TOTAL CONTROL™

Total Control
Quad V.34 Modem

REFERENCE MANUAL

U.S. Robotics®
The Intelligent Choice in Information Access

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Skokie, IL 60076-2999

Table Of Contents

About this Guide

This guide serves as a reference for the operation of the modems on the Quad Modem Card. Installation instructions, technical specifications, warranty, and regulatory information for the Quad Modem Card and Quad Network Interface Card (NIC) can be found in the *Quad Modem Card/Quad NIC Hardware Install Guide.* Technical support information is included in the packaging with your modem.

We Welcome Your Suggestions

Every effort has been made to provide useful, accurate information. If you have any comments or suggestions concerning the documentation of this product, please let us know.

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Modem Features

The Quad Modem Card provides four modems on a single card. It is designed especially for use in Total Control chassis. Each modem contains the following features:

Standard Features

- V.34 modulation
- 33.6K bps connections with other U.S. Robotics and compatible modems
- Flash ROM for software upgrades
- Programmable NVRAM for custom default configurations
- V.42, V.42 *bis* and MNP 1–5 error correction and data compression
- Fallforward, fallback, and automatic retrain for speeds above 2400bps
- Link Security
- Remote Access
- Synchronous transmission up to 28.8K bps
- Analog, digital, and remote analog / digital testing
- Class 1 and Class 2.0 Group III fax capability
- Call detection automatically switches between fax and data

T1 Features (Digital and Analog/Digital Models)

- T1 interface with chassis T1 Application Card
- Modem initialization string and DNIS / ANI code storage (3 sets)
- DS0 busy out
- ANI / DNIS code dependent modem configuration
- Supports ground start and loop start supervision and E and M, Type 2

Cellular Features (Cellular Models)

- ETC and MNP10 cellular protocols
- Cellular configuration templates

Compatibility

U.S. Robotics high speed Quad modems adhere to the following standards, ensuring compatibility with a wide base of installed modems.

ITU-T V.34	28.8K / 26.4K / 24K / 21.6K / 19.2K / 14.4K / 12K / 9600 / 7200 / 4800 bps
V.Fast Class	28.8K / 26.4K / 24K / 21.6K / 19.2K / 14.4K bps
V.32 *bis* Plus	21.6K / 19.2K / 16.8K / 14.4K / 12K / 9600 / 7200 / 4800 bps
HST	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
ITU-T V.23	1200 bps with asymmetric channel rates (France)
V.21	300 bps
Bell 208B	4800 bps synchronous, half duplex
Bell 212A	1200 bps
Bell 103	300 bps
V.25 *bis*	Synchronous
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.8	Answer sequence for calls originating in the U.S. and Canada
ITU-T V.25	Answer sequence for calls originating outside the U.S. and Canada
ITU-T V.54	Digital and remote digital loopback testing, analog loopback testing (Analog modems only)

Cellular

AT&T ETC	Cellular protocol for enhanced throughput across cellular links (cellular modems only)
MNP10	Cellular protocol for transmissions across cellular links (cellular modems only)

Fax

Quad fax modems provide Group III-compatibility when combined with a Class 1 or Class 2.0 fax software package, and support 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	14400 / 12000 bps
ITU-T V.29	9600 / 7200 bps
ITU-T V.27 *ter*	4800 / 2400 bps
ITU-T V.21	300 bps

Quad Network Interface Card

A Quad Network Interface Card (NIC) is necessary to provide EIA RS-232 and RJ-11 analog line source connections. Digital only modem cards are not capable of analog line connections, but can be paired with digital only NICs that provide EIA RS-232 connections to a DTE.

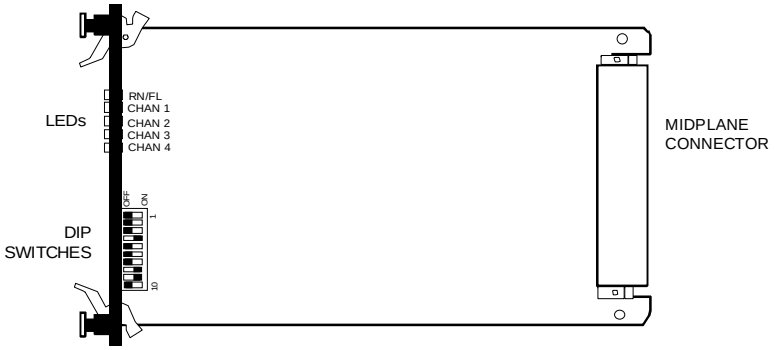
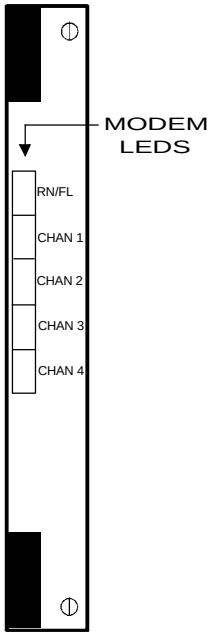


Figure 1. Location of modem DIP switches and LEDs

LEDs



LED	Function
RN/FL	RUN/FAIL Green—normal operation Flashing green—testing/ SDL Red—critical failure
CHAN 1–4	Status for modems 1–4 OFF—modem is idle Orange—off hook/ training Green—online Red—critical failure/SDL

Figure 2. Quad Modem Card Front Panel

DIP Switches

Table 2. Hardware Factory Settings

Switch	Factory Setting	Function
1	**OFF**	**Data Terminal Ready (DTR) 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 (effective when DIP Switch 3 is ON).** OFF Verbal (word) results ON Numeric results
3	**OFF**	**Result Code Display.** OFF Results suppressed (quiet mode) ON Results enabled
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 (CD) Operations.** OFF Sends CD when it connects with another modem, drops CD on disconnect ON CD always ON (Override)
7	**OFF**	**Auxiliary, when DIP Switch 3 is 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 Recognition enabled (Smart mode)
9	**ON**	**Escape Code (+++) Response. Requires DIP Switch 8 to be ON.** OFF Modem hangs up, returns to Command mode, sends NO CARRIER result ON Modem maintains connection, returns to Command mode, sends OK result
10	**OFF**	**Power-on and Reset Defaults.** OFF Load from nonvolatile memory (NVRAM) ON Load fail-safe default configuration template from ROM (&F0)

Chapter 1
Using AT Commands

In addition to instructions for sending AT commands to a modem, this chapter includes the following information:

- How to issue commands while online
- How to dial, answer calls, and disconnect using AT commands

Syntax

The following guidelines apply to all AT commands, except where noted otherwise.

- All commands, with the exception of +++, A>, and A/, use the AT prefix and are executed with a carriage return (Enter). For example, to go off hook with the H*n* command, you would type the following:

  ATH1

  and press Enter.

- A command string may be a maximum of 56 characters.
- Commands may be typed in upper (AT) or lower case (at), but not a combination of both.
- Missing parameters are assumed to be zero (ATH=ATH0).
- A valid command receives the OK response. The ERROR response indicates an invalid command or parameter.

Changing S-Register Settings

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. For example:

ATS11=50

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

ATS1?
ATS27.3?

Bit-Mapped Registers

Some registers are bit-mapped (bits 0–7). To turn on one or more bits in any bit-mapped register, use the total of the values of the bits you want to turn on. For example, to turn on bits 0, 2, and 5, set the S-Register equal to 37 (S*r*=37). To turn on all the bits in a register, set it with a value of 255 (S*r*=255).

Alternatively, you can turn on bits one at a time using the following format: S*r*.*b*=1, where *r* is the register and .*b* is the bit. 1 is ON and 0 is OFF. For example, to turn on bit 3 of Register 27, send the following command:

ATS27.3=1

Sending Commands to the Modem

Setup

In order to use AT commands, you must first establish an EIA RS-232 serial connection with the modem. Use the following steps:

1. Attach the fan cable (included with the NIC) to the DB-50 connector on the back of the NIC (the NIC must be installed in the slot directly behind the modem card). It provides RS-232 ports 1-4 for the corresponding modems at channels 1-4.

2. Connect the COM port of a terminal or a PC running a terminal emulation program (or a communications program in terminal mode) to the corresponding connector on the fan cable using an EIA RS-232 cable. Be sure the terminal or terminal emulation program is properly configured.

   NOTE: Most communications programs send an initialization string to the modem when you load the program. You should remove your software's initialization string so it does not interfere with the modem's power-on defaults.

Typing Commands

After establishing a terminal session with the modem, type AT and press Enter. If you do not see the command on the screen as you type or the OK reply from the modem after pressing Enter, you may need to adjust your modem's settings.

- In order to see AT commands as you type them, Command mode local echo, or local echo, must be enabled (E1).
- In order to see the OK reply from the modem, result codes must be enabled (Q0).

When sending commands to a modem, you can temporarily enable local echo and result codes using the following command:

ATE1Q0

Local echo may be disabled again by resetting the modem or by using the following command:

ATE0Q1

NOTE: The E*n* and Q*n* commands can *not* be saved to NVRAM. Use DIP Switches 3 and 4 on the modem card to change local echo and result code defaults. DIP Switch 4 is factory set to suppress local echo (ON) and DIP Switch 3 is factory set to suppress result codes (OFF), as these functions can sometimes interfere with DTE operations in dial-up applications.

Repeating a Command

The following commands may be used to repeat a command after it has been sent to the modem. Time between re-execution set using Register S8. **Do NOT use the AT prefix or press Enter after typing the command.**

>	Use at the end of a command string to repeat the command continuously until you hit any key.
A/	Repeats last command once.
A>	Repeats last command continuously until you hit any key.

Issuing Commands While Online

Online command mode allows you to issue AT commands while the modem is connected to another modem or DCE. There are two ways to enter online command mode: by using the escape code (+++), or by toggling DTR.

Placing the Modem in Online Command Mode

Using the Escape Code

When DIP switch 9 is ON, the escape code (**+++**) may be used to enter online command mode. Must be preceded and followed by a guard time of at least one second of no data transmission. Do *not* use the AT prefix or press Enter.

- If necessary, change the character used in the escape code (Register S2), or the guard time (Register S12).

NOTE: The modem ONLY enters online command mode in response to +++ if DIP switch 9 is ON.

Using DTR Signaling

The modem enters online command mode during a call when DTR is toggled. DIP Switch 1 is factory set to the OFF position to allow DTR operations. If the setting of DIP Switch 1 has been set to ON, the following AT command can be used to temporarily override the setting of DIP Switch 1 and allow DTR operations:

AT&D1

This parameter must be set *before* going online.

Enter Command Mode After Dialing

To have the modem go into online command mode after dialing (assuming that the modem connects) place a semi-colon (;) after the dial string, as in the following example:

ATDT1(847)982-5092;

Returning Online

Use the O*n* command to return online when in online command mode.

O0 Return online (normal).

O1 Return online and retrain. Use if there were errors in a non-ARQ (no error control) data transfer.

D$ Dial command summary request.

D Dial the number that follows and enter Originate mode.

Optional Dial Command Parameters

Include after D command and before the number to be dialed unless indicated otherwise:

P Pulse dial.

T Tone dial.

NOTE: If the modem is set to X1 or higher, the Adaptive Dialing feature is active—the modem attempts to use tone dialing, and if not supported, reverts to rotary dialing.

/ (Slash) Pause 125 milliseconds. Commonly placed in a dial string to allow for switching from PBX to Telco lines, as in the following example:

```
ATDT9//1/847/9825092
```

, (Comma) Pause for duration set in Register S8 (2 seconds).

; Return to Command mode after dialing.

“ Quote mode. Used to dial letters, as in the following example:

```
ATDT1800"DIALUSR
```

Insert closing quotation marks if additional commands are to follow.

! Transfer a call (flash switchhook). The following example flashes the switchhook, dials the extension “1234,” returns to command mode, and hangs up.

```
ATDT!1234;H
```

W Wait for second dial tone, for example, when dialing for an outside line. Only for use with result codes set to X3 or higher.

@ Wait for an answer. After the modem detects at least one ring, it waits for five seconds of silence at the other end of the call, and then continues executing the Dial string.

If the modem is set to X2 or lower, the command is ignored. If set to X5 or X6, the modem hangs up when it detects a voice answer and sends the VOICE result code.

If the correct conditions don't occur—no rings, or no following five seconds of silence—the modem reports NO ANSWER after the timeout set in Register S7 (default, 60 seconds).

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. The command follows the Dial command, before or after the phone number.

NOTE: To cancel dial command execution, press any key.

Automated Redialing

Use the following commands to automate redialing (for example, for calls that return a busy signal). The modem dials the number, waits the number of seconds set in Register S7 for a carrier (default, 60 seconds), hangs up, and redials after the number of seconds set in Register S8 (default, 2 seconds)

> Use at the end of a dial string to dial continuously until canceled by pressing any key.

ATDT555-5555>

When used in a Dial string, automated redialing terminates after ten attempts.

A> Re-execute the last issued command continuously until canceled by pressing <any key>. Dial strings are re-executed ten times, after which execution terminates. A> doesn't take the AT prefix or a Carriage Return.

To abort automated redialing (> or A>), press any key when the result code appears, during the pause before the modem dials again. If any key is pressed while the modem is dialing, that dial attempt is canceled but the cycle continues.

Using Stored Phone Numbers

Each modem can store up to four dial strings in NVRAM, store the last dialed number, and do an inquiry of stored phone numbers.

The dial string may be up to 40 characters long. The string may include any valid Dial command options, but no other commands.

&Z*n*=*s* Write the following Dial string (*s*) to NVRAM at position *n* (*n* = 0–3).

&Z*n*=L Write the last dialed number to NVRAM at position *n* (*n* = 0–3).

&Z*n*? Display the phone number stored in NVRAM at position *n* (*n* = 0–3).

DS*n* Dial the phone number stored in NVRAM at position *n* (*n* = 0–3).

DL Dial the last-dialed number.

DL? Display the last-dialed number.

Auto Dial

When set for Auto Dial, the modem automatically dials the number stored in NVRAM at position 0.

S13.3=1 Auto Dial on DTR signal
S13.4=1 Auto Dial at power on / reset

Dial Options

See Chapter 6, *Call Control Options.*

Answering

AT Command

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

Auto Answer

The modem is shipped with DIP switch 5 OFF, enabling Auto Answer.

The Register S0 sets the number of rings before the modem answers, as in the following example:

ATS0=3

Setting ATS0 equal to 0 disables auto answer, temporarily overriding DIP switch 5.

NOTE: For additional answer

Answer Options

See Chapter 6, *Call Control Options.*

Disconnecting

AT Command

H*n* On / off hook control.

H0 Hang up (go on hook).

H1 Go off hook. Busy out phone line.

