ModemModule

ModemModule
Model MT5634SMI

Data/Fax Modem

Developer's Guide

MultiTech Systems

Developer's Guide

88310757 Revision H

Modem*Module* (Model MT5634SMI)

Record of Revisions

Revision	Description
H (10/2/00)	Added Voice ***+V*** commands, Telecom Approvals, Flash Wizard, and various editorial changes. Revision H documents firmware version 4.18 and Test/Demo PCB rev. C.
G (3/10/00)	Updated the MT5634SMI image to revision C. Added -reset pin 24 and changed the serial ttl signals to active low in the Pinouts table on page 13. All pages at revision G.
F (12/10/99)	Added the &V command to the AT command set and added Appendix B which provides instructions for developing a customized flash prgramming utility. All pages at revision F.
E (10/22/99)	Manual released. All pages at revision E. Updated Chapter 4 - Class 2 fax Commands. Added board layout and labeling compliancy requirements.

Patents

This device covered by one or more of the following patents: 6,031,867; 6,012,113;6,009,082; 5,905,794; 5,864,560; 5,815,567; 5,815,503; 5,812,534; 5,809,068; 5,790,532; 5,764,628; 5,764,627; 5,754,589; D394,250; 5,724,356; 5,673,268; 5,673,257; 5,644,594; 5,628,030; 5,619,508; 5,617,423; 5,600,649; 5,592,586; 5,577,041; 5,574,725; D374,222; 5,559,793; 5,546,448; 5,546,395; 5,535,204; 5,500,859; 5,471,470; 5,463,616; 5,453,986; 5,452,289; 5,450,425; D361,764; D355,658; D355,653; D353,598; D353,144; 5,355,365; 5,309,562; 5,301,274 Other Patents Pending

Trademarks

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Chapter 1 - Introduction and Description

Introduction

The Multi-Tech ModemModule creates communication-ready devices by integrating data/fax functionality into a single product design. The ModemModule is a space-efficient (1" × 2.5"), embedded modem that provides V.90/56K or V.34/33.6K communication. The complete, ready-to-integrate modem dramatically reduces development time and costs for system designers. The ModemModule also complies with telecom requirements globally and can be shipped worldwide.

The ModemModule Developer's Kit allows you to plug in the ModemModule and use it as a serial modem for testing, programming and evaluation. The kit includes one ModemModule, development board, wall power adapter, and RS-232 cable.

This guide provides the hardware, software, testing and troubleshooting information needed to effectively integrate the ModemModule into your equipment. This guide also provides the commands that the developer can use to configure and control a data/fax/voice modem and the responses (result codes) that the modem issues in response to the commands.

Product Description

The MT5634SMI is a standard 64-pin ModemModule used for integrating data and fax communications. The MT5634SMI is a single-port modem which integrates the controller, DSP, and DAA in a 1" x 2.5" form factor and communicates to a host controller via an Asynchronous TTL level serial interface.
The MT5634SMI includes a Lucent 1673 Venus controller + DSP and Lucent 1034CSP Codec. It also includes 4-Meg of Flash memory and 32Kx16 SRAM for V.90/K56flex modem operation and V.17 Class 1 and Class 2 Fax.

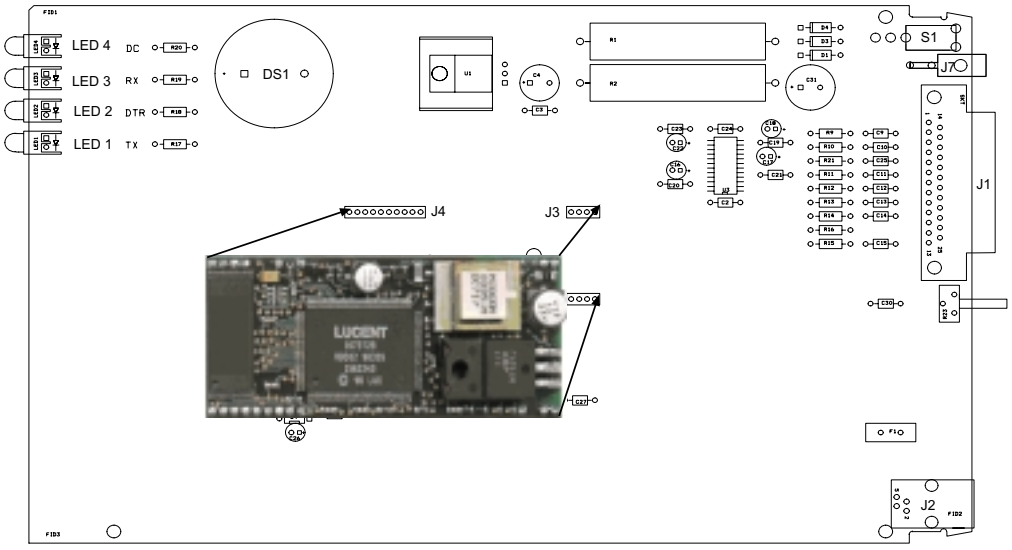

Figure 1-1. MT5634SMI and Test/Demo Board

Features

The MT5634SMI is designed to support the following features:

· Complete data/fax/voice modem solution, including the controller, data pump, and DAA
· Serial, binary, asynchronous data support
· Standard TTL serial interface supporting DTE transfer speeds to 230.4K
· V.90/56K modem module
· Class 1 and Class 2 faxing at 14.4K
· Industry-standard error correction and data compression
· Industry-standard AT-style commands
· Dial-up POTS interface (tip and ring)
· Remote configuration for centralized setup and management
· Phone number storage
· Flash memory for free firmware updates
· NOVRAM storage for user-defined parameters
· Speaker interface for user-supplied call-monitoring-tone speaker
· LED driver circuits for Carrier Detect, Transmit Data, Receive Data, and DTR signals

Technical Specifications

The Modem*Module* meets the following specifications:

Data Rates

Client-to-Server	DataComm: supports V.90 or K56flex for download speeds to 56 Kbps when connected to a fully digital V.90 or K56flex server, and upload speeds to 33.6 Kbps via enhanced V.34. Negotiates an enhanced V.34 (33.6K), V.32bis (14.4K), V.32 (9600), V.22bis (2400), or slower speed connection with non-V.90 modems
Client-to-Client	33,600, 31,200, 28,800, 26,400, 24,000, 21,600, 19,200, 16,800, 14,400, 12,000, 9600, 7200, 4800, 2400, 1200, 0-300 bps
Fax Data Rates	14,400, 12,000, 9600, 7200, 4800, 2400, 300 bps
Data Format	Serial, binary, asynchronous
Modem Compatibility	ITU V.90, K56flex; ITU-T V.34 enhanced, V.34, V.32bis, V.32, V.22bis, V.22; Bell 212A and 103/113; ITU-T V.29, V.42, V.42bis; ITU-T V.21 & V.23 in international versions
Fax Compatibility	ITU-T Group 3, Class 1 and 2, T.4, T.30, V.21, V.27ter, V.29, V.17, and TIA/EIA TR29.2
Error Correction	ITU-T V.42 (LAP-M or MNP 3–4)
Data Compression	ITU-T V.42bis (4:1 throughput), MNP 5 (2:1 throughput)
Speed Conversion	Serial port data rates adjustable to 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 57,600, 115,200, and 230,400 bps
Modes of Operation	Fax online modes; full duplex over dial-up lines; data mode, command mode, and online command mode; V.54 Test mode.
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Intelligent Features	Fully AT command compatible; autodial, redial, repeat dial; pulse or tone dial; dial pauses; auto answer; adaptive line probing; automatic symbol and carrier frequency during start-up, retrain, and rate renrgotiation; DTMF detection;

	call status display, auto-parity and data rate selections; keyboard-controlled modem options; non-volatile memory; on-screen displays for modem option parameters; command lines of up to 40 characters each; help menus; remote configuration; DTR dialing.
Command Buffer	40 characters
Data Modulation	FSK at 300 bps, PSK at 1200 bps, QAM at 2400, 4800, and 9600 bps (non-trellis), QAM with trellis-coded modulation (TCM) at 9600, 12,000, 14,400, 16,800, 19,200, 21,600, 24,000, 26,400, 28,800, 31,200, 33,600, and 56,000 bps
Fax Modulation	V.21 CH2 FSK at 300 bps (half duplex) V.27ter DPSK at 4800 and 2400 bps V.29 QAM at 9600 and 7200 bps V.17TCM at 14400, 12000, 9600, and 7200 bps
Carrier Frequencies	1600, 1646, 1680, 1800, 1829, 1867, 1920,
ITU-T V.34	1959, 2000 Hz
Carrier Frequencies ITU-T V.32bis/V.32	1800 Hz
Carrier Frequencies	Transmit originate: 1200 Hz
V.22bis/V.22 or Bell 212A Standard (2400 & 1200 bps)	Transmit answer: 2400 Hz Receive originate: 2400 Hz Receive answer: 1200 Hz
Carrier Frequencies ITU-T V.23 (1200 bps)	Transmit originate: 390 Hz mark 450 Hz space Receive originate: 1300 Hz mark 2100 Hz space Transmit answer: 1300 Hz mark 2100 Hz space Receive answer: 390 Hz mark 450 Hz space
Carrier Frequencies ITU-T V.21 (0–300 bps)	Transmit originate: 980 Hz mark 1180 Hz space Receive originate: 1650 Hz mark 1850 Hz space Transmit answer: 1650 Hz mark 1850 Hz space Receive answer: 980 Hz mark 1180 Hz space
Carrier Frequencies Bell 103/113 (0–300 bps)	Transmit originate: 1270 Hz mark 1070 Hz space Receive originate: 2225 Hz mark 2025 Hz space Transmit answer: 2225 Hz mark 2025 Hz space Receive answer: 1270 Hz mark 1070 Hz space
Fax Carrier	V.21 Ch2 (half duplex):
Frequencies	1650 Hz mark, 1850 HZ space for transmit originate 1650 HZ mark, 1850 Hz space for transmit answer V.27ter: 1800 Hz originate/answer V.29 QAM: 1800 Hz originate/answer V.17 TCM: 1800 Hz originate/answer
Transmit Level	-11 dBm (dial-up)
Frequency Stability	±0.01%

