not available in the B103 and V.21 modulation modes.*

**Data Set Ready &S**

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

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

\* default

**Data Terminal Ready &D**

In data mode DTR may be used for modem control.

Command	Operation
&D	The modem ignores DTR.*
&D1	The modem goes to command mode from data mode when DTR goes from on to off.
&D2	Disconnects when DTR goes from on to off; disables autoanswer while DTR is off
&D3	Disconnects, recalls command mode, and resets the modem to a stored configuration when DTR goes from on to off  In dial line mode the modem disconnects; in leased line, the modem retrains.

\* default

**Note**

*If DTR controls dialer is selected, then selecting DTR active will cause an autodial after an off-to-on transition of DTR.*

### Serial Port Ring Indicator (Pin 22) \R

The \R commands determines how the ring indicate signal operates on pin 22 of the EIA-232 DTE connector.

Command	Operation
\R	Causes ring indicate signal on pin 22 to turn on (high) during each ring and remain on during the call
\R1	Causes ring indicate signal on pin 22 to turn on (high) during each ring and turn off (low) when the call is answered *

\* default

### Request to Send / Clear to Send &R

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

Command	Operation
&R	Enables RTS to CTS delay
&R1	CTS forced on*
&R2	CTS follows DCD
&R9	CTS equals RTS

\* default



#### Note

*RTS/CTS delay is not valid in buffered mode or with error control enabled.*



#### Note

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

**DTE Controlled Fallback Rate (Pin 23) \*FB**

Pin 23 of the EIA-232 DTE connector provides signal input to the modem for DTE fallback. If the modem is not using DTE fallback, set this option to ignore pin 23. To cause the modem to act on high/low levels of pin 23, enable this option. Negative level forces a higher rate for primary data rate; positive forces a lower rate providing a fallback rate.

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

\* default

**GENERAL COMMANDS**

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

**Changing from Data Mode to Command Mode +++**

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

This sequence temporarily suspends data mode transmissions and allows command mode operations without breaking or otherwise disturbing the telephone line connection. The modem responds with OK when it detects the escape code. Return to data mode by entering the *O* command.

**Note**

*The AT command set must be enabled.*

**Local Character Echo E**

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

If the screen shows *AATT* enter the *E* command to correct the double characters or disable character echo by the modem.

If the screen shows no characters, enter the *E1* command to turn modem echo on or enable local echo on the terminal.

Command	Operation
E	Echo off
E1	Echo on *

\* *default*

### Online Character Echo F

In some lower speed modems the *F* command determines if characters are echoed to the DTE from the modem when online. This function is generally controlled by the communications software. The modem does not support online character echo.

### Hanging Up H, H1

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

Enter the *H1* command to take the modem off hook. The modem automatically goes off hook when a dial command is keyed in.

### Fast Disconnect H2, H3

The results of the *H* command can be modified by the *H2* and *H3* commands. *H2* or *H3* will not cause a hang up but will affect the method of hanging up the next time the *H* command is issued. If *H2* is entered, the *H* command will hang up according to CCITT V.32 standards. If operating in V.32b mode the *H2* command could take several seconds. If *H3* (the fast command) is entered, the *H* command will hang up much more rapidly at those speeds.

Command	Operation
H	The modem hangs up.
H1	Forces modem off hook
H2	Sets H command to normal hangup procedure (long space, clear-down, protocol) *
H3	Sets H command to fast hang up

\* *default*

**EPROM Check I**

PC software packages may issue the *I* command to verify the modem will support all commands needed by the software package. The modem returns ASCII characters representing the model and revision level. To request the checksum to be calculated on the EPROM, enter the *I1* command. The modem returns four ASCII characters representing the CRC in hexadecimal form. Enter the *I3* command to request the product version.

Command	Operation
I	Request product code
I1	Request EPROM checksum value
I3	Request product version
I4	Request capability code
I5	Last disconnect reason

**Speaker Volume L**

The *L* commands offer three volume levels.

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

\* default

**Speaker Control M**

The *M* commands enable or disable the speaker for monitoring purposes.