NOTE: ATH1 may be used to busy out a channel (go off hook). Be careful when using this command in a digital (T1) application. Some TELCO Central Offices frown on having digital DS0 channels busied out.

Using the Escape Code

When DIP switch 9 is OFF and the escape code (+++) is sent to the modem, the modem hangs up and sends the NO CARRIER result code. The +++ must be preceded and followed by a guard time of at least one second of no data transmission. Do not use the AT prefix or press ENTER after sending the command.

- If necessary, change the character used in the escape code (Register S2), or the guard time (Register S12).

NOTE: If DIP switch 9 is ON, the modem remains connected and enters online command mode (see *Online Command Mode.*)

WARNING: For unattended modem operations: in rare instances, the modem may fail to recognize the +++ escape code. If the modem is running unattended under software control, we suggest using the surefire method of dropping the RS-232 DTR signal for at least 50 milliseconds to ensure against costly phone charges.

Chapter 2
Inquiries

When an inquiry command is issued, the modem displays information on the terminal screen. The following commands are available.

I0 Display product code

I1 Display results of ROM checksum. Factory testing only.

I2 Display results of RAM test. The modem tests its RAM and returns either the OK (0) or ERROR (4) result code, followed by OK when the test is completed. This can be used as a checkpoint if the modem appears to be malfunctioning.

I3 Display call duration if set to K0 or real time if set to K1 (realtime clock is set using ATI3=HH:MM:SS K1).

I4 Display current modem settings.

I5 Display settings stored in the modem's NVRAM. If your modem connects to a modem that has Link Security and local access enabled, you cannot view the stored phone numbers.

I6 Display link diagnostics. The modem displays a link diagnostic summary of the previous call, including characters transferred, data blocks retransmitted under error control, disconnect reasons, line source, and other information. For an explanation of the results displayed for this inquiry, see *Link Diagnostic Results* on the following pages.

I7 Display product configuration. Displays code date, revision, the slot and channel number of the modem, and other information useful to U.S. Robotics' Technical Support staff in diagnosing problems.

I8 Reserved.

I9 Display standard Feature Group B settings.

I10 View Link Security account status. Unavailable if Local Access security is enabled.

I11 Advanced link diagnostics.

I12 Reserved

I13 MNP10 Diagnostics. Cellular modems only.

I14 ETC Diagnostics. Cellular modems only.

Monitoring Calls Using Inquiry Commands

Besides being used to display information on previous calls, I6, I11, and other diagnostic inquiries can be performed while online to determine speed, modulation, and other performance factors for the current call.

To perform an inquiry while online:

1. Enter online command mode by sending the modem the escape code (+++). See Chapter 1, *Issuing Commands While Online.*
2. Send the modem the desired inquiry command
3. For 2 second incremental updates, type **A>** after sending the inquiry command (see Chapter 1, *Repeating Commands).*

Link Diagnostic Results (from I6)

Some results listed in the I6 display are not self-explanatory and have the following meanings:

Octets: Compressed characters; may be greater than the number of characters sent due to buffering operations.

Line Reversals: The number of times modem in HST mode switched the high and low speed channels.

Blers: Errors in data and protocol (non-data) blocks, but corrected by ARQ (error control).

Link Timeouts: Error correction protocol severed momentarily (during which no data was transferred), but the protocol was able to recover.

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

Data Compression: Indicates the type of data compression negotiated for the call (V42BIS or MNP5) or NONE. A V42BIS response includes the size of the dictionary and the maximum string length used, e.g., 2048 / 32.

Equalization Long/Short: Status of S15 bit 0; long if bit 0=0, short if bit 0=1.

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

Protocol: Indicates the error control protocol negotiated (LAPM, MNP, NONE) or SYNC for a synchronous call.

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

Disconnect Reason.

Possible reasons for disconnect are as follows:

Keypress Abort: The modem detected a keypress while training.

DTR dropped: The DTE dropped the Data Terminal Ready signal, terminating the call.

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

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.

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).

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

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.

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

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

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

Unable to Retrain: After several attempts, disturbances on the phone line prevented the modems from retraining, and they could no longer transmit or receive data.

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.

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

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

Break Timeout: Incompatible processing of a Break signal occurred.

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

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

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

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

Call Teardown: The T1 Card initiated a disconnect.

Link Security Disconnect Reasons

Possible reasons the answering modem may have hung up during a Link 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.

Chapter 3
Result Codes

When enabled, the modem returns result codes to the DTE or terminal display in response to various modem events:

- *Command results* are returned in response to AT commands (OK and ERROR).
- *Call progress reports* are returned during originate and answer modes (for example, RINGING, RING, BUSY, NO ANSWER, and NO CARRIER)
- *Connect messages* are reported when the modem makes a connection. Optional settings allow the basic CONNECT message to be appended with various *indicators* that report connection diagnostics such as the speed at which the modems connect, protocol used, and whether the connection is under ARQ (error control).

A typical use of result codes is for accounting purposes. For example, service providers may charge different rates to callers depending on the speed at which they connect. The result code is used to log the connect speed (9600, 14400, 19200, etc.) and the customer is charged accordingly. The following examples offer additional ways result codes may be used:

- Performance logs. Extended result codes can be used to determine such performance issues as the average connect speed using V.34 modulation. A low average may indicate the need for better phone lines or transmitter level adjustment in the modems.
- Statistics. Using result code logging, an administrator can generate statistics such as the number of callers using V.34 modems or the busiest hours during the work week.
- Alarms. Using connect messages, a system administrator can be alerted to command errors, loss of dial tone, or unusually low connect rates.

Enabling Result Codes

The modems are shipped with result codes disabled. Result codes must be enabled if you plan to monitor calls through a DTE (EIA RS-232) connection.

NOTE: Be aware that there may be some software incompatibility with result codes. You may need to adjust certain settings or contact your software manufacturer for support if you run into problems.

To permanently enable connect messages and result codes, use the following DIP Switches:

DIP Switch 3

ON Result codes enabled.

OFF Result codes disabled.

DIP Switch 7 (applies only when DIP Switch 3 is ON)

ON Enable result codes during originate mode only.

OFF Normal (Result codes during originate and answer).

DIP Switch 2

ON Numeric result codes. Modem result codes are displayed as numbers. For a complete list of numeric result codes, see Table 3-2.

Numeric result codes are followed by a carriage return but no line feed, as in the following example, where a number is dialed and the numeric result code 3 is returned:

ATD5551234

becomes:

3TD5551234

OFF Verbal result codes. Modem result codes are displayed as words. Verbal responses are preceded and followed by a carriage return and line feed.

Temporarily Enabling/Disabling Result Codes

AT commands can be used to override DIP switch settings and temporarily enable / disable result codes. These settings can NOT be saved in NVRAM, and the modem returns to the DIP switch settings at power-on / reset.

Q*n* Enable / Disable result codes

- Q0 Display result codes
- Q1 Result codes suppressed
- Q2 Result codes during originate mode only

V*n* Verbal / Numeric result codes

- V0 Numeric
- V1 Verbal

Result Code Groups

The X*n* command can be used to eliminate software incompatibility with certain result codes. The modem returns only those result codes for a particular group.

X0 Basic group. Returns result codes 0-4, but does not return call progress and connect rates or offer advanced functions.

X1–X7 Extended result codes. See table 3-1.

Table 3-1. Result Code Options

Result Codes	Setting							
	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						•	•	•
12/VOICE						•	•	
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			•		•		•	•

Function Definitions (See Table 3-1)

Adaptive Dialing: The modem first attempts to use tone dialing. If that doesn't work, it reverts to rotary dialing.

Wait for Second Dial Tone: See *D* command, the W option.

Wait for Answer: See *D* command, the @ option.

Fast Dial: The modem dials immediately on dial tone detect, instead of waiting the normal 2 seconds set in Register S6.

Extended Connect Message Indicators

Use the &A*n* command to enable extended connect message indicators. The verbal result code is appended with an indicator according to the settings below. For the numeric result code equivalents, see Table 3-2.

&A0 No additional result code indicators. Use if there is a software incompatibility with these indicators.

&A1 ARQ indicator. Default. If the modem is set to X0, displayed only if the connection is between 1200 and 21.6K bps. At the remaining connect rates, a setting of X1 or higher is required.

&A2 Additional V32/HST modulation indicator.

&A3 Protocol indicator. Reports HST, LAPM, or MNP and V42BIS or MNP5. Also reports SYNC and NONE. There are no numeric result codes for &A3 protocol indicators. When set to &A3, the modem returns the same numeric result codes as &A2.

Additional Options

Disable 250ms Delay Before Result Code

Set Register S13.2=1 to disable the 250-millisecond pause preceding transmission of modem result codes.

Default: S13.2=0 (Enabled)

Unusual Software Incompatibility

Setting Register S27.7=1 can often overcome unusual software incompatibility. This setting disables certain result codes and displays the 9600 code instead.

Default: S27.7=0 (Displays result codes set by X*n*)

Numeric Result Code Equivalents

Table 3-2. Numeric Result Codes

0/ OK
1/ CONNECT
2/ RING
3/ NO CARRIER
4/ ERROR
5/ CONNECT 1200
6/ NO DIAL TONE
7/ BUSY
8/ NO ANSWER
10/ CONNECT 2400
11/ RINGING
12/ VOICE
13/ CONNECT 9600
14/ CONNECT/ARQ
15/ CONNECT 1200/ARQ
16/ CONNECT 2400/ARQ
17/ CONNECT 9600/ARQ
18/ CONNECT 4800
19/ CONNECT 4800/ARQ
20/ CONNECT 7200
21/ CONNECT 12000
22/ CONNECT 12000/ARQ
23/ CONNECT 9600/HST
24/ CONNECT 7200/ARQ
25/ CONNECT 14400
26/ CONNECT 14400/ARQ
27/ CONNECT 9600/ARQ/HST
28/ CONNECT 4800/HST
29/ CONNECT 4800/ARQ/HST
30/ CONNECT 7200/HST
31/ CONNECT 12000/HST
32/ CONNECT 12000/ARQ/HST
33/ CONNECT 9600/V32
34/ CONNECT 7200/ARQ/HST
35/ CONNECT 14400/HST
36/ CONNECT 14400/ARQ/HST
37/ CONNECT 9600/ARQ/V32
38/ CONNECT 4800/V32
39/ CONNECT 4800/ARQ/V32
40/ CONNECT 7200/V32
41/ CONNECT 12000/V32
42/ CONNECT 12000/ARQ/V32
43/ CONNECT 16800
44/ CONNECT 7200/ARQ/V32
45/ CONNECT 14400/V32
46/ CONNECT 14400/ARQ/V32
47/ CONNECT 16800/ARQ
53/ CONNECT 16800/HST
57/ CONNECT 16800/ARQ/HST
83/ CONNECT 16800/V32
84/ CONNECT 16800/ARQ/V32
85/ CONNECT 19200
87/ CONNECT 19200/V32
88/ CONNECT 19200/ARQ
90/ CONNECT 19200/ARQ/V32
91/ CONNECT 21600
93/ CONNECT 21600/V32
94/ CONNECT 21600/ARQ
96/ CONNECT 21600/ARQ/V32
97/ CONNECT 21600/VFC
98/ CONNECT 21600/ARQ/VFC
99/ CONNECT 24000
101/ CONNECT 24000/VFC
102/ CONNECT 24000/ARQ/VFC
103/ CONNECT 26400
105/ CONNECT 26400/VFC
106/ CONNECT 26400/ARQ/VFC
107/ CONNECT 28800
109/ CONNECT 28800/VFC
110/ CONNECT 28800/ARQ/VFC
111/ CONNECT 21600/V34
112/ CONNECT 21600/ARQ/V34
113/ CONNECT 24000/V34
114/ CONNECT 24000/ARQ/V34
115/ CONNECT 26400/V34
116/ CONNECT 26400/ARQ/V34
117/ CONNECT 28800/V34
118/ CONNECT 28800/ARQ/V34
120/ CONNECT 2400/V34
122/ CONNECT 2400/ARQ/V34
124/ CONNECT 4800/V34
126/ CONNECT 4800/ARQ/V34
128/ CONNECT 7200/V34
130/ CONNECT 7200/ARQ/V34
132/ CONNECT 9600/V34
134/ CONNECT 9600/ARQ/V34
136/ CONNECT 12000/V34
138/ CONNECT 12000/ARQ/V34
139/ CONNECT 14400/VFC
140/ CONNECT 14400/V34
141/ CONNECT 14400/ARQ/VFC
142/ CONNECT 14400/ARQ/V34
143/ CONNECT 16800/VFC
144/ CONNECT 16800/V34
145/ CONNECT 16800/ARQ/VFC
146/ CONNECT 16800/ARQ/V34
147/ CONNECT 19200/VFC
148/ CONNECT 19200/V34
149/ CONNECT 19200/ARQ/VFC
150/ CONNECT 19200/ARQ/V34
151/ CONNECT 31200
152/ CONNECT 31200/ARQ
153/ CONNECT 31200/V34
154/ CONNECT 31200/ARQ/V34
155/ CONNECT 33600
156/ CONNECT 33600/ARQ
157/ CONNECT 33600/V34
158/ CONNECT 33600/ARQ/V34

Chapter 4
Stored Configurations

Nonvolatile Read Access Memory

Each modem is equipped with nonvolatile random access memory (NVRAM). A modem's current configuration is stored in NVRAM by issuing the following command:

&W

This overwrites any settings currently stored in NVRAM.

The modems are factory set so that when the modem is powered-on or reset, the NVRAM settings are loaded into active memory. This setting may be changed using DIP switch 10 (OFF=load NVRAM, ON=load factory defaults).

Default NVRAM Settings

Tables 4-1 and 4-2 list the factory default NVRAM settings. These settings are identical to the &F1 template settings.

Table 4-1. Factory Default Settings

NVRAM Options	Setting	Description
Handshake option	B0	ITU-T answer sequence
Error control/sync	&M4	Normal/error control
Data compression	&K1	Enabled
Transmit data flow control	&H1	Hardware flow control enabled
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. Includes all codes except VOICE
Protocol response codes	&A3	Full protocol codes
Tone/Pulse dialing	T	Tone dial
Online local echo	F1	Disabled
Remote Digital Loopback (RDL)	&T4	Grant RDL
Normal/Leased/Cellular line	&L0	Normal phone line
Data Set Ready operations	&S0	Override enabled
Break handling	&Y1	Clear buffer, send immediately
Stored telephone number	&Z0–3=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 command 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.