Receiver Sensitivity	-43 dBm under worst-case conditions
AGC Dynamic Range	43 dB
Interface	Serial interface for EIA RS-232C/ITU-T V.24/V.28
Diagnostics	Local analog loop, local digital loop, remote digital loop.
Weight	0.02 Kg. (0.04 lb.)
Dimensions:	1.045" × 2.541" × 0.680" (2.7 x 6.5 x 1.8 cm)
Power consumption:	Typical: 245 mA (1.25 W @ 5v DC) Maximum: 420 mA (2.1 W @ 5.25v DC)
Environmental:	0-50° C; humidity range 20–90% (non-condensing)
Approvals*:	UL 1950 approved FCC Part 68 approved Industry Canada CS03 EN60950

* Approvals are provided in controlled configurations and must be re-evaluated in end-user configurations.

Physical Dimensions

Figure 1-2 illustrates the the physical dimensions of the MT5634SMI.

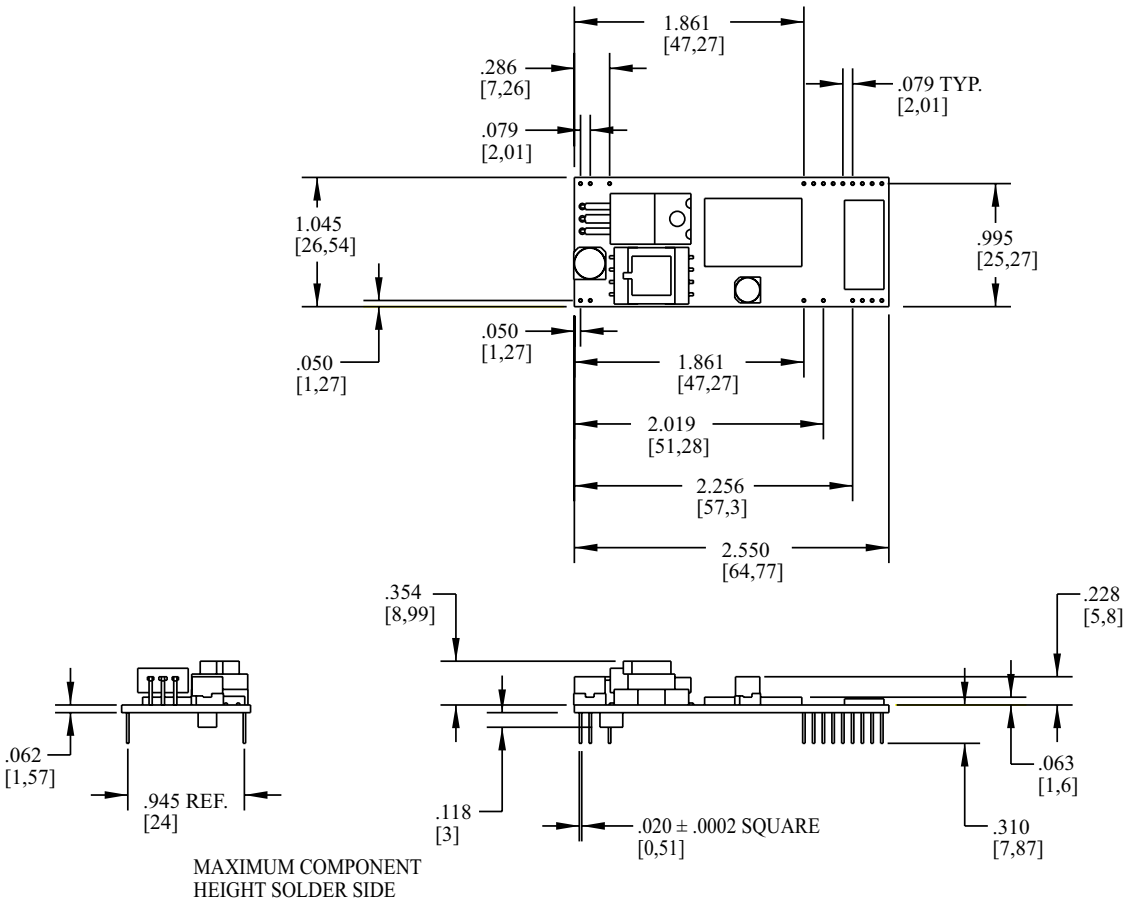

Figure 1-2. MT5634SMI Physical Dimensions

CAUTION: If any component(s) is placed under the ModemModule or if any component(s) should extend to the point where part of it is under the ModemModule, the component(s) must NOT exceed .060 inches in height.

Test/Demo Board Specifications

The Modem*Module* Test/Demo Board kit includes a modem module, a power transformer for the test board, and a diskette (this Developer's Guide manual, etc.). Figure 1-4A illustrates the Rev. B demo/test board and Figure 1-4B illustrates theRev. C Test/Demo board.

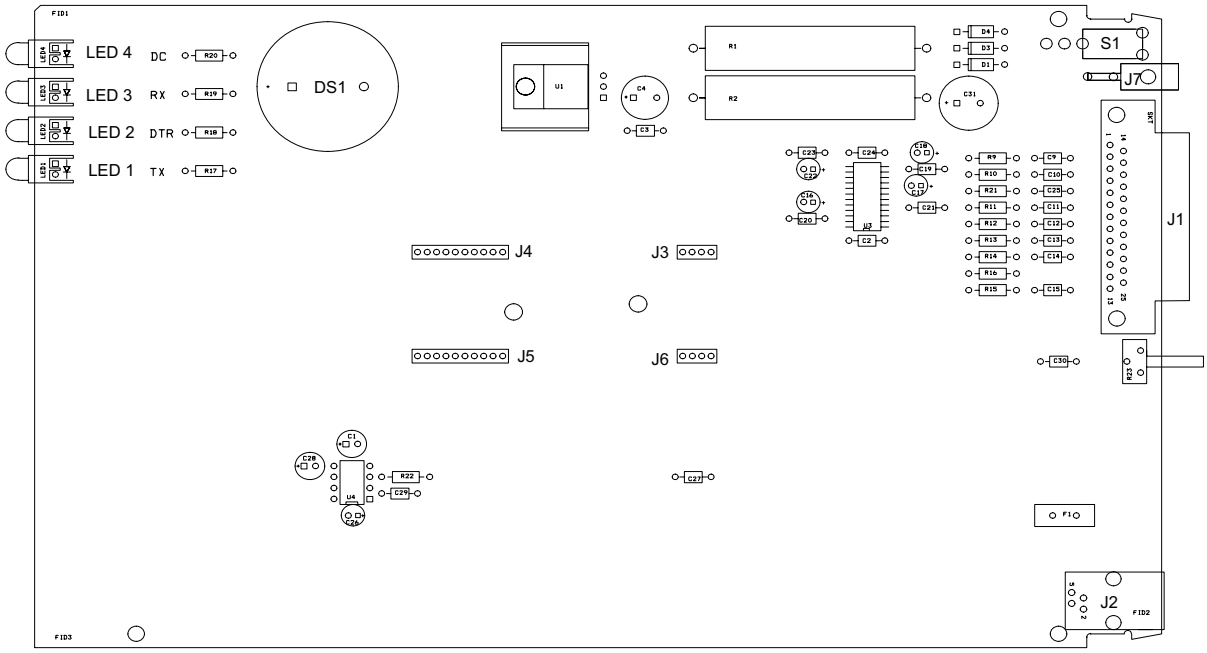

Figure 1-4A. MT5634SMI Test/Demo Board (Rev. B)

Designation	Function
DS1	Speaker
J1	25-Pos. DSUB
J2	6-Pin Mod. Jack (Line jack)
J3, J6	4-Pos. Connector
J4, J5	10-Pos. Connector
J7	2-Pos. Header
LED1-LED4	Red LED
S1	SPST Switch

Figure 1-4B. MT5634SMI-ITP Test/Demo Board (Rev. C)

Designation	Function
DS1	Speaker
F1	1/2 Amp Fuse
J1	25-Pos. DSUB
J2	4-Pin Mod. Jack (Phone Line)
J3, J6	4-Pos. Connector (ModemModule)
J4, J5	10-Pos. Connector (ModemModule)
J7	2-Pos. Header (Power Connector - keyed)
JP1	5V / 3V Jumper (Rev. C / + PCBs only)
LED1	Red LED (TX)
LED2	Red LED (DTR)
LED3	Red LED (RX)
LED4	Red LED (DC)
S1	SPST Switch (Power ON/OFF)
S2	SPST Switch (Test/Operation)
R23	Pot. - Speaker Volume Control

5V / 3V Jumper JP1 (Rev. C / + PCBs only)

Jumper JP1 provides for selection of either 5 volt or 3 volt operation on Rev. C and above PCBs.
The factory default setting is 5V (the 3V setting is intended for future use).