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

\* default

### Return Online **O**

Use the *O* command when operating in the online command mode and need to return to data mode. It returns the modem to the same mode (originate or answer) that it was in before escaping to the (online) command mode. Enter the *O1* command to cause a retrain to occur before going back to data mode.

### Long Space Disconnect **Y**

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



#### Note

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

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

\* default

### V.22 bis Guard Tones **&G**

Guard tones are not used in the United States. If required where operating the unit, select the appropriate guard tone.

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

\* default



## Asynchronous / Synchronous Mode Selection &M

The *&M* commands select synchronous or asynchronous operation and synchronous dial method.

The *&M* command selects asynchronous data mode.

The *&M1* command selects synchronous data mode 1. Calls are placed asynchronously. Operation switches to synchronous after connecting with the remote modem.

The *&M2* command selects synchronous data mode 2. The modem automatically dials a stored number when it detects a DTR off-to-on transition. DTR must be programmed to be active by the *&D* commands.

The *&M3* command selects synchronous data mode 3. Calls are placed manually.

The *&M4* command selects synchronous data mode 4 with V.25 bis autodialer set for Bisync protocol.

The *&M5* command selects synchronous data mode 5 with V.25 bis autodialer set for SDLC protocol.

The *&M6* command selects synchronous data mode 6 with V.25 bis autodialer set for asynchronous.

Use register *S30* to select NRZ/NRZI for data format if using SDLC.

Command	Operation
&M	Async mode (V.25 bis disabled) *
&M1	Sync mode 1 (AT commands if enabled)
&M2	Sync mode 2 (DTR dials if active)
&M3	Sync mode 3 (manual calls)
&M4	Sync mode 4 with V.25 bis bisync
&M5	Sync mode 5 with V.25 bis SDLC
&M6	Sync mode 6 with V.25 bis async

\* *default*



**Caution**

*Synchronous terminal equipment must be available to communicate with the modem if the V.25 bis dialer is enabled.*

**Make / Break Dial Pulse Ratio &P**

Use the *&P* command for the dial pulse to be on for 39% and off for 61% of one cycle. Use the *&P1* command for the dial pulse to be on for 33% and off for 67% of one cycle.

Command	Operation
&P	39% : 61% US and Canada *
&P1	33% : 67%

*\* default*

**Synchronous Transmit Clock Source &X**

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

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

*\* default*

**V.34 Rate Selection Thresholds \*TH**

The *\*TH* commands sets the V.34 rate selection thresholds. The V.34 modulation dynamically selects the optimum bit rate to run, based on line quality.

Command	Operation
*TH	Low threshold ( $10^{-6}$ BER)
*TH1	Medium threshold ( $10^{-4}$ BER)
*TH2	High threshold ( $10^{-2}$ BER) *

*\* default*

**V.34 Asymmetric Bit Rates \*AS**

The *\*AS* command enables or disables the V.34 Asymmetric bit rate capability. This feature allows the modem to run different bit rates on the receiver and transmitter.

Command	Operation
*AS	Disable V.34 Asymmetric bit rates
*AS1	Enable V.34 Asymmetric bit rates

**Modulation \*MM**

The *\*MM* command sets the current modulation type to use when attempting to make a connection. Using this command automatically selects the maximum DCE speed (*%B*) for the selected modulation.

Command	Operation
*MM	Automode (typically used on dial line)
*MM1	V.21
*MM2	B103
*MM3	Reserved
*MM4	B212A
*MM5	V.22 bis
*MM6	V.27 bis 4-wire leased only
*MM7	Reserved
*MM8	V.29 4-wire leased only
*MM9	Reserved
*MM10	V.33 4-wire leased only
*MM11	V.32 bis
*MM12	V.34

### Maximum DCE Speed %B

The %B commands set the originating DCE speed to follow the DTE speed. When originating a call the two modems will not connect at a speed faster than the lower DCE speed setting of the two modems. To allow the modem to transmit data at a speed different from DTE speed, enter the %Bn command where n=1 to 16.