Table 4-2. Factory Default S-Register Settings

NVRAM S-Register Options (S*r*=*n*)	Factory Setting		
Number of rings to answer, ASCII decimal	S0	=	1
Escape code character, ASCII decimal	S2	=	43
Carriage Return character, ASCII decimal	S3	=	13
Line Feed character, ASCII decimal	S4	=	10
Backspace character, ASCII decimal	S5	=	8
Dial wait-time, sec.	S6	=	2
Carrier wait-time, sec.	S7	=	60
Pause during dial/before repeat, sec.	S8	=	2
Carrier Detect time, 1/10th sec.	S9	=	6
Carrier loss wait-time, 1/10th sec.	S10	=	7
Tone duration, spacing, msec.	S11	=	70
Escape code guard time, 1/50th sec.	S12	=	50
Bit-mapped	S13	=	0
Bit-mapped	S25	=	0
Inactivity/hang up timer, min.	S19	=	0
Received break length, 10-msec. units	S21	=	10
XON character, ASCII decimal	S22	=	17
XOFF character, ASCII decimal	S23	=	19
Duration of pulsed DSR, 20-msec. units	S24	=	150
Minimum DTR recognition time, 10-msec. units	S25	=	5
Delay between RTS, CTS response (sync oper.)	S26	=	1
Bit-mapped	S27	=	0
V.32 handshake time, 10-msec. units	S28	=	8
V.21/V.23 fallback timer, 1/10th sec.	S29	=	20
Unusual software compatibility	S31	=	0
Bit-mapped	S33	=	0
Bit-mapped	S34	=	0
Unusual software incompatibility	S37	=	0
Delay ARQ-call hang-up when DTR drops, sec.	S38	=	0
Transmit level	S39	=	11
Allowable login attempts	S41	=	0
Remote Access ASCII characters	S42	=	126
Remote guard time, 1/50th sec.	S43	=	200
Re-establish leased-line connect, sec.	S44	=	15
Bit-mapped	S47	=	0
Additional answer tone duration, 1/10 sec.	S49	=	16
Billing delay period, 1/50 sec.	S50	=	100
Bit-mapped	S51	=	0
Bit-mapped	S53	=	0
Bit-mapped	S54	=	0
Bit-mapped	S55	=	0
Bit-mapped	S56	=	0
MNP10 protocol options	S60	=	0
ANI digits	S62	=	0
DNIS digits	S63	=	0
ETC maximum link rate	S64	=	0
ETC transmit level	S65	=	0
ETC protocol options	S66	=	0

Customizing NVRAM Settings

To modify the active configuration in NVRAM, type your changes and then save them to NVRAM with the &W command, as in the following example.

AT &K3 X3 S10=40 &A2 T &W

NOTE: Some commands, such as the &C*n*, &E*n*, &Q*n*, and V*n*, share the same function as a DIP switch. These AT commands are used to temporarily override the DIP switch setting until the modem is powered-on or reset. These commands *cannot* be stored in NVRAM, as they would defeat the DIP switch default.

Changing Settings Temporarily

Any setting can be changed just for the current session. You may want to use this feature for experimentation if you are experiencing performance difficulties. If the change doesn't achieve the desired effect, reset the modem (described below) to return it to its previous saved configuration. The example below changes the result code setting, but the power-on / reset default remains intact.

ATX6

Reset Options (Z, S13)

Resetting the modem restores the modem to the configuration saved in NVRAM. You can reset a modem by powering it off and on (removing and replacing it in the chassis), issuing an AT command, or by toggling DTR.

The following AT command resets the modem.

ATZ

If bit 0 of Register S13 is ON (S13 = 1 or greater), the modem automatically resets when DTR drops and the modem hangs up. To enable this feature, issue the following command:

ATS13=1

Optional NVRAM Lockout (Read-Only)

This option makes the NVRAM settings and stored phone numbers read-only. The modem displays these settings and numbers if it is in Smart mode and receives the ATI5 command.

To secure the NVRAM configuration from being changed by unauthorized persons, send the following command:

ATR&W

OK will be displayed. If the &W command is issued a second time, an ERROR message is displayed.

To disable the lockout, making NVRAM programmable by anyone, complete the steps below:

1. Remove the modem from the chassis and set DIP switch 10 ON (load settings from ROM).
2. Re-insert the modem in the chassis until powered on. Send the following command:

   AT&F1&W <ENTER>

3. Remove the modem from the chassis again and set DIP switch 10 OFF (NVRAM settings).
4. Re-insert the modem in the chassis until powered on. The NVRAM feature is disabled and you may now send the modem NVRAM configuration commands.

Configuration Templates

The modems have three permanent configuration templates, which are stored in the modem's ROM.

A template may be loaded into active memory by typing the following command:

AT &F*n*

where &F*n* indicates one of the following templates.

&F0 *Fail-safe template.* This template does not include features such as a fixed serial port rate or hardware flow control. It does offer compatibility with non-typical computers, older equipment, or software that cannot handle flow control and other features.

NOTE: If DIP switch 10 is set ON, the low performance (&F0) template is loaded at power-on or reset.

&F1 *Hardware flow control template (factory default settings).* This template sets the modem to hardware flow control, a fixed serial-port rate, and the highest level result codes.

This template is recommended for all systems and software that support Request to Send and Clear to Send, and a fixed serial port rate.

&F2 *Software flow control template.* This template sets the modem to all of the &F1 defaults except hardware flow control. Instead, it substitutes software flow control (XON / XOFF). Use if your

software doesn't support hardware flow control. Software flow control is not as reliable as hardware flow control.

NOTE: Loading a template into active memory returns *all* the current settings to those defined by the chosen template.

Saving Configuration Templates in NVRAM

Save a configuration template in NVRAM just as you would save any other AT command, as in the following example:

```
AT&F1&W
```

Configuration templates can *not* be customized since they are a part of the modem's ROM. However, a template may be loaded into active memory, modified, and saved to NVRAM. This may be performed with a single command string, as in the following example:

```
AT &F2 &K3 M2 S10=40 &A2 &W
```

Be sure to insert your changes *after* the &F*n* command but *before* &W. Otherwise, the changes will be overwritten by &F*n*.

Initialization Strings

Most communications applications send an initialization string to the modem when you load the program. You may want to modify your software's initialization string to reflect the modem's factory settings. The initialization string that corresponds to each template is as follows:

&F0 AT &B0 &H0 &R1 X1 &A1

&F1 AT &B1 &H1 &R2 X7 &A3

&F2 AT &B1 &H2 &R1 &I2 X7 &A3

Tables 4-3 and 4-4 list the settings of each configuration template.

&F0—Fail-Safe Template

If DIP switch 10 is ON when the modem is powered on or reset, or when you load the fail-safe template (&F0), the following settings take effect. **All other settings are returned to the factory defaults.**

Table 4-3. &F0 Fail-safe Template Settings

NVRAM Options	Setting	Description
Transmit data flow control	&H0	Disabled
Rec'd data hardware flow control	&R1	Disabled
Result code subset	X1	Basic
Error-control response codes	&A1	Enabled
Word length*	7	
Parity*	1	Even
DTE rate* (bps)	9600	_

* Detected by the modem from the AT prefix of the &W command 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.

&F1—Hardware Flow Control Template

The settings for the hardware flow control template are identical to the factory default NVRAM settings. See Tables 4-1 and 4-2.

&F2—Software Flow Control Template

The &F2 template configures the modem with the following settings. **All other settings are returned to factory defaults.**

Table 4-3. &F2 Software Flow Control Template

NVRAM Options	Setting	Description
Transmit data flow control	&H2	Software flow control enabled
Rec'd data hardware flow control	&R1	Disabled
Rec'd data software flow control	&I2	Enabled

Cellular Templates

Three additional templates, &F4, &F5, and &F6, are used for cellular modems. See the cellular section in Chapter 5.

Chapter 5
Special Features

Remote Access

The modem's Remote Access feature allows you to view and configure its settings from across a telephone connection.

Be aware of the following terms used when describing remote access operations:

Host Refers to the modem that will be accessed and controlled by a remote modem.

Guest Refers to the modem that will access and control the host modem. It does not have to be a U.S. Robotics modem.

Host Modem Setup

Step 1—Set Remote Access Security Passwords

- Assign the read-only password, which allows a guest to view settings only. Use the following command:

  AT%P0=[PASSWORD]

- Assign the read / write password, which allows a guest to view and change settings. Use the command format below:

  AT%P1=[PASSWORD]

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

To Display Password. Type %P*n*? where *n* is 0 or 1 to display passwords

To Disable Password Security. If you want to disable an assigned password (and thereby disable remote access security), use the %*Pn*= command to send a blank password, as in the following examples:

AT%P0=

AT%P1=

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

Step 2—Enable Remote Access

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

AT S41=1

Establishing a Session from the Remote Modem

Remote Access can be performed any time during a connection (except synchronous connections).

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, the guest modem sends the host modem the following escape sequence:

   ~~~~

   preceded and followed by four seconds of no transmission. *Do not press Enter*.

   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. The login sequence begins. The guest modem will display something similar to the following:

   ```
   USRobotics Analog/Digital Quad V.34 Fax Remote
   Access Session
   Serial Number 0007940012345678-00
   ```

4. At this point, if password security is active, the caller is prompted for the password.

   PASSWORD (CTRL-C TO CANCEL)?.....

   If the read-only password is used, the guest can only view settings. If the read / write password is used, the guest can also change settings. Note that there is a 3-minute time limit for entering the password.

   If the number of unsuccessful login attempts exceeds the set limit (Register S41), the modem returns online and refuses any further login attempts during the remainder of that connection.

When a password is accepted, the following prompt appears on the guest modem's screen indicating that it has entered remote access mode.

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 send AT commands and receive inquiry displays as if you were connected directly to the modem. If you have read-only privileges, you can use any of the inquiry (I*n*) commands. If you have read / write privileges, you can configure modem parameters.

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+>

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

Remote Configuration Commands

The following commands are only used during remote access.

Configure 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		

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

Ending a Remote Access Session

One of the four commands below can be used to end 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.

NOTE: A remote access session automatically times out after 3 minutes of no activity.

Configuration Control

Use the %C*n* command to defer, restore, or execute remote access configuration changes.

%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 configuration 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.

Remote Access Attempt Limit

Command: S41=n

This function stores the number of login attempts the modem will accept for a remote access session. The default value of 0 disables remote access. If a user exceeds the number of attempts, the normal online session resumes and the user is blacklisted from further remote access attempts for that session.

Settings: 0–255

Default: 0

Remote Access Escape Code

Command: S42

This function stores the ASCII decimal value of the remote access escape code character. The default is the decimal value for the tilde (~). (See *Remote Access Escape Guard Time*.)

Settings: 0..255

Default: 126

Remote Access Escape Guard Time (20 ms)

Command: S43

This function sets the duration, in 20 millisecond increments, of the guard time that the modem requires for the remote access escape sequence. (See Remote Access Escape Code.)

Settings: 0..255

Default: 200 (4 sec.)

Link Security

Link Security is designed to protect networks and data centers from unauthorized access. Unlike other security features based in computer or network software, Link Security is based in the modem's firmware, so security measures are activated *before* callers are allowed any type of access to your computer or network.

WARNING: *Follow the instructions in the order presented.* If you activate Link Security without the proper settings, you risk locking yourself out of your modem.

1. Set the Local Access, Autopass, and Fallback passwords
2. Enable the options you want
3. Enable Link Security
4. Activate Link Security by saving settings to NVRAM and resetting the modem

Step 1—Set Passwords

Set each of the following passwords. Autopass and Fallback passwords may be the same, but the Local Access password should be different. Passwords may be up to 8 characters, and are **CASE SENSITIVE**.

Local Access Password

Set the Local Access password using the following syntax:

AT%L=*password*

Prevents anyone other than the network manager from viewing or changing passwords or otherwise modifying the Link Security account through Remote Access or the modem's RS-232 port.

Autopass Password

Set the Autopass password using the following syntax:

AT%V=*password*

Autopass can only be used by callers with U.S. Robotics modems. The caller stores this password in their modem's NVRAM, and access is granted automatically when they call, without being prompted to enter a password.

Fallback Password

Set the Fallback password using the following syntax. **The comma is required**:

AT%A=*password***,**

Step 2—Enable Options

You may enable any of the following options:

Local Access Protection

Set Register S53.2 to enable Local Access protection.

S53.2=1 Enable Local Access protection

S53.2=0 Disable Local Access protection

Once you have enabled local access protection, the Link Security account cannot be viewed or changed unless you know the Local Access password.

If you want to view or configure the Link Security account after enabling local access protection, you may do so by using the %S command and the Local Access password. This command uses the following syntax:

AT%S=*password*

where *password* is the local access password assigned in Step 1.

After making the desired changes, re-activate local access protection by resetting the modem using the ATZ command.

Dialback Prompting

Can be used to provide an extra layer of security or to reverse charges on a call. After the modem receives the valid Autopass or Fallback password from the caller, the caller is prompted for their modem's phone number. After a one-minute pause, the modem dials back to the caller's modem (Telco policy dictates the one-minute delay).

Use the following syntax to enable or disable dialback prompting. **The comma is required**:

%A=,Y Enable dialback prompting

%A=,N Disable dialback prompting

Fallback Password Prompting

Fallback prompting allows secured access for callers who do not have Autopass, do not have Autopass enabled in their modems, or do not have a U.S. Robotics modem. If the modem does not receive an Autopass password from a caller, the caller is prompted for the Fallback password.

NOTE: If a caller has Autopass, but the Autopass password is invalid, the call is terminated.

Set Register S53.1 to enable Fallback prompting.

S53.1=1 Enable Fallback prompting

S53.1=0 Disable Fallback prompting

Forced Password Prompting

Forced prompting adds an extra layer of security to the Autopass feature. When the modem receives a valid Autopass password from the caller's modem, the caller is also prompted for the Fallback password.

Set Register S53.3 to enable or disable forced password prompting:

S53.3=1 Enable forced password prompting

S53.3=0 Disable forced password prompting

Step 3—Enable Link Security

Set Register S53.0 to enable link security.

S53.0=1 Enable Link Security

S53.0=0 Disable Link Security

Step 4—Activate Link Security

Link Security is not fully active until you store all settings to the modem's NVRAM and reset the modem. Before completing this step, *verify your passwords* to avoid the risk of being locked out of your modem.

a Verify your passwords using the following command:

ATI10

b Use the following command to store settings to NVRAM:

AT&W

c The following command resets the modem, activating Link Security

ATZ

Viewing Account Status

To view account status, use the following command:

ATI10

If Local Access Protection is enabled, the ATI10 command cannot be used unless the %S command has first been used to gain local access to the Link Security account (See *Local Access Protection* in *Step 2* above).

Erasing Account Information

After entering the local access password, use the %E=*n* command to make system edits.

%E=1 Erase local access password.

%E=2 Erase autopass password.

%E=3 Erase the Security account password.

%E=4 Erase account status information.

To edit or overwrite the host Security account, use the %A= command described in *Set Up the Host Security Account* earlier in this appendix.

Cellular

Modems with cellular support can negotiate for either of two cellular protocols: ETC and MNP10. These protocols are designed to combat a variety of link establishment and data transfer problems specific to cellular calls.

NOTE: Cellular features are available only if you purchased cellular support with the Quad modem card or through your chassis NMC. For more information on the purchase of cellular support, please contact your distributor or U.S. Robotics sales representative.

Functional Description

MNP10

MNP10 modifies data transfer techniques for increased reliability over cellular links. It uses three major strategies:

- *Aggressive Adaptive Packet Assembly (AAPA).* Adjusts the data packet size during data transfer in response to line conditions, ensuring the maximum allowable packet size at all times.

- *Link Management Idle (LMI).* Used to monitor line conditions when no data is being sent, and helps guard against lost connections.
- *Dynamic Transmit Level Adjustment (DTLA).* Changes the transmit level "on the fly" to adapt to changing line conditions and determine the best level for a cellular link.

DTLA is necessary only for calls across cellular links. In answer mode, the modem detects when an incoming call is using DTLA, and automatically activates its own DTLA. If you are originating calls from a mobile site (cell side), the modem must be set for *MNP10 Cellular* (S60.3=1) to implement DTLA.

Non-Cellular MNP10 Calls

MNP10 can be negotiated for non-cellular calls, but offers no advantage over other protocols for those calls. MNP10 must be disabled (S60.1=0) to originate calls under V.34, V.FC, HST, or V.32 Terbo.

ETC

When ETC is enabled, the modems recognize calls from other modems using ETC and alter settings for increased performance when transmitting data across cellular links.

ETC requires that the modems establish V.42 error control. ETC also requires a V.32 *bis*, V.32, or V.22-type connection. ETC does not function under V.34 modulation.

The modem uses ETC whenever it answers a call and receives the ETC calling tone. The modem must receive the ETC calling tone from the originating modem. It is the only way for the modem to know that it will be transmitting over a cellular link. If the modem does not receive the ETC calling tone, the call progresses normally without ETC settings.

Originating Non-Cellular ETC Calls

When enabled for ETC, the modem implements ETC settings for *all* outgoing calls. Even if it is not connecting across a cellular link, the modem forces a V.32- or V.22-type modulation and V.42 with a reduced packet size, and will not connect using V.34. It also transmits using de-emphasis and reduced transmit level, which results in reduced throughput or even dropped calls. If the modem is going to be used for originating calls across non-cellular links, we recommend using the *Disable ETC During Originate Mode* setting (S66.7=1).

Cellular Templates

Three cellular templates stored in the modem's ROM allow you to activate ETC or MNP10 with the modem settings that offer maximum performance.

A template may be loaded by using the &F*n* command.

WARNING: Do NOT load cellular templates if you have made special configuration changes to the modem. When you load a template, it overwrites all settings with the modem defaults. Instead, use the AT command string equivalent or configure cellular parameters individually with the settings listed under the appropriate template.

NOTE: Only one template may be loaded at a time. If you wish to activate *both* ETC and MNP10:

1. Load the ETC Cellular Template.
2. Configure the modem with the settings or AT Command String listed for the MNP10 template.

MNP10 Cellular Template

AT Command: &F4

AT Command String Equivalent: ATS60=3

This template includes the following settings:

- **MNP10 Negotiation**
  AT Command: S60.0=1
- **Enable MNP Extended Services**
  AT Command: S60.1=1

ETC Mobile Cellular Template

AT Command: &F5

AT Command String Equivalent: ATS66=103 S7=90 S10=100

Enables ETC when the modem is answering or dialing from a cellular phone. Although the Quad modem is usually not located on the mobile end (cell side) of a connection, you can advise callers to use these settings when placing calls from mobile locations.

Settings for this template are identical to those for the ETC fixed site template (&F6), except for the following setting:

- **Enable ETC Mobile**
  AT Command: S66.1=1

ETC Fixed Site Cellular Template

AT Command: &F6

AT Command String Equivalent: ATS66=101 S7=90 S10=100

This template includes the following settings:

- **Negotiate ETC**
  AT Command: S66.0=1
- **ETC Fixed Site Operations**
  AT Command: S66.1=0
- **Enable ETC Calling Tone**
  AT Command: S66.2=1
- **9600 DCE Startup Rate**
  AT Command: S66.4=0 S66.5=1
- **Wait for Carrier 90 Seconds**
  AT Command: S7=90

  Lengthens the time the modem waits for a carrier to 90 seconds, since modems often take longer to establish a carrier over cellular links.
- **Loss of Carrier Disconnect**
  AT Command: S10=100

  Cellular links frequently receive disturbances that cause extended loss of carrier. This setting lengthens the time before the modem hangs up upon loss of carrier (guard time) to 10 seconds.

MNP10 Parameters

NOTE: All the options listed apply only for MNP10 calls. The settings do not affect normal connections.

MNP10 Negotiation

S60.0=1 Enables MNP10 negotiation.
S60.0=0 Modem does not negotiate for MNP10.

MNP Extended Services

Extended Services (MNPX) allows the modems to negotiate MNP10 as a part of the V.42 negotiation process.

WARNING: If MNPX is disabled, calls from modems using MNPX and V.42 connect without MNP10.

S60.1=0 MNPX Disabled
S60.1=1 Enables MNPX

Disable V.42bis Compression

Used for testing purposes only. With V.42*bis* compression disabled, the modem only negotiates for MNP5 compression, and if unsuccessful, connects without compression. Affects MNP10 calls only.

S60.2=0	Negotiates for V.42*bis* compression
S60.2=1	Disables V.42*bis* compression

MNP10 Cellular

When enabled, Dynamic Transmit Level Adjustment (DTLA) is used when originating calls. Use only when originating calls from the cell side of a cellular link. With the default setting, DTLA is only used when answering calls from across cellular links (if the caller's modem is set for cellular).

S60.3=0	Use DTLA only if caller is using DTLA
S60.3=1	MNP10 Cellular (originate using DTLA)

Force 1200 bps Connection

Used to force a V.22 1200 bps link rate for MNP10 connections. Provides stability and reliability for extremely noisy link conditions.

S60.4=0	Negotiate for highest rate
S60.4=1	Force 1200 bps

Disable MNP10 Fallback

Prevents the modem from falling back to lower speeds during MNP10 connections. Used for testing purposes only.

S60.5=0	Fallback
S60.5=1	Disables fallback

Disable MNP10 Fallforward

Prevents the modem from falling forward to higher speeds during MNP10 connections. Used for testing purposes only.

S60.6=0	Fallforward
S60.6=1	Disable fallforward

Disable MNPX Detection Pattern

Normally, the MNPX detection pattern expedites connections under MNP10 when connecting with other modems that support MNPX. However, the MNPX detection pattern can cause problems when dialing to MNP10 modems without MNPX—they connect, but without MNP10. Disable the MNPX detection pattern if you experience this problem.

NOTE: In answer mode, the MNPX detection pattern should always be enabled.

S60.7=0	Enable detection pattern
S60.7=1	Disable MNPX detection pattern

V.42*bis* Short Form Negotiation Rules

Provides V.42*bis* compatibility when originating to some older MNP10 modems that do not have MNPX capabilities. The short form assumes that the maximum string length is 32 octets and the direction of compression is always bi-directional.

S61=0 Normal V.42*bis* compression
S61=1 Form 1 Code Words 512
S61=2 Form 2 Code Words 1024
S61=3 Form 3 Code Words 2048

ETC Parameters

NOTE: All the options listed apply only for ETC calls. The settings do not affect normal connections.

Enable ETC

Modem uses ETC in response to the ETC calling tone.

S66.0=0	ETC Disabled
S66.0=1	Enables ETC negotiation

ETC Site Operations

Determines whether the modem uses a fixed site or mobile site cellular profile. The cellular profile sets transmit levels based on ETC specifications.

S66.1=0	Fixed site
S66.1=1	Mobile site

Enable ETC Calling Tone

Enable the ETC calling tone when originating calls from the mobile side (cell side) of a cellular link. The calling tone is generated during link establishment, and tells the answering modem to use ETC settings.

Disable the calling tone only if you experience problems when originating calls to non-cellular modems.

S66.2=0	Disable calling tone
S66.2=1	Enable calling tone

Force ETC

Some callers may be using an earlier ETC version that does not generate the ETC calling tone used as of version 1.1. In order for the modem to implement ETC when answering calls from these modems, it must be set to force ETC for every call it receives. (In this circumstance, the system administrator may wish to dedicate some modems for cellular calls only.)

S66.3=0	ETC on calling tone detect only
S66.3=1	Force ETC for all calls

DCE Startup Rate

Some cellular links may be so poor that calls are dropped even before the modems can initialize modulation and error control negotiation. To reduce the number of dropped calls, the modem should be set to a 9600 bps startup rate. The modems negotiate at the lower and more stable link rate, and after the link has been established, raise the link rate to the higher levels afforded by ETC.

S66.4=	S66.5=	Startup Rate
0	0	Auto
1	0	4800
0	1	9600
1	1	*Reserved*

Enable Transmit De-emphasis

Transmit de-emphasis is recommended when connecting over a cellular link, whether the modem is on the fixed site or mobile site. When enabled, transmit de-emphasis is automatically implemented whenever the modem receives an ETC call.

S66.6=0 Disables Transmit de-emphasis
S66.6=1 Enables Transmit de-emphasis

Disable ETC During Originate Mode