Warning: be sure to set the 5V/3V jumper to match the requirements of your ModemModule. If this jumper is set incorrectly, damage to the ModemModule and/or the Test/Demo card could result.

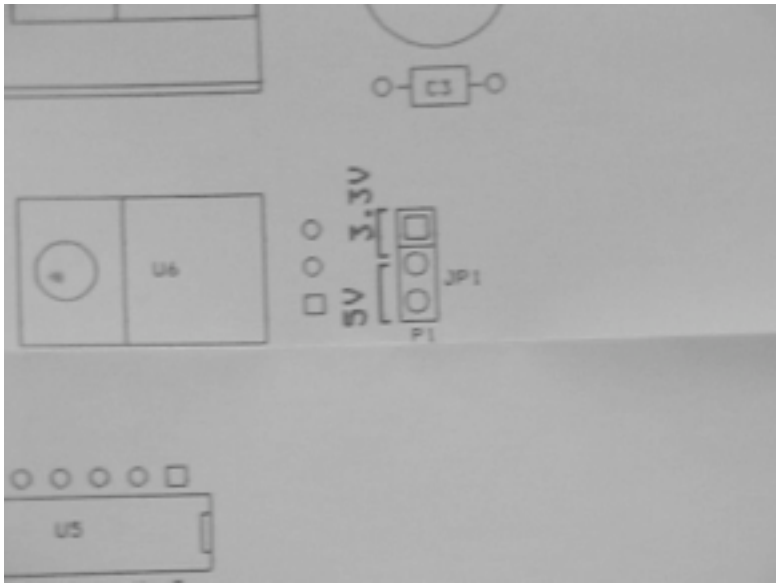

Figure 1-4C. 5V / 3V Jumper JP1 (Rev. C PCB only)

Test/Demo Board Block Diagram

Figure 1-4 illustrates the Test/Demo board block diagram.

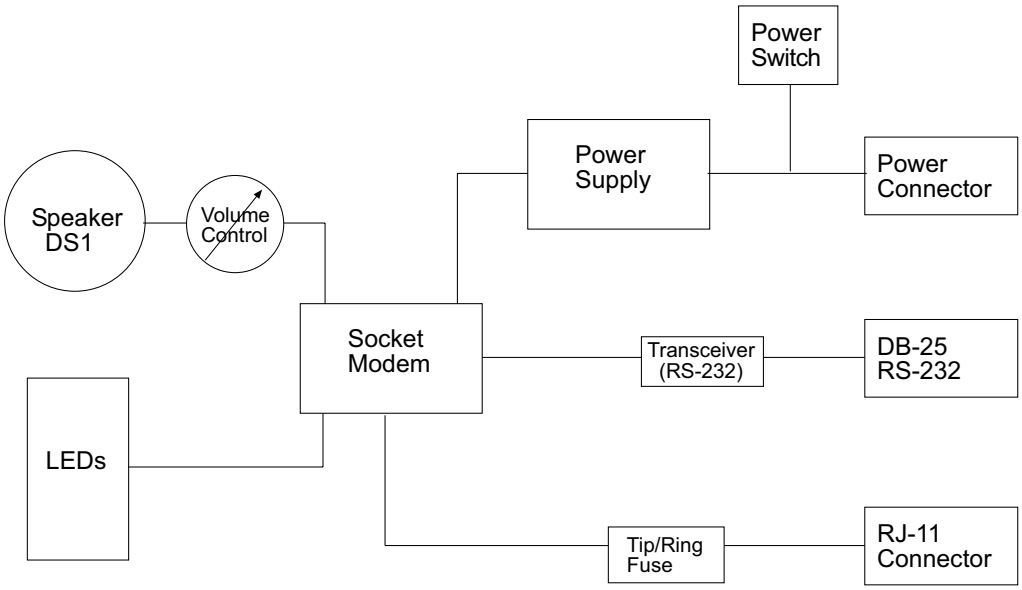

Figure 1-4. MT5634SMI Test/Demo Board Block Diagram

Transformer

Caution: use only the provided Multi-Tech transformer with the Test/Demo board; use of any other power source will void the warranty and will likely damage the Test/Demo board and ModemModule. The transformer connector is keyed to prevent improper connection to the Test/Demo board.

The provided Multi-Tech transformer is shown below.

Figure 1-5. Transformer

MT5634SMI Pin-out

The MT5634SMI uses a 20-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring, LED driver for call status annunciation, and serial interface via TTL level signals.

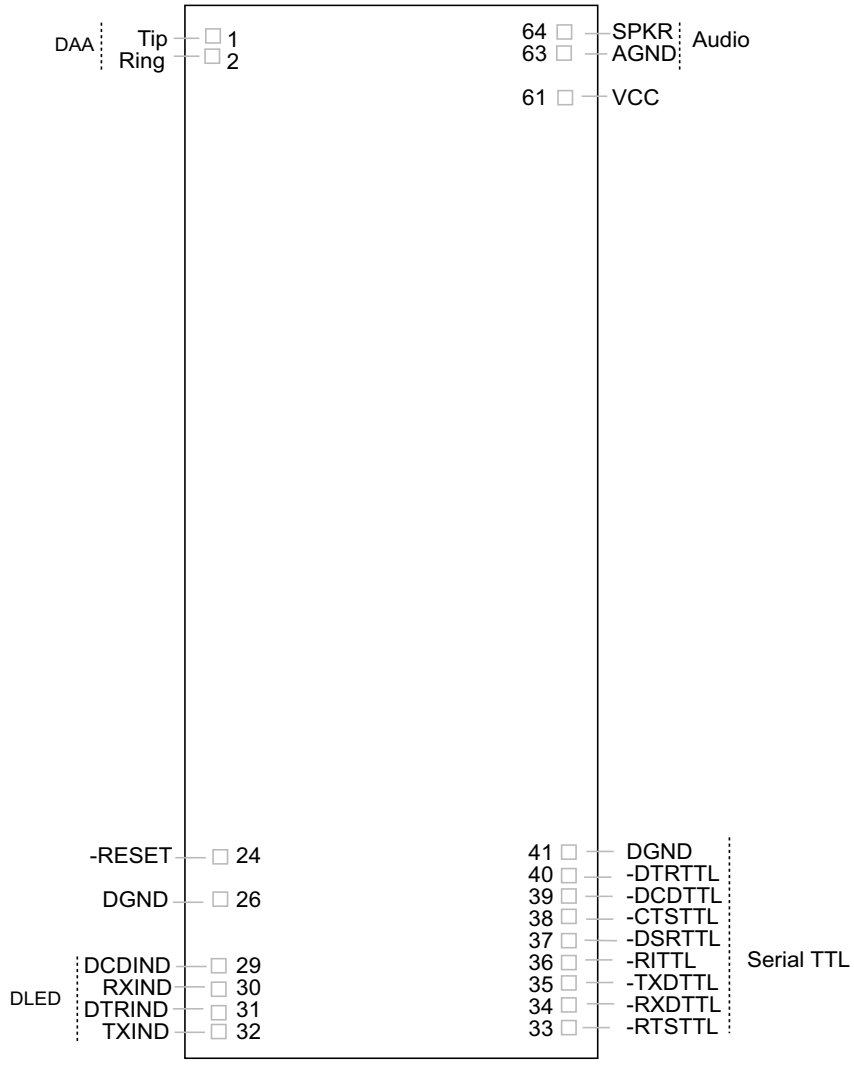

Figure 1-5. MT5634SMI Pinout

Typical Application

The table below shows the MT5634SMI pinouts and Figure 1-6 illustrates a typical OEM application.