Command	Operation
%B	Use DTE speed
%B1	300 bps
%B2	1200 bps
%B3	2400 bps
%B4	4800 bps
%B5	9600 uncoded bps
%B6	9600 bps
%B7	7200 bps
%B8	12000 bps
%B9	14400 bps
%B10	Reserved
%B11	16800 bps
%B12	19200 bps
%B13	21600 bps
%B14	24000 bps
%B15	26400 bps
%B16	28800 bps*

\* default



#### Note

The %B command should be used after the \*MM command when specific modulations are required.

**Minimum DCE Speed %L**

If the modem connects at a rate lower than the minimum DCE speed, it disconnects the link automatically.

Command	Operation
%L	Disabled
%L1	Disabled *
%L2	1200 bps
%L3	2400 bps
%L4	4800 bps
%L5	9600 uncoded bps
%L6	9600 bps
%L7	7200 bps
%L8	12000bps
%L9	14400 bps
%L10	Reserved
%L11	16800 bps
%L12	19200 bps
%L13	21600 bps
%L14	24000 bps
%L15	26400 bps
%L16	28800 bps

\* default

**Auto Retrain %E**

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

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

\* default

### Automatic Rate Adaption %R

Automatic rate adaption (ARA) allows the modem to automatically decrease the DCE rate when the allowable bit error rate is exceeded. If condition improves the modem automatically increases the rate.

Select this feature by front panel operation or AT command. Options include disabled (factory default), low (BER= 1 in  $10^5$  ), medium (BER= 1 in  $10^4$  ), high (BER= 1 in  $10^3$  ).

The following apply to automatic rate adaption:

- Automatic rate adaption is disabled during direct mode.
- Manual rate adaption is disabled from the front panel when automatic rate adaption is enabled.
- Only one increment or decrement in the DTE rate is allowed at a time during rate adaption from the initiating modem.
- When online, initiator rate adaption occurs a maximum of every 12 to 14 seconds from the last occurrence of a rate adaption.
- After the modem drops data rate because of poor signal quality, the line must improve by approximately 2.5 dB before an increase in rate can occur.



#### Note

*Automatic rate adaption is disabled during direct mode.*

If automatic rate adaption is enabled, the modem automatically decreases DCE rate if signal quality deteriorates beyond the allowable bit error rate. If signal quality improves, the modem increases DCE speed.

Command	Operation
%R	Disable automatic rate adaption *
%R1	Enable automatic rate adaption using low BER: 1 in $10^5$
%R2	Enable automatic rate adaption using medium BER: 1 in $10^4$
%R3	Enable automatic rate adaption using high BER: 1 in $10^3$

\* default

**Manual Rate Adaption \*RR**

The *\*RR* command forces the modem to re-adapt the DCE rate with the remote modem.

Command	Operation
*RR	Rate adaption to 2400
*RR1	Rate adaption to 4800
*RR2	Rate adaption to 7200
*RR3	Rate adaption to 9600
*RR4	Rate adaption to 12000
*RR5	Rate adaption to 14400
*RR6	Rate adaption to 16800
*RR7	Rate adaption to 19200
*RR8	Rate adaption to 21600
*RR9	Rate adaption to 24000
*RR10	Rate adaption to 26400
*RR11	Rate adaption to 28800

**Product Revision Level %V**

The *%V* command displays the product revision level.

**Online Quick Reference \$H**

The *\$H* command displays an AT command set quick reference. The <return> key terminates the page displays and any other key scrolls through the pages.

Command	Operation
\$H	Displays online quick reference
\$H=<string>	Search online quick reference for string.

**Product Serial Number \$V**

The *\$V* command displays the product serial number.

### Permissive / Programmable %Z

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

Command	Operation
%Z	RJ11 (permissive) *
%Z1	RJ45 (programmable)

\* default



#### Note

Selecting programmable jack (RJ45) without a programmable jack causes the transmit level to be -12 dBm.

### Talk / Data \*DA

The \*DA commands select talk or data mode.

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

\* default

### V.32 Fast Train \*FT

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

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

\* default

### Incoming Call \*IC

The \*IC command causes the modem to disregard an incoming call.