This setting disables ETC when originating calls, yet allows it to negotiate ETC in answer mode. If the modem is used to place outgoing calls to non-cellular modems, use this setting to disable V.42ETC during originate mode.

S66.7=0 Originate ETC
S66.7=1 Disable ETC during originate

Set Maximum Link Rate

Prevents modem from connecting or falling forward to link rates higher than that specified. Lowering the maximum link rate to 9600 bps can provide more stability for cellular calls under adverse conditions. However, higher throughput is sacrificed for calls over stronger cellular links that can support higher link rates.

S64=0 Modem selects maximum link rate.

Register S64, settings 4-8
To set maximum rate, see the following table. Selecting values not listed is invalid and leaves the setting unchanged.

Setting	Max Rate
S64=4	4800 bps
S64=5	7200 bps
S64=6	9600 bps
S64=7	12000 bps
S64=8	14400 bps

Set ETC Transmit Level

A reduced transmit level is required for data transfer across cellular links. When ETC is established for a call, the modem automatically reduces its transmit (TX) level to the value specified by this parameter.

With the default setting, the modem sets the TX level according to ETC specifications based on whether it is transmitting over T1 or analog lines and whether the modem is set for fixed site or mobile. We do not recommend changing this setting.

S65=0 Modem controls TX level

S65=*n* TX level fixed to *n* for ETC calls, where *n*=10–25 (negative dBms)

DNIS/ANI/Carrier Access Code

%CN*n*=*s* Sets the Carrier Access Code (CAC) number, where *n* is a position in NVRAM (from 1–3) and *s* is a numeric string containing from 1 to 10 digits. This code allows programming of DNIS (Dialed Number Indicate Service) or ANI (Automatic Number Indicate), a service offered by the TELCO.

%CI*n*=*s* Sets the Carrier Access Code (CAC)-associated initialization string, where *n* is a position in NVRAM (from 1–4) and *s* is a configuration string of up to 30 characters. Do not include the AT attention prefix in the initialization string.

%CN*n*=*s* and %CI*n*=*s* allow the operator to configure a stored initialization string feature in the Quad modems. The first step is to define up to three full or partial telephone numbers that may be dialed to access the modem, using the AT%CN*n*=*s* command. An initialization string (without the AT command prefix) can then be associated with the CAC number by using the AT%CI*n*=*s* command. Four initialization strings may be stored: three of them to match the position of a specified CAC number, and the fourth to be executed if the modem receives an unknown CAC (no full or partial match).

When a call comes in, the Quad modem compares the number dialed against the defined CAC numbers. An initialization string is then used to configure the modem to answer the call.

The CAC numbers defined, with their associated initialization strings, can be viewed by entering the ATI9 command.

The Quad modem identifies the CAC on incoming calls by returning special RING result codes, as follows.

- No DNIS or ANI information received: RING (normal).
- Only DNIS information received: RING/5 (where 5 is the DNIS number).
- ANI and DNIS information received: RING/5/5551212 (where 5 is the DNIS and 5551212 is the ANI).
- Only ANI information received: RING//5551212 (where two slashes indicate no DNIS, and 5551212 is the ANI).

The CAC associated with the last call received is displayed on the current settings screen (obtained by issuing the command ATI4), as follows:

LAST DNIS #: NN. .NN

or

LAST ANI #: NN..NN

Fax Guidelines

Fax operations require facsimile-compatible software. Follow the instructions in the fax software manual.

The modem normally operates in Data mode. Fax software typically switches the modem to Fax mode when the program runs, and resets the modem to Data mode when it exits.

NOTE: Use one of the following AT commands to manually switch modes if there is a problem and the modem is possibly in the wrong mode. Most users will never need to use these commands.

AT+FCLASS=0	(Switch to Data mode)
AT+FCLASS=1	(Switch to Class 1 Fax mode)
AT+FCLASS=2.0	(Switch to Class 2.0 Fax mode)

Type **AT+FCLASS?** to see if the modem is in Data or Fax mode. The modem returns a 0 to indicate Data mode , a 1 to indicate Class 1 Fax, or 2.0 to indicate Class 2.0 Fax mode.

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

Note to Programmers

Lists of supported Class 1 fax commands and optional Class 2.0 commands are in the Technical Specifications in the *Quad V.34 Modem/Quad NIC Hardware Install Guide.*

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

U.S. Robotics 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 and download the file CALLSEL.TXT.

For information on implementing Fax Class 2.0 Call Detection, see the standard listed in the previous section, *Notes to Programmers.* For a list of the optional Fax Class 2.0 commands supported by U.S. Robotics, see the Technical Specifications in the *Quad V.34 Modem/Quad NIC Hardware Install Guide.*

Chapter 6
Modem Parameters

This chapter lists AT commands according to function. These Commands may be alphabetically referenced using the alphabetical command list on the first page of the index.

For instructions on using AT commands, see Chapter 1. For complete instructions on cellular, synchronous, leased line, and link security operations, see Chapter 5, *Special Applications.*

NOTE: The defaults listed are based on the modem's shipping configuration. They are loaded from nonvolatile random access memory (NVRAM), and are equivalent to configuration template &F1. For information about NVRAM and templates, see Chapter 4, *Stored Configurations.*

Help/Command Summary Requests

$	Basic command summary
&$	Ampersand command summary
%$	Extended command summary
D$	Dial command summary
S$	S-Register summary
S*r*?	Display contents of Register *r*

Call Control Options

Answer Sequence/Tone Select.

Command: B*n*

Selects type of answer sequence / tone. ITU-T V.8 / V.25 answer sequence is required to answer all V.32- and V.34-type calls and any overseas calls at 1200 bps and above. Bell answer tone. May be used for connections at 2400 bps and below. Bell 208B is for 4800 bps synchronous mode.

NOTE: Modem uses the V.8 answer sequence and falls back to V.25 if not supported. V.8 can be disabled using Register S54.7.

B0 ITU-T V.8 / V.25 answer sequence
B1 Bell answer tone
B2 Bell 208B 4800 synchronous

Default: B0

Additional Answer Tone Time

Command: S49=*n*

Sets extra answer tone time, in msec., transmitted in answer mode. The modem normally transmits 1000 msec. Allowable values are 0–30, so the answer tone can be increased to 4000 msec. Values greater than 30 are treated as 30. Default is 16 for an answer tone of 2600 msec.

Settings: 0–30

Default: 16

Answer in Originate Mode

Command: S13.1=1

Enables Auto Answer in Originate mode.

Default: S13.1=0 (Disabled)

ARQ Negotiation

Command: &Mn

If set to None, allows async connections without error control. If set to Normal ARQ (default), the local modem attempts to connect under error control, but will connect without if it can't be negotiated. If set to ARQ Only, the local modem attempts to use error correction and hangs up if the remote modem is not using error correction.

&M0 None
&M4 Normal ARQ
&M5 ARQ Only

Default: &M4 (Normal ARQ)

Auto-Dial on DTR

Command: S13.3=1

When enabled, the modem dials the number stored in position 0 of the modem's NVRAM when DTR is toggled.

Default: S13.3=0 (Disabled)

Auto Dial on Power Up

Command: S13.4=1

When enabled, the modem dials the number stored in position 0 of the modem's NVRAM when the modem is powered on or reset.

Default: S13.4=0 (Disabled)

Billing Delay Time

Command: S50=n

Sets the billing delay period, in fiftieths of a second. This defines a period of silence between the time the modem goes off-hook and when it begins the answer sequence.

Settings: 0–255

Default: 100

Blacklist Restriction

Command: S40.1

Used to disable blacklist operation, which sets a limit of 12 failed call attempts in a row. Required primarily for international modems.

Carrier Wait After Dialing (sec)

Command: S7=*n*

Sets the duration, in seconds, that the local modem waits to detect a carrier signal from the remote modem.

Settings: 0–255

Default: 60

Default Phone Number

Command: &Z0=*s*

Stores dial string *s* in the modem's NVRAM at position 0. Used for either the Dial on DTR Active or Auto Dial on Power Up features.

Disconnect/Reset on DTR Drop

Command: S13.0=1

With this setting, the modem hangs up and resets when DTR drops. .

Default: S13.0=0 (The modem does not reset when DTR drops)

DTR Low Before Ready

Command: S27.6

When enabled, the modem requires that DTR go low before it will accept another call. The modem also implements a Fast Connect in Native Mode, which asserts CD before the link negotiation process is complete. This feature is reserved for a private, custom application and is not recommended for general usage.

Idle Time Before Disconnect (min)

Command: S19=n

If the value of this function is set greater than 0, the Inactivity Timer is activated when there is no data activity in either the transmit or receive direction. If no data activity is detected by the timeout period (specified in minutes), the modem hangs up.

Settings: 0–255

Default: 0

Guard tone for 2400/1200 bps calls from overseas.

Command: &G*n*

Sets a guard tone of either 550 Hz (required for some European countries) or 1800 Hz (for UK and some Commonwealth countries). Requires B0 setting (ITU-T answer sequence).

&G1 550 Hz guard tone
&G2 1800 Hz guard tone

Default: &G0 (No guard tone, U.S. and Canada)

MI/MIC Closure for Call Detection

Command: S34.5=1

This setting enables the MI/MIC closure function required for some systems.

NOTE: Not supported by all modems.

Default: S34.5=0 (Disabled)

MNP/V.42 Link Request Timeout (sec)

Command: S52=*n*

This function stores the duration of the timeout, in seconds, when the modem is negotiating an MNP/V.42 link request for 1200/2400 answer mode.

Settings: 0–14

Default: 5

Off Hook Restriction

Command: S40.2

Used to disable off-hook restriction, which controls the pause duration between failed call attempts. Required primarily for international modems.

V.32 300/600 Hz Tone Times

Command: S28=*n*

This function sets the duration, in tenths of a second, of the EIA-specified Multimode Training sequence for V.32 modems, which includes U.S. Robotics Dual Standard modems set to answer V.32 calls (set to B0). The delay gives V.32 modems additional time to connect with most U.S./Canada modems at 9600 bps before falling back to attempt a V.21 connection (to answer overseas calls, 300 bps) or a V.23 connection (some United Kingdom modems, 1200 bps with a 75-bps back channel). The fallback occurs only if the modem is set for V.21 (S27, bit 0 enabled) and/or V.23 (S34, bit 3 enabled).

Settings: 0..255

Default: 8

Rings for Auto Answer

Command: S0=*n*

Sets the number of rings on which to answer incoming calls when the modem is in Auto Answer mode. Setting to 0 or setting DIP Switch 5 ON disables the modem's Auto Answer feature.

Settings: 0–255

Default: 1

Time to Start Dialing

Command: S6=*n*

This function sets the number of seconds the modem waits to dial after detecting a dial tone.

Settings: 0–255

Default: 2

Tone Recognition

Command: %T1

Enables modem, when off hook, to recognize the tone frequencies of dialing modems

Default: %T0

UK Pulse Dialing Make/Break Ratio (&P*n*)

Command: &P1

Set pulse dialing make / break ratio to that necessary for UK and some Commonwealth countries.

Default: &P0 (U.S. / Canada make / break ratio)

V.21/V.23 Fallback Time

Command: S29=*n*

Sets the duration, in tenths of a second, of the V.21 / V.23 fallback timer.

Settings: 0–255

Default: 20

V.23 Call Negotiation

Command: S34.3=1

Allows the modem to negotiate a V.23 connection (used in UK) at 1200 bps after failing to negotiate a higher rate.

Default: S34.3=0 (Disabled)

V.23 Answer Tone Times

Command: S45=*n*

This function sets the duration, in tenths of a second, of the V.23 handshake timer for the multimode training sequence. When set to 0 the V.23 answer tones are disabled, resulting in faster connect times on modems capable of Bell 208B operation. The default setting should be appropriate for most installations.

Settings: 0–255

Default: 20

DTE Interface Settings

Appletalk InterBridge Network

Command: S15.7

This function should be enabled only when connecting with an AppleTalk InterBridge Network

Break Length (10 ms)

Command: S21=*n*

This function sets the duration of breaks, in 10-millisecond increments, sent by the modem to the DTE when in ARQ (error control) mode.

Settings: 0–255

Default: 10

CD State

Command: &C*n*

With CD always ON, CD remains true (high). With the CD on Connect option, the modem asserts CD only when it connects with a remote modem, and drops CD when it disconnects.

NOTE: The &C*n* command only temporarily override the DIP Switch 6 setting until power-on or reset.

&C1 CD on Connect
&C0 CD always ON

Default: DIP Switch 6 OFF (CD on Connect)

CTS Delay after RTS (10 ms)

Command: S26=*n*

Sets the duration, in 10-millisecond increments, of the delay between the DTE's assertion of RTS and the modem's assertion of CTS. This function is valid only for synchronous communications when the Hardware Flow Control parameter is set to CTS Delayed after RTS.

Settings: 0–255

Default: 1

DSR Functionality

Command: &S*n*

DSR signaling is normally overridden (always on). However, some systems require the modem to signal the DTE when the modem is ready to answer a call.

Depending on your system requirements, set DSR functionality to one of the following settings.

NOTE: The duration of pulsed DSR is programmable. See Register S24.

&S0 DSR always ON (DSR normal).
&S1 Modem sends a DSR signal when it detects a modem tone on the phone line.
&S2 On loss of carrier, modem sends computer a pulsed DSR signal and Clear to Send (CTS) follows Carrier Detect (CD). This setting is also required by Smart-mode modems on leased lines (see Appendix B).
&S3 This is the same as &S2, but without CTS following CD.
&S4 DSR follows CD.
&S5 CTS follows CD, with DSR normal.

Default: &S0 (DSR always ON)

DTE Rate Mode

Command: &B*n*

When set to the default, Fixed, the modem automatically sets its port speed to that of the DTE. The modem determines the DTE rate from the speed at which AT commands are sent to it.

NOTE: If your system does not send AT commands, you must manually match the modem's port speed with that of the DTE. This can be done by sending the modem the AT prefix through a communications software set at the port speed of your DTE.

With the Follows Link Rate setting, the modem switches its DTE speed to match the connection (link) rate. This is not recommended for non-ARQ (non-error-corrected) calls.

With the Adaptive setting, the modem's serial port reverts to the fixed mode for ARQ calls, or Follows Link Rate for non-ARQ calls. Requires X1 or higher, &A1 or higher, and that the desired high fixed rate (38.4K, 57.6K, or 115.2K bps) be stored in NVRAM. Set the software to the high rate and send the modem the following command to write the rate to NVRAM.

AT&B2&W

When the modem makes an error control connection, it checks the rate in NVRAM and shifts up to that rate. If the connection isn't under error control, the modem acts as though it were set to &B0 and shifts its serial port rate to match the link rate.

&B0 Follows Link Rate
&B1 Fixed
&B2 Adaptive

Default: &B1 (Fixed)

DTR Response

Command: &D*n*

Sets response to Data Terminal Ready (DTR) signal from the computer (DTE).

NOTE: The &D*n* command only temporarily overrides the setting of DIP Switch 1 until power-on / reset.

&D0 Does not respond to loss of DTR. Behaves as if DTR always ON.

&D1 When DTR is toggled during a call, the modem enters online command mode. Must be issued before connecting. See Chapter 1, *Using Commands While Online.*

&D2 Normal DTR. The computer must provide DTR for the modem to accept commands. Dropped DTR terminates a call.

Default: DIP Switch 1 OFF (Normal DTR)

Escape Code Guard Time

Command: S12=*n*

Defines the guard time, in 50ths of a second, for the modem escape code sequence.

Settings: 0–255

Default: 50 (1 second)

Half Duplex Connection (Local Echo)

Command: F*n*

Defines whether or not the modem sends a local echo of the data transmitted to the DTE during a half duplex connection.

F0 Local Echo ON
F1 Local Echo OFF

Default: F1 (Local Echo OFF)

Pulsed DSR Mode Pulse Length (20 ms)

Command: S24=*n*

This function determines the length of a pulse, in 20-millisecond increments, during which DSR is high, when pulsed DSR mode has been selected.

Settings: 0–255

Default: 150

Link Options

Data Format Requirements

To successfully exchange data, both modems must use the same data format. One Start bit is universal and not programmable. The other allowable options are listed in the following table. Default setting is 8-none-1.

Word Length	Parity	Stop Bits
7	Even, Odd, Mark, Space	1
7	None	2
8	None	1

Line Source.

Command: %D*n*

Use I6 to display current line source (see Chapter 3, *Inquiries*). Standard Analog setting is for analog phone lines through a Quad Analog/Digital NIC. T1/DS0 setting is for a T1 DS0 through a chassis T1 card. T1/PRI is for an ISDN line through a chassis PRI card.

%D0 Standard Analog (POTS)
%D1 T1/DS0
%D2 T1/PRI (ISDN)

Link Rate Setting

Command: &N*n*

&N0 Variable link operations. Default.

The variable link setting negotiates highest possible link rate with remote modem. Recommended setting.

For fixed link rate settings, see the following table. The modem only connects at the fixed rate. Modem hangs up if called or calling modem does not operate at that rate.

NOTE: The link rate should never be fixed higher than the serial port (DTE) rate.

&N1	300 bps	&N2	1200 bps
&N3	2400 bps	&N4	4800 bps
&N5	7200 bps	&N6	9600 bps
&N7	12K bps	&N8	14.4K bps
&N9	16.8K bps	&N10	19.2K bps
&N11	21.6K bps	&N12	24K bps
&N13	26.4K bps	&N14	28.8K bps
&N15	31.2K bps	&N16	33.6K bps

Break Handling Methods

Command: &Y*n*

Selects one of the methods for sending a break to abort a data transfer without disconnecting from the data link.