Pin #	Circuit Type	Signal Description	Input/Output
1	RJ-11 Jack	Tip	Input/Output
2	RJ-11 Jack	Ring	Input/Output
24		-Reset	Input
26	Ground	DGND	
29	External Call Status LEDs	DCD	Output
30	External Call Status LEDs	RX	Output
31	External Call Status LEDs	DTR	Output
32	External Call Status LEDs	TX	Output
33	Serial TTL	-RTS	Input
34	Serial TTL	-RXD	Output
35	Serial TTL	-TXD	Input
36	Serial TTL	-RI	Output
37	Serial TTL	-DSR	Output
38	Serial TTL	-CTS	Output
39	Serial TTL	-DCD	Output
40	Serial TTL	-DTR	Input
41	Ground	DGND	
61	Power	VCC	
63	Audio	AGND	
64	Audio	SPKR	

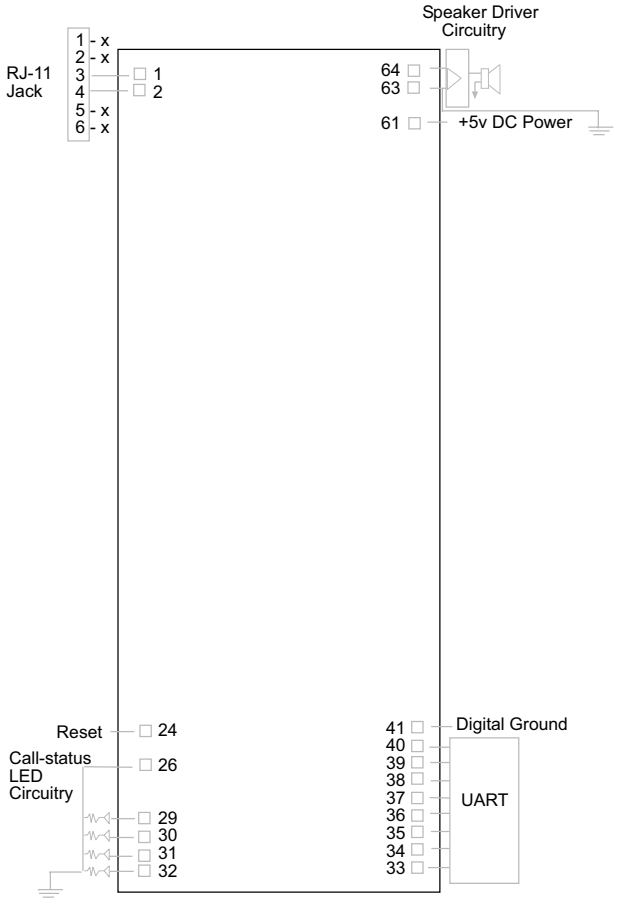

Figure 1-6. MT5634SMI Typical OEM Application

MT5634SMI Design Considerations

This section discusses hardware considerations, PC board layout considerations, and Telecom labeling requirements.

Hardware Considerations

Disclaimer: Multi-Tech Systems makes no warranty claims for vendor product recommendations listed below. Other vendor products may or may not operate satifactorily. Multi-Tech System's recommended vendor products only indicate that the product has been tested in controlled conditions and were found to perform satisfactorily.

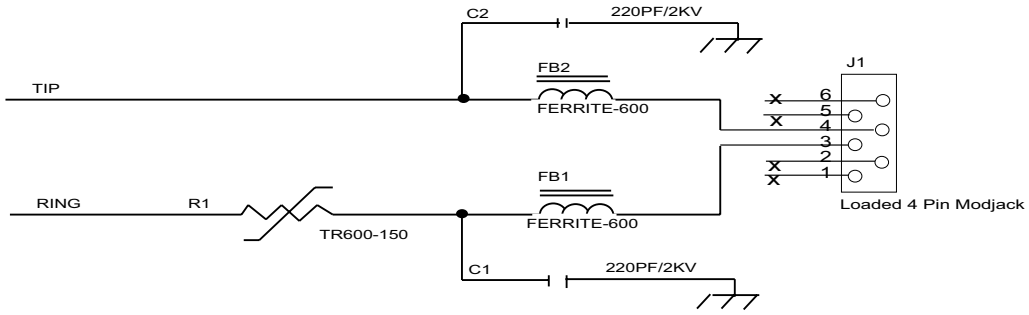

Figure 1-7. Tip and Ring Ferrite Connections

EMC: Surface mount ferrites are used on T&R (Tip and Ring) to mitigate emission levels out the RJ-11 cable. 220pF capacitors are also used on T&R to reduce the common mode emissions that may be present in certain systems. The ferrite and capacitors also aid in reducing the effects of transients that may be present on the line.

Recommended Ferrite

Manufacturer – Associated Component Technology (ACT)
Part # - YCB-1206

Manufacturer – Murata Erie
Part # - BLM31A601SPT

Recommended Capacitor

Manufacturer – Murata Erie
Part # - GHM3045X7R221K-GC (Surface mnt)
Part # - DE0807B221K-KH (Thru-hole device)

Manufacturer - Ever Grace Electronic Industrials
Part # - YP221K2EA7PS

Note: The capacitors used on T&R must have a Y2 safety rating.

Telecom: The RJ-11 connector must meet FCC Part 68 requirements. Refer to FCC Part 68 section 68.500 subpart F for connector specifications. A self-healing fuse is used in series with line to help prevent damage to the DAA circuit. This fuse is needed for FCC Part 68 compliance.

Recommended Connector

Manufacturer – Stewart
Part # - 6446S/RP-30

Recommended Fuse

Manufacturer – RayChem
Part # - TR600-150

Note: The fuse is also needed to meet UL1950 3rd edition protection against overvoltage from power line

crosses.

Safety: All creepages and clearances for the MT5634SMI have been designed to meet requirements of safety standards EN60950 and IEC950. The requirements are based on a working voltage of 250V. When the recommended DAA circuit interface is implemented in a third party design all creepage and clearance requirements must be strictly adhered to. The third party safety design must be evaluated by the appropriate national agency per the required specification.

User accessible areas: Based on where the third party design is to be marketed/sold or used, it may be necessary to provide an insulating cover over all TNV exposed areas. Consult with the recognized safety agency to determine the requirements.

Notice: Even if the recommended design considerations are followed, there are no guarantees that a particular system will comply with all the necessary regulatory requirements. It is imperative that specific designs be completely evaluated by a qualified/recognized agency.

Recommended Transceiver

Manufacturer – Analog Devices
Part # - ADM207EAR

PC Board Layout Considerations

This section discusses the FCC Part 68 and Industry Canada CS-03 Telecom compliance of the Multi-Tech Systems, Inc. Model MT5634SMI socketed modem module.

This module was tested by the NVLAP accredited KTL Dallas Inc. laboratory and conforms to the above said standards. The modem module was tested in the MultiTech MTASR3-200, a 3-modem asynchronous router that uses three ModemModules for dial-up telephone access. The developer's guide (included on diskette) with the MT5634SMI modem includes design specifications listing recommendations for the RJ-11 phone jack and fuse which are needed for FCC Part 68 compliance.

The MTASR3-200 tested has sockets for three modem modules each having traces of varying lengths out to the RJ-11 connectors. Trace lengths ranged from 1.97 to 3.15 inches. The trace widths were all 12 mil. Since three ports with varying trace lengths were tested, we concluded that as long as the customer's printed circuit board characteristics are reasonably close to these parameters there should not be any issues relating to telecom compliance. In addition to a recommended external fuse, the modem module also has a Sidactor on board.

It is our opinion, provided the same components are used and parts placement is similar, Telecom compliance will be maintained for the system and no additional testing is required.

Calculating Z for Tip and Ring Traces

Trace Impedance - Side-by-Side Traces

$$Z_o = \frac{120}{\sqrt{Er}} \times \ln\left(\frac{\pi S}{w + t}\right)$$

Where: Er = Relative permittivity of the PCB dielectric material. Typically 4 - 4.7
s = Spacing between traces - 12 mils (.012)
w = Trace width - 12 mils (.012)
t = Trace thickness - (.0022)

$$Z_o = \frac{120}{2.16} \times \ln\left(\frac{.03769}{.0142}\right)$$

$$Z_o = 54\ \Omega$$

Note: The trace inductance for the tested design varied from 61nH to 105nH.

MT5634SMI Placement

Figure 1-8 illustrates where to place the MT5634SMI on a typical Motherboard. It must be placed so that the analog end is near the phone jack.