**Line Current Disconnect \*LC**

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

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

\* default

**Disable AT Command Set \*NT**

The \*NT command disables the AT command set.

The \*NT1 command allows the user at a remote modem to enable AT command operation of another modem via remote configuration.

Command	Operation
*NT	Disable AT command set
*NT1	Enable AT command set at remote site *

\* default

If the AT command set of a local modem is accidentally disabled and must be recovered locally, alternate power on and off seven times. The time that power is on must be greater than 1 second but less than 5 seconds. This process loads factory set 1 as the powerup configuration, enabling the AT command set.

**Dial Line Transmit Level \*TDn**

Command	Operation
*TDn	Sets dial line TX level to $n$ where $n$ is a number 9 through 30 corresponding to a TX level of -9 to -30 dBm

## PRIVATE LINE OPERATION



### Note

*For a 2- or 4-wire leased line connection to succeed one modem must be configured as forced answer and the other modem as normal originate. Both modems should have only one protocol, MNP or LAPM, enabled and PROTOCOL FALLBACK must be disabled. DCE line speed must be the same for both modems.*

## 4-Wire Operation

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



### Note

*The V3229, V3227, V3225, and V3257 modems use V.33 as the modulation type. The V.3400 must be set up to V.33 to connect to these modems.*

## 2-Wire Operation

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

### 2-wire Leased Line Operation:

The 2-wire leased line is connected to the AUX jack; the LINE jack connects to a 2-wire dial-up line for dial backup. The leased line connects the local and remote modems directly and dialing is not necessary. One of the modems must be configured for forced answer and the other for normal originate. When connected via leased line the modems will connect and begin communicating with each other.

The `&L` command is used to select Private Line (leased line) operating mode. The `*OR` commands selects the origination or answer mode when operating in the leased line configuration.

**Note**

*DTR must be held high in 2-wire or 4-wire leased line operation. This is accomplished by DTE control, wiring pin 20 of the digital interface cable high, or by selecting the option, IGNORES DTR. If DTR is terminal controlled, loss of synchronization can be corrected by cycling DTR. This causes the modem to initiate the 2-wire training sequence. DSR goes off during the training procedure.*

**2-wire Dial-up Operation:**

Connection to the telephone network is through the LINE jack. A standard telephone can be connected to the AUX jack for manual dialing.

**Dial Backup**

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

- Automatic - backup due to extended loss of carrier or 4 unsuccessful retrains in 3 minutes
- Manual - user determined using front panel controls or AT commands

**Caution**

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

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

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

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



**Note**

*A diagnostic test initiated during dial backup mode terminates when the modem performs a leased line lookback.*

**Dial / Leased Line &L**

&L selects line operation as required:

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

\* default

**Dial Backup \*DB**

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

\* default

**Return to Leased Line from Dial Backup \*LB**

During dial backup operation, \*LB causes the modem to return to leased line operation.

During leased line operation with forced answer enabled, \*LB causes the modem to wait for a dial backup call.

**Manual Dial Backup \*LD**

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

**Answer / Originate \*OR**

\*OR forces the modem to answer or originate mode. This option is used during 2- and 4-wire leased line operation with error correction and/or dial backup.

Command	Operation
*OR	Force originate *
*OR1	Force answer

\* default

**Leased Line Transmit Level \*TLn**

Command	Operation
*TLn	Sets leased line TX level to $n$ where $n$ is a number 0 through 30 corresponding to a TX level of 0 to -30 dBm

## **CONFIGURATION COMMANDS**

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

## **CONFIGURATION PROFILES**

Modem operations are controlled by option settings selected from factory defaults stored in ROM, active settings stored in RAM, and custom settings stored in nonvolatile memory. These three code storage locations are called profiles.

### **Active Profile**

The active profile holds the current option settings and is used by the modem for all operations and functions. Any active profile option can be changed to meet an immediate requirement. The active profile is maintained in volatile memory referred to as S-registers.

### **Stored Profile**

When an active configuration is established that meets all operating requirements, it can be transferred to one of the stored profiles. Two stored profiles are available for greater versatility.