- Destructive Breaks clear data from the modem's transmit buffer.
- Expedited Breaks are sent immediately to the remote system, ahead of any data currently in the transmit buffer.
- Unexpedited Breaks are sent in sequence with data received from the computer.

NOTE: Under data compression, destructive Breaks cause both modems to reset their compression tables. The tables adapt to allow compression to become increasingly efficient as data is transferred, so resetting the tables temporarily lessens the call's throughput.

&Y0 Destructive, unexpedited
&Y1 Destructive, expedited
&Y2 Nondestructive, expedited
&Y3 Nondestructive, unexpedited

Default: &Y1 (Destructive, expedited)

NOTE: Under data compression, destructive breaks cause both modems to reset their compression tables. The tables adapt to allow compression to become increasingly efficient as data is transferred, so resetting the tables temporarily lessens the call's throughput.

2100 Hz Answer Tone (V.42)

Command: S27.3=1

This setting allows the operator to disable the 2100 Hz answer tone, allowing V.42 modems to connect more quickly and / or eliminating problems with older 2400-bps modems that do not recognize this tone.

Default: S27.3=0 (Enable)

Carrier Receive Delay (.1 sec)

Command: S9=*n*

This function sets the duration, in tenths of a second, that the remote modem's carrier signal must be present before the local modem recognizes the signal. Ignored at speeds above 2400.

Settings: 0–255

Default: 6

Delay from CD to RX (.1 sec)

Command: S35, S27.6

When S35 is set to a number greater than 0, and the Custom Connect / Disconnect Mode is enabled (S27.6=), the modem inserts an RX character transmission delay. The number selected for the delay represents 10 millisecond units between CD and the first received character. This feature is reserved for a private, custom application and is not recommended for general usage.

Settings: 0..255

Default: 0

Dial Pause Delay (sec)

Command: S8=*n*

This function sets the duration, in seconds, for the pause (,) option in the Dial command (ATD) and for the pause between dialing attempts with automatic redialing (> or A>) commands.

Settings: 0–255

Default: 2

Loss of Carrier Disconnect (.1 sec)

Command: S10=*n*

This function sets the duration, in tenths of a second, that the modem waits after the loss of the remote modem's carrier signal before hanging up. This setting allows the modem to distinguish between a momentary lapse due to line quality and a true disconnect by the remote modem.

If this value is set to 255, the modem does not hang up on loss of carrier. It hangs up only when DTR is dropped or if it receives the +++ escape code sequence and returns to command mode. **NOTE:** The exact action taken by the modem on receipt of the escape sequence depends on the setting of the Response to +++ parameter. When Response to +++ is set to Ignore or Enter Online Command Mode, the ATH command must be used to hang up the modem.)

Settings: 0–255

Default: 7

Transmitter Level Adjustment

Command: S39=*n*

NOTE: Transmitter level normally does NOT need adjustment.

Transmitter level has a possible range of -9 to -20 dBm for analog line sources and -3 to -30 dBm for digital T1 line sources. The default setting of -11 dBm (S39=11) provides optimal performance for most analog line sources. A setting of -13 dBm (S39=13) is recommended for calls over digital T1 or PRI lines.

Default: S39=11

Transmitter Disable

Command: C*n*

This function allows you to disable the modem's transmitter. When two DTEs and modems share a phone line for monitoring, the transmitter of the second modem must be disabled. This feature should be used only at 1200 or 300 bps.

C0 Disable
C1 Enable

Default: C1 (Enabled)

Tone Dial Timing (ms)

Command: S11=*n*

This function sets the duration and spacing, in milliseconds, of dialed touch tones.

Settings: 0–255

Default: 70

Flow Control

NOTE: Hardware flow control is recommended since it does not affect the data stream. With software flow control, there is the possibility of characters in the data stream being confused with the control characters (XON / XOFF) being sent by the modem. Some file transfer protocols also use characters that can be interpreted as software flow control characters.

Transmit Data Flow Control

Controls data flow from the computer (or DTE) to the modem. Necessary when the modem is receiving data from the computer at a higher rate than it can transmit it over the phone line.

The modem uses either hardware (CTS) or software (XON / XOFF) to signal the computer to stop or start sending data. This setting should match the setting of your communications software.

&H0 Transmit Data flow control disabled.
&H1 Hardware (CTS) flow control enabled.
&H2 Software (XON / XOFF) flow control enabled.
&H3 Hardware and software flow control enabled.

Default: &H1

Transmit Data Buffer Sizes

The size of the Transmit Data buffer depends on whether or not the connection is under error control (ARQ).

ARQ connections: 3.25 Kbytes.

Non-ARQ connections: 1.5 Kbytes, allowing error control file transfer protocols such as XMODEM and YMODEM to be used without flow control.

If bit 3 of Register S15 is turned ON, the non-ARQ buffer size is reduced to 128 bytes, for the convenience of remote users of slower modems. Limiting the buffer size allows these users to send an XOFF to the remote

DTE without causing the data already in transit or in the modem's buffer to exceed the size of their screens. See Register S15.

Received Data Flow Control

Controls data flow from the modem to the computer (or DTE). The computer uses either hardware (CTS) or software (XON/XOFF) to signal the modem to stop or start sending data. Use of received data flow control is optional for most types of connections. For example, there may be a need to signal the modem to temporarily stop passing data to read what's on the screen.

Hardware and software received data flow control options are set using separate commands. As explained in the note at the beginning of this section, hardware flow control is recommended whenever possible.

Software Received Data Flow Control

&R0 Delay between DTE's RTS signal and the modem's CTS response; duration set by Register S26. Used for synchronous calls.

&R1 Ignore RTS. Required for systems that do not support RTS.

&R2 Enable received data hardware flow control. Received data sent to computer only when RTS is high; used only if computer supports RTS.

Default: &R2

Hardware Received Data Flow Control

&I0 Software flow control disabled.

&I1 XON/XOFF to local modem and remote computer. Use with ARQ connections only.

&I2 XON/XOFF to local modem only. Use with ARQ connections only, recommended over &I1. For non-ARQ connections, use &I5.

&I3 Host mode, Hewlett Packard protocol. Use this setting if the modem is attached to a Hewlett Packard Host computer using the ENQ/ACK protocol, and the remote DTE is an HP terminal that recognizes the ENQ/ACK exchange. Use in ARQ mode only. The modem's Transmit Data flow control setting must be either &H0 (disabled) or &H1 (hardware control).

&I4 Terminal mode, Hewlett Packard protocol. Use this setting if the modem is attached to a Hewlett Packard terminal. This setting implements the Hewlett Packard ENQ/ACK protocol when the remote DTE is an HP Host. Use in ARQ mode only. The modem's Transmit Data flow control setting must be either &H0 (disabled) or &H1 (hardware control).

&I5 Same as &I2 during ARQ connections. When used with non-ARQ connections, acts on XON/XOFF signals from the remote computer.

Default: &I0

Decimal XOFF Flow Control Character

Command: S23=*n*

This function stores the ASCII decimal value of the XOFF character.

Settings: 0–255

Default: 19

Decimal XON Flow Control Character

Command: S22=*n*

This function stores the ASCII decimal value of the XON character.

Settings: 0–255

Default: 17

Error Control

Error control is required for data compression and recommended for all calls above 2400 bps.

Cyclic redundancy checking is used to detect errors. An automatic repeat request (ARQ) is issued when a corrupted data frame is detected, and the data frame is retransmitted. The term ARQ is used to denote error control in U.S. Robotics error control commands and response codes.

A data frame may be retransmitted a maximum of twelve times, after which the modem aborts the call. Disconnection from retry time-out only occurs under serious line disturbances.

Error Control Disable

Command: &M0

Disables error control. Not recommended for calls above 2400 bps.

Default: &M4 (Enabled)

Error Control Only

Command: &M5

Use this setting to guard against the transfer of data at high speeds without the reliability of error control. Modem hangs up if ARQ connection cannot be made.

Default: &M4 (will establish non-ARQ call)

Special 2400 bps MNP

Command: S15.6=1

This setting is used to enable connections with older, non-U.S. Robotics 2400 bps modems that are not fully compatible with the MNP protocol.

Default: S15.6=0 (Standard 2400 bps MNP)

V.42/MNP Negotiation Method

Command: Registers S27.4 and S.27.5

This determines the error control handshaking mode.

When set to disable either V.42 or MNP, the modem will only attempt to negotiate the enabled protocol.

If you know the remote modem does V.42, set to Disable Detection Phase. The V.42 detection phase is skipped during the handshaking process, allowing for a faster connection.

Settings: See table below

S27.4=*n*	S27.5=*n*	Result
1	0	Disable MNP
0	1	Disable V.42
1	1	Disable Detection Phase

Default: Complete handshaking sequence (.4 and .5 = 0)

ARQ Buffer Timing

Command: S38=*n*

This sets the duration, in seconds, before a forced hang-up and clearing of the Transmit buffer when DTR drops during an ARQ call. This allows time for a remote modem to acknowledge receipt of all transmitted data. If the modem is in Smart mode and receives the ATH command to hang up, it ignores the S38 setting and hangs up immediately.

Settings: Integers

Non-ARQ Transmit Buffer Size

Command: S15.3=1

This setting reduces the size of the non-ARQ mode Transmit buffer to 128 bytes. The smaller value is designed for bulletin boards, to accommodate callers with slower modems so that they can control received data scrolling up and off the screen.

NOTE: The default 1.5K byte non-ARQ buffer allows data transfer with X- and Y-MODEM-type file transfer protocols without using flow control.

Default: S15.3=0 (1500 byte non-ARQ transmit buffer)

Selective Reject

You may notice significant throughput improvements over noisy lines when connecting with other modems using this feature. Selective reject allows the modems to re-transmit only those blocks that contained errors, rather than having to re-transmit data that was successfully transmitted during the time between when the block was sent and when it was detected as having been corrupted.

Selective reject can be disabled by issuing the following command:

AT S51.6=1

Disabling this feature is only necessary for certain troubleshooting purposes.

Data Compression

Data Compression Mode

Command: &K*n*

When compression is enabled, the modem negotiates for V.42 *bis* first, and if unsuccessful, tries for MNP level 5 data compression.

NOTE: Compression does not occur unless the modems are able to establish an error control (ARQ) connection.

The Auto Enable setting disables compression if the DTE rate matches the connection rate (if the modem is set to &B0), as compression offers no advantage if the DTE rate is not higher than the link rate.

The Enable option allows data compression regardless of the modem's DTE rate.

The MNP level 5 Disabled setting allows V.42 compression only. For use when transferring compressed files. MNP level 5 compression is not

useful when transferring files that are already compressed because it tends to add data to the transmission so that throughput over the link degrades. V.42 *bis* only compresses data when compression will yield an advantage.

&K0 Compression Disabled
&K1 Auto Enable
&K2 Enable
&K3 MNP level 5 Disabled

Default: &K1 (Auto Enable)

Appendix A
Synchronous Operations

Synchronous data is not formatted with start/stop bits. Instead, the flow of data is governed by the precise timing of transmit and receive clocks at both ends of the link. Transmit and Receive synchronous timing is implemented through RS-232 pins 15 (internal DCE transmitter clock), 17 (DCE receiver clock) and 24 (external DTE transmitter clock).

There are two ways the modem can operate in synchronous mode:

- Selecting the ITU-T standard V.25 *bis* protocol, which formats data in HDLC or character-oriented frames. This method is used by mainframe operators and synchronous terminal users.

  V.25 *bis* acts as an interface between the mainframe and modem, sending synchronous responses between the modem and the mainframe. An asynchronous device or a "dumb" terminal is used to configure the modem before it dials out in synchronous mode.

- Dedicating a PC as a synchronous device by installing the proper hardware and software so it can communicate with a mainframe. The modem is configured and dials out in asynchronous mode, then switches to synchronous mode once a connection is made.

  NOTE: HST modulation is not supported for synchronous communications.

General Requirements

Modems in asynchronous mode adapt to many conditions of remote asynchronous modems. But synchronous connections to a mainframe require strict adherence to specific operating parameters. If you are operating a terminal designed for a particular network, you probably need only set the modem properly before calling or answering.

The EIA RS-232 Interface

Transmit and Receive synchronous timing pins are required at the EIA RS-232 interface. You'll need either pin 15 or pin 24 for Transmitter timing signals, depending on whether the modem (pin 15) or the DTE (pin 24) generates the signals. You'll also need pin 17, for Receiver timing signals. If you're building your own cable, review the RS-232 Interface in the *Quad V.34 Modem/Quad NIC Hardware Install Guide.*.

Protocol Compatibility

The devices at both ends of the link must use the same protocol. These protocols format data into blocks or frames and add control information.

If the modem is in V.25 *bis* mode, the link protocol must be HDLC (High-Level Data Link Control), or character-oriented. If the modem is in Online Synchronous mode it may use HDLC, character-oriented, or another protocol determined by the mainframe manufacturer.

*Data Rate Synchronization (&X*n*)*

During synchronous operations, transmit and receive clocks at both ends of the phone link control the precise timing of the data flow. The communications equipment at the remote DTE and your modem and DTE must all handle the data at the same speed.

The transmit clock timing signals setting, &X*n*, determines whether the modem or DTE will generate the timing signals. For Online synchronous operations, the source for this setting must be the same on both systems. For V.25 *bis* operations this is not necessary. See *Connection Rates (%Nn, &Nn)* later in this appendix.

Most Online synchronous users will require the default setting, &X0. The &X1 and &X2 settings are only valid for the Quad Analog Modem and the Quad Analog / Digital Modem in analog mode.

&X0 The modem is the source of the Transmit clock timing signals and sends them to your DTE over the RS-232 interface. The DTE rate will follow the connection rates. Default.

&X1 The DTE is the source of the Transmit clock timing signals and sends them to the modem over the RS-232 interface. This setting is used typically in leased line multiplexed operations. (Multiplexors divide the phone channel so that the channel carries several calls at the same time.)

The DTE ignores the modem's clock timing signals and negotiates the DTE and connection rates.

&X2 The modem's Receiver clock is the source of the timing signals. The signals are looped to the Transmit clock and sent to your DTE over the EIA RS-232 interface. This setting is only used in those systems that require synchronization of data flowing in both directions.

V.25 *bis* Requirements

V.25 *bis* is an ITU-T standard that uses the HDLC or character-oriented protocols to format data.

Before you attempt to connect to a synchronous network, you must configure the modem in command (asynchronous) mode by using either an asynchronous device or dumb terminal. Once the modem is in synchronous mode, it no longer accepts asynchronous commands.

Commands begin with a required AT prefix and end with a required Carriage Return, which we denote with the symbol <Enter>. For example, the following command causes the modem to disable flow control, pause between RTS and CTS, set the modem to send the DTE the DSR signal after detecting CD, select character-oriented as the synchronous link protocol, and save the settings to NVRAM. Spaces have been added only for readability.

AT &I0 &H0 &R0 &S4 &M6 &W

Be sure that DIP switch 10 is OFF so that the modem loads the settings you've stored in nonvolatile random access memory (NVRAM) when it powers on. Until you customize your own settings, the settings in NVRAM are the same as the factory defaults.

Connection Rate (&Nn, %Nn)

There are three phases to obtaining and maintaining a connection rate during synchronous communication.

Clock Speed Control

The first phase is in deciding where the clock speed will be determined. (See *Data Rate Synchronization*, above.)

Offline Host/Modem Clock Speed

The second phase involves the data rate between the host computer or terminal and its modem during offline mode. The %N command is used to set the clock speed between the modem and host, but this speed is only during offline mode, before the synchronous connection is made.

The %N*n* command works with &X*n*. If the modem is set so that it is the source of the Transmit clock timing signals (&X0—default), the %N*n* commands set the computer or terminal-to-modem V.25 *bis* clock speed. If the modem is set to &X1, the computer is the source of the Transmit clock signals.

If %N*n* is set to 0 or 1, you will receive an error message, since they are not valid values. The %N*n* rates are as follows:

%N0	Reserved	%N8	14.4K bps
%N1	Reserved	%N9	16.8K bps