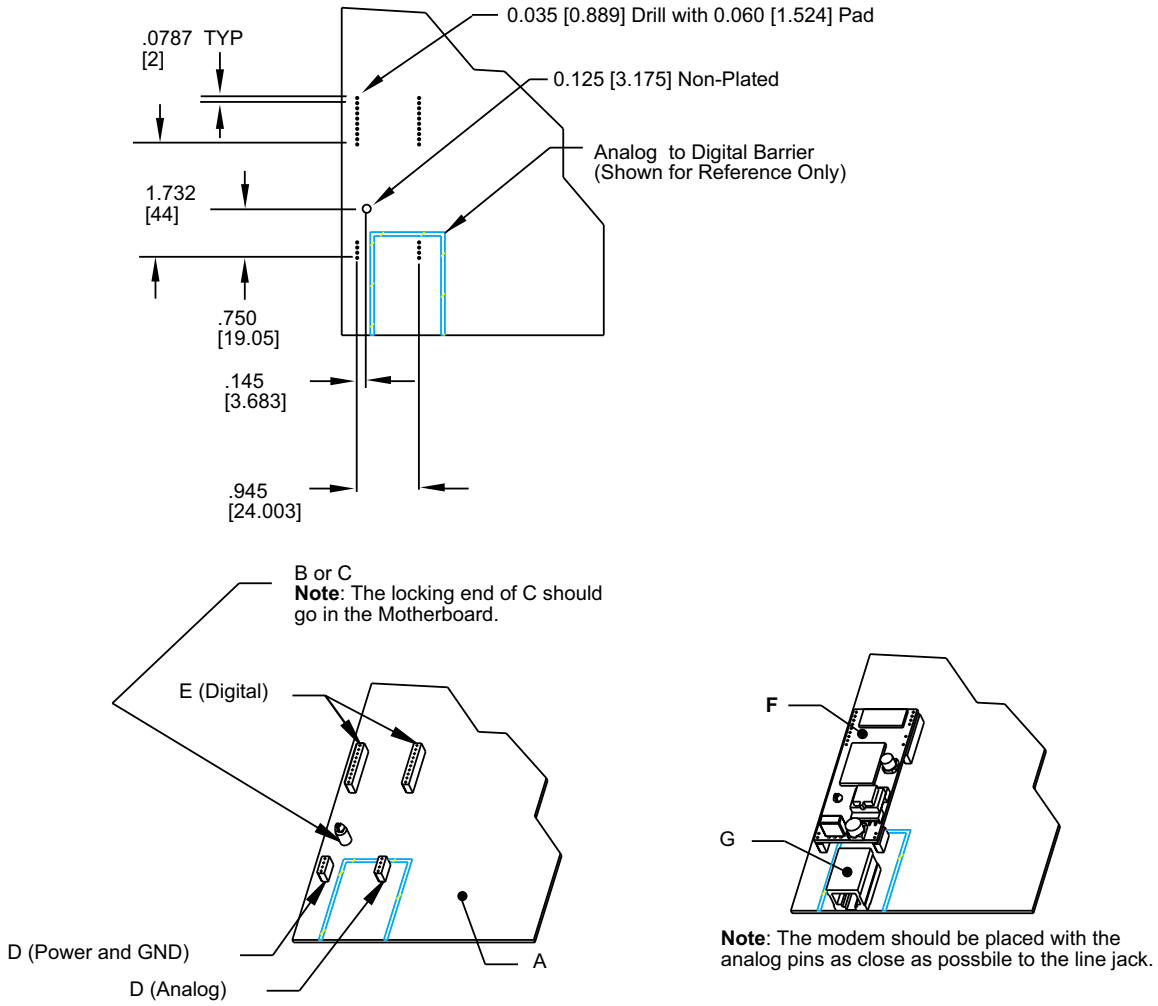

Figure 1-8: Placing the MT5634 SMI on a Typical Circuit Board

Key:

Qty	Ref	Name	Description
1	A	Reference	Generic Motherboard
1	B (or C)	Recommended	RICHCO DLMSM-4-01 Support Post (L=.250")
1	C (or B)	Recommended	RICHCO MSM-4-01 Support Post (L=.250")
2	D	Recommended	Singatron Enterprises 1211-04-S-01-B)
2	E	Recommended	Singatron Enterprises 1211-10-S-01-B)
1	F	Reference	ModemModule Assembly
1	G	Reference	Line Jack

Telecom Labeling Requirements

FCC regulations require labeling of registered Telephone and Data Terminal Equipment in accordance with Part 68 Subpart D. There are two options available for labeling of the device containing the MT5634SM modem module. The first option would be to use the registration number assigned to Multi-Tech Systems, Inc. by the FCC as explained in Section 68.300 below and shown in the sample label. The second option would be for the customer to submit applications for and use their own registration number that would be assigned by the FCC. This would require a letter of authorization for reregistration written by Multi-Tech Systems, Inc. giving the customer permission to reregister the product. The customer would also need to obtain and file the necessary documents and pay the required fees to the FCC.

Similarly, Industry Canada requires labeling in accordance with CS-03 requirements. Each modem module includes an Industry Canada label that should be attached to the final product as described in the Industry Canada CS-03 section below. Multiple Listing (similar to FCC's re-registration) is also an option for Industry Canada labeling. Instructions are also detailed below.

FCC Part 68

(From FCC PART 68 Subpart D—Conditions for Registration)
Complete document available from US Government Printing Office:

http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=199847

Section 68.300 Labeling requirements.

(a) Registered terminal equipment and registered protective circuitry shall have prominently displayed on an outside surface the following information in the following format:

Complies With Part 68, FCC Rules
FCC Registration Number: _____
Ringer Equivalence: ____

(b) Registered terminal equipment and registered protective circuitry shall also have the following identifying information permanently affixed to it.

(1) Grantee's name.
(2) Model number, as specified in the registration application.
(3) Serial number or date of manufacture.
(4) Country of origin of the equipment: "Made in _____."
Required if the equipment is not manufactured in the United States. (Country of origin shall be determined in accordance with 19 U.S.C. 1304 and regulations promulgated thereunder.) (5)

As used herein, permanently affixed means that the required nameplate data is etched, engraved, stamped, indelibly printed or otherwise permanently marked. Alternatively, the required information may be permanently marked on a nameplate of metal, plastic, or other material fastened to the enclosure by welding, riveting, or with a permanent adhesive. Such a nameplate must be able to last for the expected lifetime of the equipment and must not be readily detachable.

(6) When the device is so small or for such use that it is not practical to place the statements specified in this section on it, the information required by paragraphs (a) and (b) of this section shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user. The FCC Registration Number and the Model Number shall be displayed on the device.

Sample:
Complies With Part 68, FCC Rules
FCC Registration Number:
AU7USA-25814-M5-5
Ringer Equivalence
Multi-Tech Systems, Inc.
Model MT5634SM
S/N: xxxxxxx

Reregistration

(From Form 730 Application Guide Appendix C-2) http://www.fcc.gov/formpage.html

Private label distributors may obtain a registration number in their own name. In this case, a reregistration filing is made with the submission of Exhibit B, a copy of a letter from the original registrant to the applicant giving permission for the reregistration and a willingness to provide the applicant with any technical support. The applicant will replace the registration label on the original grantee with the one containing the newly assigned registration number.

Industry Canada CS-03

Canadian regulations require that certified equipment bear an identifying certification label which is obtained from Industry Canada. The label provided must be displayed on the equipment according to Industry Canada specifications. http://spectrum.ic.gc.ca/~cert/

From Certification Procedure 01 (CP-01):

Certified equipment will bear an identifying certification label and the certificate holder will be responsible for permanently affixing this certification label. The certification label identifies certified equipment to the public, representatives of the telecommunications common carriers, the Department, and other interested parties. The label must be permanently affixed to the equipment.

Multiple Listing

This terminal device may be multiple listed to other distributors based upon the approval granted to the original certificate holder. In order to obtain a multiple listing certification, the following documentation must be presented to Industry Canada:

(a) The model number, Industry Canada certificate number and certification number of the approved equipment;

(b) a letter from the original certificate holder authorizing the Department to use information on file to grant a multiple listing certification. The name / model number, certificate number and certification number for the subject equipment must be shown. The letter must also declare that the model to be multiple listed is identical in design and construction to the originally approved model;

(c) a letter, from the proposed multiple listee, requesting the certification;

(d) a Terminal Equipment Certification / Testing Application and Agreement form, completed by the proposed multiple listee;

(e) a drawing, sample or illustration of the product label; and

(f) payment in accordance with TRC-49 section on Multiple Listings.

Chapter 2 - AT Commands, S-Registers, and Result Codes

Introduction

The AT commands are used to control the operation of your modem. They are called *AT* commands because each command must be preceded by the characters *AT* to get the *AT*tention of the modem.

AT commands can be issued only when the modem is in command mode or online command mode. The modem is in *command mode* whenever it is not connected to another modem. The modem is in *data mode* whenever it is connected to another modem and ready to exchange data. *Online command mode* is a temporary state in which you can issue commands to the modem while connected to another modem. To put the modem into online command mode from data mode, you must issue an *escape sequence* (+++) followed immediately by the *AT* characters and the command, e.g., **+++ATH** to hang up the modem. To return to data mode from online command mode, you must issue the command **ATO**.

To send AT commands to the modem you must use a communications program, such as the HyperTerminal applet in Windows 98/95 and NT 4.0, or some other available terminal program. You can issue commands to the modem either directly, by typing them in the terminal window of the communications program, or indirectly, by configuring the operating system or communications program to send the commands automatically. Fortunately, communications programs make daily operation of modems effortless by hiding the commands from the user. Most users, therefore, need to use AT commands only when reconfiguring the modem, e.g., to turn autoanswer on or off.

The format for entering an AT command is **AT*Xn***, where *X* is the command and *n* is the specific value for the command, sometimes called the command *parameter*. The value is always a number. If the value is zero, you can omit it from the command; thus, **AT&W** is equivalent to **AT&W0**. Most commands have a *default* value, which is the value that is set at the factory. The default values are shown in the "AT Command Summary" (See below).

You must press ENTER (depending on the terminal program it could be some other key) to send the command to the modem. Any time the modem receives a command, it sends a response known as a *result code*. The most common result codes are *OK*, *ERROR*, and the *CONNECT* messages that the modem sends to the computer when it is connecting to another modem. For a table of valid result codes, see "Result Codes" at the end of this chapter.

You can issue several commands in one line, in what is called a command *string*. The command string begins with **AT** and ends when you press ENTER. Spaces to separate the commands are optional; they are ignored by the command interpreter. The most familiar command string is the *initialization string*, which is used to configure the modem when it is turned on or reset, or when your communications software calls another modem.

AT Command Summary

Command:	AT	**Attention Code**
Values:		n/a
Description:		The attention code precedes all command lines except **A/**, **A:**, and escape sequences.
Command:		ENTER Key
Values:		n/a
Description:		Press the ENTER (RETURN) key to execute most commands.
Command:	A	**Answer**
Values:		n/a
Description:		Answer call before final ring.
Command:	A/	**Repeat Last Command**

Values: n/a
Description: Repeat the last command string. Do not precede this command with **AT**. Do not press ENTER to execute.