If the active profile has been temporarily changed it can be reset to either of the stored profiles with the *Z* command. The *&Y* command selects one of the two stored profiles to be the powerup profile.

### **Factory Profile**

The factory configurations are stored in ROM and cannot be changed by the user; they can be transferred to the active profile and then modified to fit a specific application if needed. The *&F* command recalls one of the nine factory configurations.

### Storing a Configuration &W

The &W commands store the current configuration options in one of two nonvolatile memory locations (Figure 5-1). The stored configurations are retained in memory even when power is off, or until &W is issued with a new configuration options with a single command.

Command	Operation
&W	Store options to user option set 1 *
&W1	Store options to user option set 2

\* default

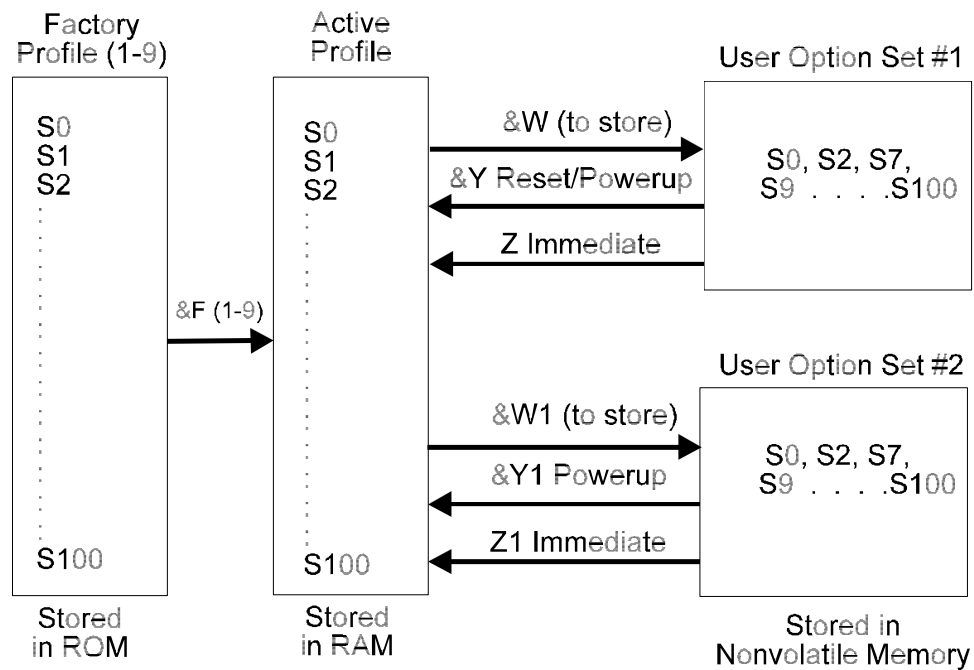


Figure 5-1 Configuration Storage and Recall

### Powerup Option Set &Y

The &Y command determines which user option set is loaded during powerup and reset.

Command	Operation
&Y	Powerup with user option set 1 *
&Y1	Powerup with user option set 2
&Y?	Displays currently selected powerup option set

\* default

### Load Factory Options &F

The &Fn command loads one of the existing configuration sets, providing a complete configuration for a compatible system/network environment. Refer to Appendix E for a complete list of the options in each set.

Command	Operation
&F, &F1	Load factory option set 1 (async dial-up with V.42 bis) *
&F2	Load factory option set 2 (async dial-up without V.42 bis)
&F3	Load factory option set 3 (sync dial-up without V.42 bis)
&F4	Load factory option set 4 (sync 4-wire leased line without V.42 bis)
&F5	Load factory option set 5 (async 4-wire leased line with V.42 bis)
&F6	Load factory option set 6 (async 4-wire leased line without V.42 bis)
&F7	Load factory option set 7 (sync 2-wire leased line normal originate)
&F8	Load factory option set 8 (sync 2-wire leased line forced answer)
&F9	Load factory option set 9 (sync V.25 bis dialer)

\* default



**Reset to Stored Configuration Z**

The Z commands reset the modem and immediately load either user option set 1 or 2 as the current configuration. This command saves time once a proven configuration is established.