%N2	1200 bps	%N10	19.2K bps
%N3	2400 bps	%N11	21.6K bps
%N4	4800 bps	%N12	24K bps
%N5	7200 bps	%N13	26.4K bps
%N6	9600 bps	%N14	28.8K bps
%N7	12.2K bps		

Online Connection Rate

The &N command sets the data rate during the synchronous connection.

If &N*n* is set for 2–10, the modem ignores the %N*n* rate and follows the &N*n* rate to set the Online connection rate. The &N*n* rates are as follows:

&N0	Variable (default)	&N8	14.4K bps
&N1	Reserved	&N9	16.8K bps
&N2	1200 bps	&N10	19.2K bps
&N3	2400 bps	&N11	21.6K bps
&N4	4800 bps	&N12	24K bps
&N5	7200 bps	&N13	26.2K bps
&N6	9600 bps	&N14	28.8K bps
&N7	12K bps		

Recommended Settings

When the connection is made and the data rate is determined, host/modem rates may change dramatically to match the connection rate (when in online synchronous mode, the modem is transparent on the line). To avoid this dramatic rate switching, we recommend that the modem be set with a fixed rate between the computer or terminal and modem (%N*n*) and that the connection rate (&N*n*) be set to the same rate.

Result Codes (Xn)

The modem displays normal or extended synchronous result codes, depending on the setting of the X*n* command. The modem displays extended result codes if X = 1–7. By default, the modem is set to X7. To change to normal result codes, set the modem to X0.

The normal result codes return messages such as VAL or INV (VALID or INVALID), whereas the extended codes offer explanations—INVPS (INVALID Parameter Syntax Error).

Automatic Answering (S0=1)

When the modem is operating in V.25 *bis* mode, it ignores the DIP switch 5 setting, which controls Auto Answer. To set the modem to automatically answer incoming calls, set the modem to S0=1, so it answers on the first ring. You can substitute a higher value. See the S-Register summary in Chapter 3.

Suppressing Auto Answer

To disable Auto Answer, set the modem to answer on zero rings, S0=0.

Choosing a Synchronous Protocol (&Mn)

Once the &X*n*, %N*n*, &N*n*, X*n*, S0 commands are configured, you must use the &M*n* command to choose the HDLC or character-oriented link protocol so that your synchronous software can properly format its commands.

&M6 Use the character-oriented protocol for synchronous communications.

The local and the remote modem must use the same eight-bit data format. The character length must be 7 bits and either ODD or EVEN parity (ODD is preferred), or 8 bits and NO parity.

&M7 Use the High Level Data Link Control (HDLC), a ITU-T standard, for synchronous communications. HDLC ignores parity.

V.25 *bis* Commands and Result Codes

Supported V.25 *bis* commands and result codes are listed in the technical specifications section of the *Quad V.34 Modem/Quad NIC Hardware Install Guide*..

Hanging Up

The modem remains online until the remote disconnects or the local DTE drops DTR. This is normally done with software.

Returning to Asynchronous Mode

Once you've completed a communication session, you can switch between synchronous and asynchronous modes by flipping DIP switch 10 OFF (factory settings, asynchronous mode) and then ON (NVRAM settings, synchronous mode if the modem is set to &M6 or &M7). Use the hardware flow control initialization string found in Chapter 4 to maintain your modems' high performance.

The modem cannot switch between synchronous and asynchronous while it is connected.

Online Synchronous Requirements

When the modem is set to Online Synchronous mode, it remains in command (asynchronous) mode until it makes a synchronous connection with a remote modem. Upon connection, the modem enters synchronous mode and sends synchronous timing signals to your DTE.

Setting the Modem

Because the modem will not accept commands when it is in synchronous mode, you will have to configure it in asynchronous mode before trying to connect to a synchronous network.

NOTE: Be sure that DIP switch 1 is OFF (factory setting). The Data Terminal Ready (DTR) override must be OFF so that the modem detects when the DTE raises and lowers the DTR signal.

For example, the following command causes the modem to set the modulation, the connection rate, and choose a timing source. Spaces have been added only for readability.

AT B0 &N0 &X0

Modulation/Connection rate (Bn, &Nn)

Use the following guidelines for your modem type.

If the modem is connecting with another U.S. Robotics modem, try setting both modems to B0 and to a variable connection rate, &N0. The modems should connect at the highest possible rate.

If the variable connection rate doesn't work, try a fixed connection rate such as &N6 (9600 bps) or &N3 (2400 bps).

NOTE: HST modulation for synchronous communications is not supported.

NOTE: If your modem is set to a fixed rate, and the remote modem is not set to the same rate, your modem hangs up.

Connection Rate (&Nn)

Use this command to set variable or fixed rates at the link interface. The default is &N0, variable rate. The local modem negotiates with the remote modem for the highest possible connection rate, depending on the capabilities of the remote modem. If &N0 does not work, try a fixed rate.

NOTE: The modem is not capable of connecting at 21.6K bps in synchronous mode.

When you set the modem to a fixed rate it will only connect if the remote modem is operating at the same rate. If not, your modem hangs up.

The fixed rate options are as follows.

&N0	Variable (default)	&N8	14.4K bps
&N1	Reserved	&N9	16.8K bps
&N2	1200 bps	&N10	19.2K bps
&N3	2400 bps	&N11	21.6K bps
&N4	4800 bps	&N12	24K bps
&N5	7200 bps	&N13	26.2K bps
&N6	9600 bps	&N14	28.8K bps
&N7	12K bps		

Generating Clock Timing Signals

The &X*n* setting specifies whether the modem or your DTE generates the Transmit clock timing signals for a synchronous call. Most users will require the default setting, &X0. See *Data Rate Synchronization (&Xn)*, earlier in this appendix, for more information.

Dialing Out

If the installation has a computer capable of switching between synchronous and asynchronous modes, a standard Dial command can be issued when the modem is configured for synchronous mode. The modem does not enter synchronous mode until the connection is established.

In many synchronous applications, however, the user's host port does not have the ability to switch to asynchronous mode. If this is the case, connect the modem to a computer that is capable of asynchronous operations, and store a number to be autodialed at a later time.

First store the phone number of the synchronous modem to be called at position 0 in nonvolatile memory (NVRAM). Use the &Z*n*=*s* command, where *n* is the position in NVRAM and *s* is the phone number. The modem assumes *n* to be zero if it is omitted, as in the following example: AT&Z=5551234.

The stored number can be dialed in two ways: both require modifying the value of Register S13. Include the S13 setting in the same command string that initiates synchronous mode. Once the value of S13 has been changed, the modem dials the stored number when the appropriate event occurs, as follows.

Setting	Effect
S13=8	The modem dials the number stored in NVRAM at position 0 when the DTE raises the DTR signal.
S13=16	The modem dials the number stored in NVRAM at position 0 when it is powered on (that is, when the modem is pulled out from the rack and re-inserted).

Answering

The modem must be in Answer mode, DIP switch 5 OFF. Follow the instructions in the next section on issuing the &M1 command.

Initiating Online Synchronous Mode

The modem enters synchronous mode on receipt of the &M1 command. If the modem is to dial out, first store the number to be called in NVRAM as described previously under *Dialing Out*. Then set the modem for synchronous operation in a single command string, as follows.

AT S13=8 &N8 &M1

- The AT prefix is required.
- S13=8 instructs the modem to dial the phone number stored in NVRAM at position 0 when the DTE raises the DTR signal.
- &N8 optionally fixes the link rate at 14.4K bps (read the previous guidelines before doing this).
- &M1 instructs the modem to enter synchronous mode.

Hanging Up

The modem remains online until the remote modem disconnects or the local DTE drops DTR.

Testing and Inquiry Commands

The modem testing commands, &T*n*, and inquiry commands, I*n*, cannot be used when the modem is operating in synchronous mode.

Bell 208B Operations

The Bell 208B standard defines a modulation scheme for 4800-bps, half-duplex, synchronous data transmission. The Quad modem can be set to use Bell 208B modulation exclusively, or add Bell 208B modulation to the other modulations it attempts when negotiating with a remote modem.

If you leave the modem set for V.34 and enable the Bell 208B Multimode Handshake (with Register S31, described later), the modem can connect using Bell 208B modulation. This allows all available modulation schemes, although it takes slightly longer than if the modem uses Bell 208B exclusively.

Operation with Total Control

This modem is compatible with Total Control (U. S. Robotics' modem management system), and can be configured and monitored using either *Total Control PC* or *Total Control Manager/SNMP* software. For software equivalents to the AT commands and S-Register settings described here, see the respective software manuals.

AT Commands

B2 To set the modem to connect **only** with remote Bell 208B modems, this command selects the Bell 208B answer sequence.

&M1 Sets the modem for synchronous mode, error control sequence.

&R0 Sets a delay between DTE's RTS signal and modem's CTS response. The duration of the delay is set by S26. This setting is recommended if the synchronous mainframe requires a delay between the RTS and CTS signals.

&S1 To set the modem to answer a Bell 208B call, select the Normal [&S1] setting. When the modem senses an incoming call on the line, it raises DSR as a signal to the DTE that the modem is ready to answer an incoming call.

S-Registers

S26 Sets the duration, in 10-millisecond units, of the delay between RTS and the modem's CTS response in synchronous mode. **Default = 1**.

If you set the modem to &R0, use this timer to change the duration of the RTS/CTS delay, in 10-millisecond units. The default is 1, but in Bell 208B mode the minimum delay allowed is 70 milliseconds. When in Bell 208B mode, the modem uses a setting of at least 7, even if set to a value smaller than 7.

S31 Bit-mapped register. To add Bell 208B modulation to the connection options for the modem, issue the ATS31.0=1 command. Leave the B*n* command at its default, B0. This enables the Bell 208B modulation during the multimode training sequence. Default = 0.

Bit	Value	Result
0	1	Enable Bell 208B multimode training sequence.
1–7	—	Reserved.

Appendix B
Leased Line Operations

Traditional leased line operations are only supported by the Quad Analog Modem and the Quad Analog / Digital Modem when in analog mode.

When set according to the following instructions, the U.S. Robotics modem and the remote modem make a continuous connection without dialing. Should the connection be broken, the modems automatically reconnect.

For optimal operations, we recommend that the physical length of these lines not exceed five miles. Dial-up modems are bound by the limits on signal attenuation set by the public switched telephone networks. On longer lines, signal integrity may degrade.

NOTE: To operate on 4-wire leased lines, the modems require 4-wire-to-2-wire converters. These are usually available from the telephone company.

Setting the Modem

&L*n* Normal/Leased phone line.

&L0 Normal phone line. Default.

&L1 Leased line; enables the modem to reconnect.

If the modem is set to &L1, as described next, at power-on it automatically connects with a remote modem that has the same capability. They also reconnect, without any operator intervention, if a disturbance on the line is severe enough to break the connection.

Set the modem as follows.

1. Set the communications software for a high serial port rate; this will determine the rate at which the modems communicate. For example, use a software setting of 115.2K bps and, if both modems have the capability, they will connect at 28.8K bps.
2. Send the modem the following command:

   AT &S2 &L1 &W

   Be sure the modem is set to &B1, which fixes the modem's serial port rate at 115.2K bps. &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 follows.)

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

   NOTE: As a precaution, we recommend using the &S2 setting to delay CTS until after the connection is made. If the modems are in the process of connecting or reconnecting, they interpret any keyboard data entry, including an accidental key stroke, as a *key-press abort*, and hang up. Delaying CTS until after carrier detection prevents this from happening. Be sure the modem is set for hardware flow control, &H1.

   If the installation does not support Clear to Send (CTS), be sure to set the modem to &S0, and follow the Transmit Data flow control (&H*n*) guidelines in Chapter 2. 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. The modem may be in Dumb or Smart mode (DIP switch 8).

4. Decide which modem will be the calling modem and which will be 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. Insert the modem in the rack. This initiates the new DIP switch settings and loads the power-on defaults, including &L1. The modems go off hook and establish the connection.

Re-establishing a Connection

When the rack modem originates a leased-line connection and carrier is lost, it waits 15 seconds after sensing loss of carrier before attempting to re-establish the connection. This default delay is stored in Register S44, and is intended to give the modem at the other end of the line time to return on-hook. If the delay is too short, the calling modem attempts to reconnect while the answering modem is still off-hook. If the default delay is not giving the modems enough time to reconnect, store a higher value in S44.

NOTE: If the modems cannot restore the connection and the modem cannot be set to &S2, the reason could be a key-press abort (as described in step 2). If the problem persists, however, the telephone company may have to check the line.

Appendix C
Modem Testing

Software-initiated testing is available through the &T command or Register S16. All testing conforms to the ITU-T loopback recommendation, V.54. Earlier U.S. Robotics high speed modems, however, did not perform the &T test repertoire. If the modem's command set does not include &T capability, or if the software only supports Register S16 testing, use the S16 tests.

NOTE: If testing a modem that is set to B1 (HST mode), the software must be set to *2400 bps or lower* to avoid the asymmetrical modulation that occurs at higher speeds.

Testing With &T

The tests supported through the &T*n* command include digital loopback and remote digital loopback. Operators 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, the results will be invalid.

During testing, the CHAN LED for the modem being tested flashes.

Ending a Test—&T0, S18

The &T0 option terminates a test in progress.

Alternatively, set Register S18 to a specified number of seconds, for example, S18=15. When the 15 seconds are up, the modem automatically ends the test and returns to Command mode.

NOTE: If the S18 test timer is set, but in the process of testing an ATZ command is issued, S18 resets to zero and the timer is disabled.

Analog Loopback—&T1, &T8

These tests are available only with the Quad Analog Modem or the Quad Analog / Digital Modem in analog mode. There are two analog loopback options; they both check the operation of the modem's transmitter and receiver. The first, &T1, involves typing data that can be verified on the 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 a more specific result.

&T1

To perform this analog loopback test, do the following:

1. If testing a Dual Standard modem, set the terminal or software to 2400 bps.
2. The modem must be in Command mode. Optionally, set Register S18 as a test timer, as explained earlier.
3. Send the modem the following command.

   AT &M0 &T1

   The modem disables error control, enters analog loopback (AL) mode, and sends a CONNECT message. The RN status indicator for the modem being tested flashes green.
4. Type recognizable data so that it can be verified when it is looped back to the screen.
5. End the test. If Register S18 is set, the modem automatically stops the test at the timeout, exits AL mode and responds OK.

   If S18 wasn't set, 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, an invalid command has been issued.
6. If there were no errors, reset the modem to &M4, for error control, unless the ATZ reset command has been issued.

NOTE: If the modem is in online-command mode, that is, still connected to a remote modem, and it receives an &T1 or &T2 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 nothing is typed 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 the problem continues, it may be at the computer interface.

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

   AT &M0 &T8

   The modem disables error control and enters AL mode. The RN status indicator of the modem being tested flashes green. The modem sends its internal test pattern to the transmitter, and loops the pattern back to the receiver. No data will appear on the screen.
3. End the test. If Register S18 is set, the modem automatically stops the test at the timeout. If S18 wasn't set, type AT&T0 or ATH to end the test, or ATZ to end the test and reset 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 an invalid command has been issued.
4. If there were no errors, reset the modem to &M4, for error control unless the ATZ reset command has been issued.

&T2

This option is reserved.

Digital Loopback—&T3

If the modem has passed the AL test, this test can help locate a problem with a remote modem or the telephone channel.

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 ON (factory setting) so that the modem does not hang up on receipt of the escape code. If necessary, remove the modem and reset the switch.

To perform a local digital loopback, do the following.

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 command. The modem enters DL mode and the STAT LED for the modem being tested flashes green.