Command: **B*n*** **Communication Standard Setting**
Values: *n* = 0–3, 15, 16
Default: 1 and 16
Description:
B0 Select ITU-T V.22 mode when modem is at 1200 bps.
B1 Select Bell 212A when modem is at 1200 bps.
B2 Deselect V.23 reverse channel (same as ***B3***).
B3 Deselect V.23 reverse channel (same as ***B2***).
B15 Select V.21 when the modem is at 300 bps.
B16 Select Bell 103J when the modem is at 300 bps.

Command: **D*s*** **Dial**
Values: *s* = dial string (phone number and dial modifiers)
Default: none
Description: Dial telephone number *s*, where *s* may up to 40 characters long and include the 0–9, *, #, A, B, C, and D characters, and the **L**, **P**, **T**, **V**, **W**, **S**, comma (**,**), semicolon (**;**), **!**, **@**, ^ and **$** dial string modifiers.

Dial string modifiers:
L Redial last number. (Must be placed immediately after **ATD**.)
P Pulse-dial following numbers in command.
T Tone-dial following numbers in command (default).
V Switch to speakerphone mode and dial the following number. Use **ATH** command to hang up.
W Wait for a new dial tone before continuing to dial. (**X2**, **X4**, **X5**, **X6**, or **X7** must be selected.)
, Pause during dialing for time set in register S8.
; Return to command mode after dialing. (Place at end of dial string.)
! Hook flash. Causes the modem to go on-hook for one-half second, then off-hook again.
@ Wait for quiet answer. Causes modem to wait for a ringback, then 5 seconds of silence, before processing next part of command. If silence is not detected, the modem returns a NO ANSWER code.
^ Disable data calling tone transmission.
$ Detect AT&T call card "bong" tone. The character should follow the phone number and precede the user's call card number: **ATDT10288061278535000$123456789**

Command: **DS=*y*** **Dial Stored Telephone Number**
Values: *n* = 0–3
Default: none
Description: Dial a number previously stored in directory number *y* by the ***&Zy=x*** command.
Example: **ATDS=3**

Command: **E*n*** **Echo Command Mode Characters**
Values: *n* = 0 or 1
Default: 1
Description:
E0 Do not echo keyboard input to the terminal.
E1 Do echo keyboard input to the terminal.

Command: **F*n*** **Echo Online Data Characters**
Values: *n* = 1
Default: 1
Description:
F0 Enable online data character echo. (Not supported.)
F1 Disable online data character echo (included for backward compatibility with some software).

Command: **H*n*** **Hook Control**
Values: *n* = 0 or 1
Default: 0
Description:
H0 Go on-hook (hang up).
H1 Go off-hook (make the phone line busy).

Command: **I*n*** **Information Request**
Values: *n* = 0–5, 9, 11
Default: None
Description:
I0 Display default speed and controller firmware version.

	I1	Calculate and display ROM checksum (e.g., *12AB*).
	I2	Check ROM and verify the checksum, displaying *OK* or *ERROR*.
	I3	Display default speed and controller firmware version.
	I4	Display firmware version for data pump (e.g., *94*).
	I5	Display the board ID: software version, hardware version, and country ID
	I9	Display the country code (e.g., *NA Ver. 1*).
	I11	Display diagnostic information for the last modem connection, such as DSP and firmware version, link type, line speed, serial speed, type of error correction/data compression, number of past retrains, etc.

Command:	**L*n***	**Monitor Speaker Volume**
Values:		*n* = 0, 1, 2, or 3
Default:		2
Description:	L0	Select low volume.
	L1	Select low volume.
	L2	Select medium volume.
	L3	Select high volume.

Command:	**M*n***	**Monitor Speaker Mode**
Values:		*n* = 0, 1, 2, or 3
Default:		1
Description:	M0	Speaker always off.
	M1	Speaker on until carrier signal detected.
	M2	Speaker always on when modem is off-hook.
	M3	Speaker on until carrier is detected, except while dialing.

Command:	**N*n***	**Modulation Handshake**
Values:		*n* = 0 or 1
Default:		1
Description:	N0	Modem performs handshake only at communication standard specified by ***S37*** and the ***B*** command.
	N1	Modem begins handshake at communication standard specified by ***S37*** and the ***B*** command. During handshake, fallback to a lower speed can occur.

Command:	**O*n***	**Return Online to Data Mode**
Values:		0, 1, 3
Default:		None
Description:	O0	Exit online command mode and return to data mode (see ***+++AT<CR>*** escape sequence).
	O1	Issue a retrain and return to online data mode.
	O3	Issue a rate renegotiation and return to data mode.

Command:	**P**	**Pulse Dialing**
Values:		P, T
Default:		T
Description:		Configures the modem for pulse (non-touch-tone) dialing. Dialed digits are pulsed until a ***T*** command or dial modifier is received.

Command:	**Q*n***	**Result Codes Enable/Disable**
Values:		*n* = 0 or 1
Default:		0
Description:	Q0	Enable result codes.
	Q1	Disable result codes.
	Q2	Returns an *OK* for backward compatibility with some software.

Command:	**S*r*=*n***	**Set Register Value**
Values:		*r* = S-register number; *n* varies
Default:		None
Description:		Set value of register S*r* to value of *n*, where *n* is entered in decimal format. E.g., **S0=1**.

Command:	**S*r*?**	**Read Register Value**
Values:		*r* = S-register number
Default:		None
Description:		Read value of register S*r* and display it in 3-digit decimal form. E.g., **S2?** gives the response *043*.

Command: **T** **Tone Dialing**
Values: P, T
Default: T
Description: Configures the modem for DTMF (touch-tone) dialing. Dialed digits are tone dialed until a ***P*** command or dial modifier is received.

Command: **V*n*** **Result Code Format**
Values: *n* = 0 or 1
Default: 1
Description: V0 Displays result codes as digits (terse response).
V1 Displays result codes as words (verbose response).

Command: **W*n*** **Result Code Options**
Values: *n* = 0, 1, or 2
Default: 2
Description: W0 CONNECT result code reports serial port speed, disables protocol result codes.
W1 CONNECT result code reports serial port speed, enables protocol result codes.
W2 CONNECT result code reports line speed, enables protocol result codes.

Command: **X*n*** **Result Code Selection**
Values: *n* = 0–7
Default: 4
Description: X0 Basic result codes (*e.g., CONNECT*); does not look for dial tone or busy signal.
X1 Extended result codes (*e.g., CONNECT 46000 V42bis*); does not look for dial tone or busy signal.
X2 Extended result codes with *NO DIALTONE*; does not look for busy signal.
X3 Extended result codes with *BUSY*; does not look for dial tone.
X4 Extended result codes with *NO DIALTONE* and *BUSY*.
X5 Extended result codes with *NO DIALTONE* and *BUSY*.
X6 Extended result codes with *NO DIALTONE* and *BUSY*.
X7 Basic result codes with *NO DIALTONE* and *BUSY*.

Command: ***Z*n*** **Modem Reset**
Values: *n* = 0 or 1
Default: None
Description: Z0 Reset modem to profile saved by the last ***&W*** command.
Z1 Same as ***Z0***.

Command: **&C*n*** **Data Carrier Detect (DCD) Control**
Values: *n* = 0 or 1
Default: 1
Description: &C0 Forces the DCD circuit to be always high.
&C1 DCD goes high when the remote modem's carrier signal is detected, and goes low when the carrier signal is not detected.

Command: **&D*n*** **Data Terminal Ready (DTR) Control**
Values: *n* = 0, 1, 2, or 3
Default: 2
Description: &D0 Modem ignores the true status of the DTR signal and responds as if it is always on.
&D1 If DTR drops while in online data mode, the modem enters command mode, issues an *OK*, and remains connected.
&D2 If DTR drops while in online data mode, the modem hangs up. If the signal is not present, the modem will not answer or dial.
&D3 If DTR drops, the modem hangs up and resets as if an **ATZ** command were issued.

Command: **&F*n*** **Load Factory Settings**
Values: *n* = 0
Default: None
Description: &F0 Load factory settings as active configuration.

Note: See also the ***Z*** command.

Command: **&G*n*** **V.22bis Guard Tone Control**
Values: *n* = 0, 1, or 2
Default: 0
Description: &G0 Disable guard tone.
&G1 Set guard tone to 550 Hz.
&G2 Set guard tone to 1800 Hz.

Note: The ***&G*** command is not used in North America.

Command: **&K*n*** **Flow Control Selection**
Values: *n* = 0, 3, or 4
Defaults: 3
Description: &K0 Disable flow control.
&K3 Enable CTS/RTS hardware flow control.
&K4 Enable XON/XOFF software flow control.

Command: **&P*n*** **Pulse Dial Make-to-Break Ratio Selection**
Values: *n* = 0, 1, or 2
Default: 0
Description: &P0 60/40 make-to-break ratio
&P1 67/33 make-to-break ratio
&P2 20 pulses per second

Note: The ***&P*** command is used only in Japan.

Command: **&Q*n*** **Asynchronous Communications Mode**
Values: *n* = 0, 5, 6, 8, or 9
Default: 5
Description: &Q0 Asynchronous with data buffering. Same as ***\N0***.
&Q5 Error control with data buffering. Same as ***\N3***.
&Q6 Asynchronous with data buffering. Same as ***\N0***.
&Q8 MNP error control mode. If MNP error control is not established, the modem falls back according to the setting in ***S36***.
&Q9 V.42 or MNP error control mode. If neither error control is established, the modem falls back according to the setting in ***S36***.