Command	Operation
Z	Resets the modem and immediately loads user option set 1*
Z1	Resets the modem and immediately loads user option set 2

\* default

**View Configuration Profiles / Received Signal Options &V**

This command allows the user to view the current configuration profile in the form of S-register values. &V1 displays the received signal options.

Command	Operation
&V	Displays configuration profiles *
&V1	Displays received signal options
&V2	Displays active profile

\* default

**Storing a Telephone Command Line &Z, (\*CN<sub>x</sub>,n), \*ND**

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

Two commands can store phone numbers:

- &Z inserts a phone number in location one only.
- \*CN inserts phone numbers in locations one through nine.

To store a telephone command line in location one enter the &Z command followed by the desired command sequence of digits and modifiers.

AT &Z 554-1212

In this example the command sequence to dial the indicated number is stored at location 1 for later dialing.

 **Note**

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

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

**\*CN<sub>x</sub>,n** - Stores telephone number *n*, including dial modifiers, at location *x* (*x*=1 to 9).

**\*CN<sub>x</sub>**,- Clears telephone number location *x*

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

**Retaining / Restoring Options \*RO**

This option is used when the modem is shared by two or more DTEs.

When options are retained, the current configuration is not altered at disconnect. With options restored, the modem returns to the previously stored configuration on disconnect.

When options are restored at disconnect, the following commands return OK but are not executed:

- \*CN Store telephone number
- &Z Store telephone number
- &F Recall factory configuration
- &W Store current configuration

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

\* default

## REMOTE CONFIGURATION

This mode of operation allows viewing or modifying the options of a remote modem that supports Motorola UDS remote configuration. Remote configuration is performed using the front panel LCD or more commonly AT commands from the local terminal. Remote configuration is initiated by the local (master) modem through a proprietary protocol, a security code, and an acknowledgment from the remote (slave) unit to be modified. The security code is user inserted and provides protection from unauthorized entry. The modems are shipped from the factory without a security code.



### Note

*Remote configuration is supported at all rates except 300 bps.*

## Remote Configuration Security

The correct security code must be received by the remote modem before remote configuration can be established. Once established, the local DTE becomes a virtual terminal and can serve both local and remote modems. After starting remote configuration, the local DTE serves the remote modem.

To return DTE service to the local modem while in remote configuration, issue the +++ escape sequence.

DTE service can again be returned to the remote modem by issuing the *O* command. Switching DTE service between local and remote modems may be performed as needed.

To exit remote configuration, return DTE service to the local modem. The *&T* command will exit remote configuration mode.

Remote configuration may be entered immediately after dialing by placing the remote configuration command (*%T=*), without the = sign and followed by the security code, at the end of the dial string.

## Remote Security Code **%P=**

A security code prevents unauthorized access to remote configuration mode. This code is separate from low and high security passwords, which are discussed under Security in the next section. The security

code is user programmable and can be set to any value from a single 0 to any combination up to 99999999 using the *%P=(desired code)* command.

Example: If the remote modem security code is *12345*, the local modem must include this code in the initialization string before the remote modem responds.

Command	Operation
<i>%P=</i>	Sets security code to a value 0 to 99999999 entered after the equal sign
<i>%P?</i>	Requests local security code to be displayed
<i>%P=D</i>	Access for remote configuration is not possible when security code is disabled
<i>%P=(blank)</i>	Clears security code *

\* *default*

The *%P=D* command disables remote configuration. To enable remote configuration, insert another security code.

### Entering Remote Configuration *%T=, &T*

This mode of operation allows the modem user to view or modify the option set of a compatible remote modem. Enter the *%T= (security code of remote)* command to initiate remote configuration.

The modem is shipped from the factory with security code (*blank*). *This allows remote configuration by using (blank) as the security code.*

Command	Operation
<i>%T=</i>	This command followed by the correct security code establishes remote configuration
<i>&amp;T</i>	Exits remote configuration

Remote Configuration can also be specified by the dial command by placing *%T (password)* after the dial digits (the equal sign is left off).

Example: *ATD 555-1212%T01234*