3. The remote operator should type a short message. It will be looped back by the modem's transmitter for verification on the remote screen. Neither the message nor any other data will be displayed.
4. When the remote operator 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. If the modem sends an ERROR message, an invalid command has been issued.
5. If normal operations require DIP switch 9 OFF, remove the modem and reset the switch. When it is re-installed, the modem resets to its &M4 default. Otherwise, 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 Loopback test. This is the default.

The &T5 option cancels &T4, and the modem fails to recognize such a request.

Remote Digital Loopback—&T6, &T7

This test, like the local digital loopback test, verifies the condition of both modems and the phone link. The request for and granting of Remote Digital Loopback testing requires that both modems use ITU-T V.22 standard 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, an ERROR result code is displayed.

There are two Remote Digital Loopback options. If &T6 is selected, keyboard data is sent to the modem and is verified when it is returned over the phone lines and to the local screen. If &T7 is selected, the modem sends its internal test pattern and returns an error count to the 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 ON so that the modem does not hang up on receipt of the escape code. If necessary, remove the modem and reset the switch.

&T6

Perform a Remote Digital Loopback (RDL) as follows.

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

   Establish a connection with the remote modem. If not already done, arrange with the remote operator to cooperate with the testing and, if necessary, set the remote modem to acknowledge the RDL request.

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 STAT LED for the modem being testing flashes green.

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

4. End the test. If Register S18 is set, the modem automatically ends the test when the test timeout is reached. If S18 isn't set, 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 an invalid command is issued, the modem sends an ERROR message.

   Data errors indicate a problem with the remote modem or the phone link.

5. If normal operations require DIP switch 9 OFF, remove the modem and reset the switch. When it is re-installed, the modem resets to its &M4 default. Otherwise, reset the modem to &M4 unless the reset command, ATZ, was used.

&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.

Nothing has to be typed during this test. The modem sends only its final error count to the screen.

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

   Establish a connection with the remote modem. If not already done, arrange with the remote user to cooperate with the testing and, if necessary, set the remote modem to acknowledge the RDL request.

2. Bring the modem back to Command mode with the +++ escape code. Then send it the AT&T7 command. The modem enters RDL mode and the STAT LED for the modem being tested flashes green.

   The modem sends its internal test pattern to the remote modem, which loops it back to the local modem. The data will not be displayed on the local screen.

3. End the test. If Register S18 is set, the modem automatically stops the test when the timer times out. If S18 wasn't set, 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 an invalid command is issued, the modem sends an ERROR message.

   When the test is terminated, 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 the modem is known to be working properly, errors indicate a problem with either the phone connection or the remote modem.

4. If necessary, remove the modem and reset DIP switch 9 OFF. When it is re-installed, the modem resets to its &M4 default. Otherwise, reset the modem to &M4 unless the ATZ reset command has been sent.

Tone Test—&T9, &T10

The tone test only applies to the Quad Digital Modem, or the Quad Analog/Digital Modem in digital mode. This test uses the modem's ability to generate and receive analog tones to test the T1 line. In addition to the method described here, the modem can be sent commands to send and receive tones for the test through the management software (see the *Total Control Manager Software Guide*).

This test is performed through the T1 Card, and the T1 Card must be placed in Transparent Test mode before the test is run. This is done automatically when the test is conducted through the management software, and can be performed manually on the T1 Card through the RS-232 Operator Interface (in the *T1 Operator's Manual*, see Appendix B for instructions on the Single T1 Card and Appendix C for the Dual T1 Card).

The test can be canceled at any time by pressing any key.

&T9

The following example shows the command syntax required to generate a tone:

AT&T9=FREQ,AMP <ENTER>

There are three Frequencies reported by the modem: 404 Hz, 1004 Hz, and 2804 Hz. The Amplitude can be expressed as any number from -40 to 0 dBm. Therefore, an actual example of the command is as follows:

AT&T9=404,-20 <ENTER>

The modem prompts for confirmation before executing the command.

&T10

Send the following command to a modem to receive tones:

AT&T10 <ENTER>

This test will report the frequency and amplitude of received tones to the DTE interface on a five-second basis. It can be aborted by pressing any key.

Testing with Register S16

Register S16 is a bit mapped register with the following bit functions.

Bit	Value	Function
0	1	Reserved
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. Set a U.S. Robotics modem that does not use the &T*n* test commands to S16=8 so that it can grant RDL testing.

Analog Loopback—S16=1D

This test is available only for the Quad Analog Modem and the Quad Analog / Digital Modem in analog mode.

As with the hardware-initiated and &T AL tests, do not attempt this test under error control.

To use the modem's Test Pattern (S16, bit 2) instead of typing data, see *Test Pattern—S16=4* later in this appendix.

1. To initiate testing, type AT&M0S16=1D. The modem disables error control, enters AL mode and sends a CONNECT result code. The RN status indicator for the modem being tested flashes 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*, which is described following the next section.
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 connection 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 Test—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 (for example, ATD7 <Enter>), the modem continues to transmit that tone until another Carriage Return is typed.

Test Pattern—S16=4

This test pattern can be used instead of the typed data during Analog Loopback (AL) or Remote Digital Loopback (RDL). The test pattern is available at all speeds, but at 300 bps, the modem's DTE 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 DTE rate (&B1).

To use the test pattern during AL testing, type the following command. The test pattern is sent through the loopback.

AT&M0S16=5D <ENTER>

For RDL testing with the test pattern, type this command.

AT&M0S16=12 <ENTER>

For &T AL or RDL tests with the test pattern, set the modem to the test pattern before issuing the test command. The first of the following commands initiates AL, the second RDL:

ATS16=4&T1 <ENTER>
ATS16=4&T6 <ENTER>

Ending Testing with the Test Pattern

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

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 on connection with a remote modem. Terminate transmission of the test pattern by terminating the call.

Remote Digital Loopback—S16=8

Responding Modem

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

Initiating Modem

1. If DIP switch 9 on the initiating modem is OFF, remove the modem from the chassis and set the switch ON. Switch 9 allows the modem to make a connection and return to Command mode for the RDL command, without hanging up. Reinstall the modem.
2. Set the software to 2400 or 1200 bps. The ITU-T-specified RDL signals only define 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 modem the following command.

   NOTE: The last character is the letter O and not a zero.

   ATS16=8 O <ENTER>

   The modem enters RDL mode (S16=8), the STAT LED for the tested modem flashes green, and the modem goes online (O command). Then it transmits the ITU-T-defined RDL signals, and the remote modem enters RDL mode.
6. Type any data at the keyboard.
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 <ENTER>

   The modem signals the responding modem that RDL testing is over. Terminate the call normally, and reset the modem to its normal error control setting, &M4 or &M5.

   Or, 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 connection sequence, its status cannot be changed until the modem is back on hook and in Command mode.

Appendix D
S-Registers

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

ATS1? <ENTER>

Register	Default	Function
S0	1	Sets the number of rings on which to answer when in Auto Answer mode. Can be used to override the setting of DIP switch 5. S0 = 1 enables Auto Answer and the modem answers on the first ring. S0=0 disables Auto Answer, the same as DIP switch 5 ON. **NOTE:** Setting S0 = 0 disables Auto Answer.
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. A value of 128–255 disables 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 dial). If there is no dial tone, the modem observes the normal S6 timeout and returns a NO DIAL TONE result code.

Register	Default	Function
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.
S8	2	Sets the duration, in seconds, for the pause (,) option in the Dial command and the pause between command re-executions (> and A> commands).
S9	6	Sets the required duration, in tenths of a second, of the remote modem's carrier signal before recognition. The modem ignores this register above 2400 bps.
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 disconnect (hanging up) by the remote modem. S10=255 causes the modem to remain off hook despite loss of carrier; it hangs up only if the DTR signal drops or if it is returned to command mode and sent the ATH command.
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 for the escape code (+++) sequence. Default=1 second.

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 to software defaults 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	Disable HST (used for testing V.32 *terbo* in Dual Standard modems).
6	64	Disable MNP Level 3 (used for testing Level 2).
7	128	Watchdog hardware reset.

S14	0	Reserved.

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

Bit	Value	Result
0	1	Disable the modem's extra high-frequency equalization if problems occur on shorter-link calls—Dual Standards in HST mode only.
1	2	Disable online fallback.
2	4	Disable 450 bps and force a 300 bps back channel rate —modems in HST mode only.
3	8	Reset non-ARQ Transmit buffer from 1.5K byte to 128*.
4	16	Disable MNP Level 4; re-transmitting the larger Level 4 data blocks may be a problem if you expect numerous errors during a call.
5	32	Delete key acts as destructive Backspace key.
6	64	Some earlier 2400 bps MNP modems, not made by USR or Microcom, were not fully compatible with the MNP protocol. Difficulty making a 2400 bps MNP connection with a remote MNP modem may be due to this incompatibility. Set S15 to 64 and try to connect again.
7	128	Custom applications.

* The default 1.5K byte non-ARQ buffer allows data transfer with X- and YMODEM-type file transfer protocols without using flow control.

The 128-byte option allows remote users with slower modems to stop data you're transmitting from scrolling off their screens. When remote users send your computer an XOFF (<Ctrl-S>) and you stop transmitting, the data in transit from your modem's buffer doesn't exceed the size of their screen.

Register	Default	Function
S16	0	Bit-mapped test register. To set the register, see the instructions for S13. For information on testing, see Appendix E.

Bit	Value	Result
0	1	Analog Loopback.
1	2	Dial test.
2	4	Test pattern.
3	8	Initiate Remote Digital Loopback.
4–7	—	Reserved.

Register	Default	Function
S17	0	Reserved.

Register	Default	Function
S18	0	Test timer for software-initiated loopback testing (&T*n*), disabled when S18 is set to 0. See Appendix E. Sets 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.
S24	150	Sets the duration, in 20-millisecond units, between pulsed DSR signals when the modem is set to &S2 or &S3. The default (and maximum value) is 3 seconds.
S25	5	Sets the length, in 10-millisecond units, of the minimum DTR pulse width. Default=.05 sec.
S26	1	Sets the duration, in 10-millisecond units, of the delay between RTS and the modem's CTS response once a synchronous connection is established. The maximum allowable value is 25 (250 msec).

Register	Default	Function
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 Bell 103 and V.21 calls, but only originates V.21 calls.
1	2	Enable unencoded (non-trellis-coded) modulation in V.32 mode; option is part of ITU-T V.32 recommendation, but is rarely used.
2	4	Disable V.32 modulation; used for testing HST modulation in Dual Standards.
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.
7	128	Unusual software incompatibility. Some software may not accept certain result codes. This setting disables the codes and displays 9600 code instead. Call's true rate can be viewed with ATI6.

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.

Register	Default	Function
S28	8	Sets the duration, in tenths of a second, of the extra 3000/600 Hz answer tones sent during V.32 handshaking. Default = .8 seconds. 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. 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 handshaking. Default = 2 seconds. This gives V.21 modems additional time to connect in V.21 mode before timing out.
S30	0	Reserved.
S31	0	Bit-mapped register. **Bit Value Result** 0 1 Enable Bell 208B modulation during multimode training sequence. 1–7 — Reserved.
S32	9	Reserved at the required default of 9.
S33	0	Setting bit 1 of this register to 1 (S33=1) reduces the packet size of. May be required for HST Cellular mode. For Dual Standard modems only.

Register	Default	Function
S34	0	Bit-mapped register. See instructions for S13.

Bit	Value	Result
0	1	Disable V.32 *bis*. Used for troubleshooting; U.S. Robotics' Technical Support may require that you disable V.32 *bis* for testing purposes.
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 International connections.
4	16	Reserved.
5	32	Enable MI / MIC (if your modem supports it).
6	64	Disable the remote access busy message.
7	128	Disable V.32 *terbo*.

S35	0	Reserved.
S36	0	Reserved.
S37	0	Unusual software compatibility.
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 allows 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 is in Smart mode and 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—enabling or disabling remote access. The default setting of zero allows no remote login attempts—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.

Register	Default	Function
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	0	Reserved.
S46	255	Reserved.
S47	0	Bit-mapped register. Regulates aspects of a digital T1 line. Applies only to Quad Digital Modems or Quad Analog/Digital in digital mode. See also S62 and S63.

Bit	Value	Result
0	1	No call setup procedures are followed to request a T1 dial-out or dial-in line. Assumes that dedicated (leased) DS0 is assigned to the modem.
1	2	Dial-out signaling using DTMF tones.
2	4	No KP or STMF tones are transmitted.
3	8	Disable auto-configuration of modem settings based on Feature Group B/D.
4	16	Use auto-configuration based on ANI (instead of DNIS).
5	32	Force Gateway NAC routing. **NOTE:** Set this bit only if the Quad modem will never need to route to an RS-232 NIC. When this bit is set, the modem directs all output to the Packet Bus. If the operational mode is not set to route calls to a gateway card (as indicated by the ATI4 screen "DTE=packet bus" status message), the Quad modem will not respond to call setup requests to or from the T1 span line.
6	—	Reserved.
7	—	Reserved.

S48	0	Bit-mapped register. Selective modulation disable. See instructions for S13.

Bit	Value	Result
0	1	Disable 300 bps.
1	2	Disable 1200 bps.
2	4	Disable 2400 bps.
3	8	Disable high speed.
4–7	—	Reserved.

S49	16	Additional answer tone duration, 1/10 second units.
S50	100	Extended billing delay duration, 1/50 second units.

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* (9600 / 14,400 / 19,200 / 21,600 bps). 3–6 — Reserved. 7 128 Custom applications.
S52	5	Sets the duration in seconds, of the MNP link request timeout.
S53	0	Bit-mapped register. Select the Link 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 Link Security with fallback prompting. S53=5 enables Link Security, as well as local-access password protection. Or use ATS53.*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 Link Security enabled. 1 2 Fallback prompting enabled. 2 4 Local-access password protection enabled. 3 8 Forced prompting enabled. 4–7 — Reserved.
S54	0	Symbol rate bit-mapped register used primarily by U.S. Robotics Technical Support for debugging purposes. Default = 64 **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. Default = 0 **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
S56	0	Bit-mapped register primarily used by U.S. Robotics Technical Support for debugging purposes. Default = 0 **Bit Value Default** 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
S60	0	MNP10 protocol options. See Chapter 5, *Cellular*.
S62	0	When S47 is set for ANI (see Register S47), the number of digits programmed here indicates how many ANI digits the modem should expect for an incoming call. Maximum is 12.
S63	0	When S47 is set for DNIS (see Register S47), the number of digits programmed here indicates how many DNIS digits the modem should expect for an incoming call. Maximum is 12.
S64	0	ETC maximum link rate. See Chapter 5, *Cellular*.
S65	0	ETC Transmit level. See Chapter 5, *Cellular*.
S66	0	ETC protocol options. See Chapter 5, *Cellular*.

Index

Alphabetical Command List

A

B

C

D

E

F

G

H

I

L

M

N

O

P

Q

R

S

T

V

W

X