Command: **&S*n*** **Data Set Ready (DSR) Control**
Values: *n* = 0 or 1
Default: 0
Description: &S0 Force DSR always high (on).
&S1 Let DSR go high only during a connection.
at power-on or following the **ATZ** command.

Command: **&V** **Display Current Settings**
Values: n/a
Description: Displays the active modem settings, including the callback security settings if callback security is enabled. If the setup password has been entered, it also displays the callback security passwords.

Command: **&W*n*** **Store Current Configuration**
Values: *n* = 0
Default: 0
Description: &W0 Stores current modem settings in non-volatile memory and causes them to be loaded at power-on or following the **ATZ** command instead of the factory defaults. See also the ***&F*** command.
&W1 Clears user default settings from non-volatile memory and causes the factory defaults to be loaded at power-on or following the **ATZ** command.

Command: **&Zy=*x*** **Store Dialing Command**
Values: *y* = 0–3 (callback security disabled) or 0–29 (callback security enabled)
x = Dialing command
Default: None
Description: Stores dialing command *x* in memory location *y*. Dial the stored number using the command **ATDS=y**. See also the ***#CBSn*** command. For callback security options, see Chapter 6.

Command: **\A*n*** **Select Maximum MNP Block Size**
Values: *n* = 0, 1, 2, or 3
Default: 3
Description:
- \A0 64-character maximum.
- \A1 128-character maximum.
- \A2 192-character maximum.
- \A3 256-character maximum.

Command: **\B*n*** **Transmit Break**
Values: *n* = 0–9 in 100 ms units
Default: 3
Description: In non-error-correction mode only, sends a break signal of the specified length to a remote modem. Works in conjunction with the ***\K*** command.

Command: **\J*n*** **Data Buffer Control**
Values: *n* = 0
Default: 0
Description:
- \J0 Enable data buffer—serial port speed is independent of connect speed.
- \J1 Disable data buffer—serial port speed is forced to the line speed.

Command: **\K*n*** **Break Control**
Values: *n* = 0–5
Default: 5
Description: Controls the response of the modem to a break received from the computer, the remote modem, or the ***\B*** commnd. The response is different for each of three different states.

Data mode. The modem receives the break from the computer:
- \K0 Enter online command mode, no break sent to the remote modem.
- \K1 Clear data buffers and send break to the remote modem.
- \K2 Same as ***\K0***.
- \K3 Send break immediately to the remote modem .
- \K4 Same as ***\K0***.
- \K5 Send break to the remote modem in sequence with the transmitted data.

Data mode. The modem receives the break from the remote modem:
- \K0 Clear data buffers and send break to the computer.
- \K1 Same as ***\K0***.
- \K2 Send break immediately to the computer.
- \K3 Same as ***\K2***.
- \K4 Send break to the computer in sequence with the received data.
- \K5 Same as ***\K4***.

Online command mode. The modem receives a ***\Bn*** command from the computer:
- \K0 Clear data buffers and send break to the remote modem.
- \K1 Same as ***\K0***.
- \K2 Send break immediately to the remote modem.
- \K3 Same as ***\K2***.
- \K4 Send break to the remote modem in sequence with the transmitted data.
- \K5 Same as ***\K4***.

Command: **\N*n*** **Error Correction Mode Selection**
Values: *n* = 0–5, or 7
Default: 3
Description:
- \N0 Non-error correction mode with data buffering (buffer mode; same as ***&Q6***).
- \N1 Direct mode.
- \N2 MNP reliable mode. If the modem cannot make an MNP connection, it disconnects.
- \N3 V.42/MNP auto-reliable mode. The modem attempts first to connect in V.42 error correction mode, then in MNP mode, and finally in non-error-correction (buffer) mode with continued operation.
- \N4 V.42 reliable mode.If the modem cannot make a V.42 connection, it disconnects.
- \N5 V.42, MNP, or non-error correction (same as ***\N3***).
- \N7 V.42, MNP, or non-error correction (same as ***\N3***).

Command: **\Q*n*** **Flow Control Selection**
Values: *n* = 0, 1, or 3
Default: 3
Description: \Q0 Disable flow control (same as ***&K0***).
\Q1 XON/XOFF software flow control (same as ***&K4***).
\Q2 CTS-only flow control. Not supported.
\Q3 RTS/CTS hardware flow control (same as ***&K3***).

Command: **\T*n*** **Inactivity Timer**
Values: *n* = 0, 1–255
Default: 0
Description: \Tn Sets the time (in minutes) after the last character is sent or received that the modem waits before disconnecting. A value of zero disables the timer. Applies only in buffer mode.

Note: You can also set the inactivity timer by changing the value of ***S30***.

Command: **\V*n*** **Protocol Result Code**
Values: *n* = 0, 1, or 2
Default: 1
Description: \V0 Disable the appending of the protocol result code to the DCE speed.
\V1 Enable the appending of the protocol result code to the DCE speed.
\V2 Same as ***\V1***.

Command: **\X*n*** **XON/XOFF Pass-Through**
Values: *n* = 0 or 1
Defaults: 0
Description: \X0 Modem responds to and discards XON/XOFF characters.
\X1 Modem responds to and passes XON/XOFF characters.

Command: **-C*n*** **Data Calling Tone**
Values: *n* = 0 or 1
Defaults: 0
Description: -C0 Disable V.25 data calling tone to deny remote data/fax/voice discrimination.
-C1 Enable V.25 data calling tone to allow remote data/fax/voice discrimination.

Command: **%B** **View Numbers in Blacklist**
Values: n/a
Description: If blacklisting is in effect, **AT%B** displays the numbers for which the last call attempted in the previous two hours failed. In countries that do not require blacklisting, the *ERROR* result code appears.

Command: **%C*n*** **Data Compression Control**
Values: *n* = 0 or 1
Default: 1
Description: %C0 Disable V.42bis/MNP 5 data compression.
%C1 Enable V.42bis/MNP 5 data compression.

Command: **%DC*n*** **AT Command Control**
Values: *n* = 0 or 1
Default: 0
Description: %DC0 The modem responds to AT commands.
%DC1 The modem ignores AT commands.

Note: The modem will respond to **AT%DC** for 10 seconds after power-up.

Command: **%E*n*** **Fallback and Fall Forward Control**
Values: *n* = 0, 1, or 2
Default: 2
Description: %E0 Disable fallback and fall forward.
%E1 Enable fallback, disable fall forward.
%E2 Enable fallback and fall forward.

Command: **$D*n*** **DTR Dialing**
Values: *n* = 0 or 1

Default: 0
Description: $D0 Disables DTR dialing.
$D1 Dials the number in memory location 0 when DTR goes high.

Command: **+ES=*n*** **Enable Synchronous Buffered Mode**
Values: *n* = 6
Default: None
Description: Allows an H.324 video application direct access to the synchronous data channel. On underflow, the modem sends HDLC flag idle (0x7E) to the remote modem. This special error control mode is overridden by any of the following commands: ***&F***, ***&M***, ***&Q***, or ***\N***.

AT+ES=? shows the only allowed value.
AT+ES? shows the current value.

Command: **#S*x*** **Enter Setup Password**
Values: *x*= password (1–8 characters, case sensitive)
Default: MTSMODEM
Description: Enters the remote configuration setup password.

Command: **#S=*x*** **Store Setup Password**
Values: *x*= password (1–8 characters, case sensitive)
Default: MTSMODEM
Description: Stores a new remote configuration setup password.

Command: **+++AT<CR>** **Escape Sequence**
Values: n/a
Description: Puts the modem in command mode (and optionally issues a command) while remaining online. Type **+++AT** and up to ten command characters, then press ENTER. Used mostly to issue the hang-up command: **+++ATH<CR>**.

Command: **%%%AT<CR>Remote Configuration Escape Sequence**
Values: n/a
Description: Initiates remote configuration mode while online with remote modem. The remote configuration escape character (%) is defined in register ***S13***.

S-Registers

Certain modem values, or parameters, are stored in memory locations called S-registers. Use the **S** command to read or to alter the contents of S-registers (see previous section).

Register	***Unit***	***Range***	***Default***	***Description***
S0	1 ring	0, 1–255	1	Sets the number of rings until the modem answers. **ATS0=0** disables autoanswer completely.
S1	1 ring	0–255	0	Counts the rings that have occurred.
S2	decimal	0–127	43 (+)	Sets ASCII code for the escape sequence character.
		128–255		Values greater than 127 disable escape.
S3	decimal	0–127	13 (^M)	Sets the ASCII code for the carriage return character.
S4	decimal	0–127	10 (^J)	Sets the ASCII code for the line feed character.
S5	decimal	0–32 33–127	8 (^H)	Sets the ASCII code for the backspace character. Values greater than 32 disable backspace.
S6	seconds	2–65*	2*	Sets the time the modem waits after it goes off-hook before it begins to dial the telephone number.
S7	seconds	1–255*	50*	Sets the time the modem waits for a carrier signal before aborting a call. Also sets the wait for silence time for the @ dial modifier.
S8	seconds	0–65	2	Sets the length of a pause caused by a comma character in a dialing command.
S9	decimal	0, 1–127	37 (%)	Sets ASCII code for remote configuration escape character. **S9=0** disables remote configuration.
S10	100 ms	1–254	20	Sets how long a carrier signal must be lost before the modem disconnects.
S11	1 ms	50–150*	95*	Sets spacing and duration of dialing tones.
S28	decimal	0, 1–255	1	0 disables, 1–255 enables V.34 modulation.
S30	1 minute	0, 1–255	0	Sets the length of time that the modem waits before disconnecting when no data is sent or received. A value of zero disables the timer. See also the ***\T*** command
S35	decimal	0–1	0	0 disables, 1 enables the V.25 data calling tone, which allows remote data/fax/voice discrimination.
S36	decimal	0–7	7	Specifies the action to take in the event of a negotiation failure when error control is selected. (See ***S48***.)
S37	decimal	0–19	0	Sets the maximum V.34 “upstream” speed at which the modem attempts to connect. 0 = maximum modem speed 1 = reserved 2 = 1200/75 bps 3 = 300 bps 4 = reserved 5 = 1200 bps 6 = 2400 bps 7 = 4800 bps 8 = 7200 bps 9 = 9600 bps 10 = 12000 bps 11 = 14400 bps 12 = 16800 bps 13 = 19200 bps 14 = 21600 bps 15 = 24000 bps 16 = 26400 bps 17 = 28800 bps 18 = 31200 bps 19 = 33600 bps

S38 decimal 0–23 1

Sets "downstream" data rate where K56flex provides rates of 32,000 to 56,000 in 2,000 bps increments, V.90 provides rates of 28,000 to 56,000 bps in increments of 1,333 bps.

0 = V.90 disabled

	K56flex rates
1 = V.90 autorate	
2 = 28,000 bps	2 = 32,000 bps
3 = 29,333 bps	3 = 34,000 bps
4 = 30,666 bps	4 = 36,000 bps
5 = 32,000 bps	5 = 38,000 bps
6 = 33,333 bps	6 = 40,000 bps
7 = 34,666 bps	7 = 42,000 bps
8 = 36,000 bps	8 = 44,000 bps
9 = 37,333 bps	9 = 46,000 bps
10 = 38,666 bps	10 = 48,000 bps
11 = 40,000 bps	11 = 50,000 bps
12 = 41,333 bps	12 = 52,000 bps
13 = 42,666 bps	13 = 54,000 bps
14 = 44,000 bps	14 = 56,000 bps
15 = 45,333 bps	
16 = 46,666 bps	
17 = 48,000 bps	
18 = 49,333 bps	
19 = 50,666 bps	
20 = 52,000 bps	
21 = 53,333 bps	
22 = 54,666 bps	
23 = 56,000 bps	

Upstream data rates

Upstream V.90 data rates are 4800 to 33,600 bps in 2400 bps increments.

S42 decimal 0–1 1

Enables/disables the 56K auto rate. When 56K auto is disabled, fallback to V.34 is also disabled. 0 = disable;
1 = enable.

S43 decimal 0–1 1

For testing and debugging only. Enables/disables V.32bis start-up auto mode operation. 0 = disable; 1 = enable.

S48 decimal 7 or 128 7

Enables (7) or disables (128) LAPM negotiation. The following table lists the ***S36*** and ***S48*** configuration settings for certain types of connections.

	S48=7	S48=128
S36=0, 2	LAPM or hangup	Do not use
S36=1, 3	LAPM or async	Async
S36=4, 6	LAPM, MNP, or hangup	MNP or hangup
S36=5, 7	LAPM, MNP, or aysnc	MNP or async

S89 seconds 0, 5–255 10

Sets the length of time in the off-line command mode before the modem goes into standby mode. A value of zero prevents standby mode; a value of 1–4 sets the value to 5.

S108 decimal 0–3, 6, 7 6

Selects the 56K digital loss if using the modem thru a PBX line. The default value is -6 dB loss, the value used when calling from a typical POTS line long distance.

0 = -0 dB digital loss, no robbed-bit signaling
1 = -3 dB PBX digital loss
2 = -2 dB digital loss
3 = -3 dB digital loss
6 = -6 dB digital loss
7 = -0 dB digital loss with robbed-bit signaling

S109 decimal 0--2 1

Sets one of three 56K operating modes:
K56flex mode, V.90 mode, or Auto-mode.
S109=2 forces V.90 connections for testing purposes, etc. S109 sets the 56K operating mode as shown below:

0 = V.90 disabled
1 = K56flex or V.90 (Dual mode enabled)
2 = V.90 only (K56flex disabled).

Result Codes

In command mode your modem can send responses called *result codes* to your computer. Result codes are used by communications programs and can also appear on your monitor.

Terse	Verbose	Description
0	*OK*	Command executed
1	*CONNECT*	Modem connected to line
2	*RING*	Ring signal detected
3	*NO CARRIER*	Carrier signal lost or not detected
4	*ERROR*	Invalid command
*5 **	*CONNECT 1200*	Connected at 1200 bps
6	*NO DIALTONE*	No dial tone detected
7	*BUSY*	Busy signal detected
8	*NO ANSWER*	No answer at remote end
*10**	*CONNECT 2400*	Connected at 2400 bps
*11**	*CONNECT 4800*	Connected at 4800 bps
*12**	*CONNECT 9600*	Connected at 9600 bps
*13**	*CONNECT 14400*	Connected at 14400 bps
*14**	*CONNECT 19200*	Connected at 19200 bps
*24**	*CONNECT 7200*	Connected at 7200 bps
*25**	*CONNECT 12000*	Connected at 12000 bps
*26**	*CONNECT 16800*	Connected at 16800 bps
*40**	*CONNECT 300*	Connected at 300 bps
*55**	*CONNECT 21600*	Connected at 21600 bps
*56**	*CONNECT 24000*	Connected at 24000 bps
*57**	*CONNECT 26400*	Connected at 26400 bps
*58**	*CONNECT 28800*	Connected at 28800 bps
*59**	*CONNECT 31200*	Connected at 31200 bps
*60**	*CONNECT 33600*	Connected at 33600 bps
*70**	*CONNECT 32000*	Connected at 32000 bps, 56K rate
*71**	*CONNECT 34000*	Connected at 34000 bps, 56K rate
*72**	*CONNECT 36000*	Connected at 36000 bps, 56K rate
*73**	*CONNECT 38000*	Connected at 38000 bps, 56K rate
*74**	*CONNECT 40000*	Connected at 40000 bps, 56K rate
*75**	*CONNECT 42000*	Connected at 42000 bps, 56K rate
*76**	*CONNECT 44000*	Connected at 44000 bps, 56K rate
*77**	*CONNECT 46000*	Connected at 46000 bps, 56K rate
*78**	*CONNECT 48000*	Connected at 48000 bps, 56K rate
*79**	*CONNECT 50000*	Connected at 50000 bps, 56K rate
*80**	*CONNECT 52000*	Connected at 52000 bps, 56K rate
*81**	*CONNECT 54000*	Connected at 54000 bps, 56K rate
*82**	*CONNECT 56000*	Connected at 56000 bps, 56K rate
88	*DELAYED*	Delay is in effect for the dialed number
89	*BLACKLISTED*	Dialed number is blacklisted
90	*BLACKLIST FULL*	Blacklist is full
100	*CONNECT 28000*	Connected at 28000 bps, V.90 rate
101	*CONNECT 29333*	Connected at 29333 bps, V.90 rate
102	*CONNECT 30666*	Connected at 30666 bps, V.90 rate
103	*CONNECT 33333*	Connected at 33333 bps, V.90 rate
104	*CONNECT 34666*	Connected at 34666 bps, V.90 rate
105	*CONNECT 37333*	Connected at 37333 bps, V.90 rate
106	*CONNECT 38666*	Connected at 38666 bps, V.90 rate
107	*CONNECT 41333*	Connected at 41333 bps, V.90 rate
108	*CONNECT 42666*	Connected at 42666 bps, V.90 rate
109	*CONNECT 45333*	Connected at 45333 bps, V.90 rate
110	*CONNECT 46666*	Connected at 46666 bps, V.90 rate
111	*CONNECT 49333*	Connected at 49333 bps, V.90 rate
112	*CONNECT 50666*	Connected at 50666 bps, V.90 rate
113	*CONNECT 53333*	Connected at 53333 bps, V.90 rate
114	*CONNECT 54666*	Connected at 54666 bps, V.90 rate

* *EC* is added to these result codes when the extended result codes configuration option is enabled. *EC* is replaced by one of the following

codes, depending on the type of error control connection:

V42bis —V.42 error control (LAP-M) and V.42bis data compression
V42 —V.42 error control (LAP-M) only
MNP5 —MNP 4 error control and MNP 5 data compression
MNP4 —MNP 4 error control only
NoEC —No error control protocol).

Chapter 3 - Class 1 Fax Commands

Introduction

The Service Class 1 standard (EIA/TIA-578) defines the commands that a PC user may issue to configure and control a fax/data modem, and the responses (result codes) that the fax/data modem may issue in response to those commands.

The Class 1 standard provides the basic services needed to support Group 3 fax operation. Support of the 1988 CCITT (ITU-T) T.30 recommended procedures for session management and the T.4 recommendation for image data handling are required at the PC.

Service Class 1 provides the following services (as required, or optional in Group 3 facsimile operation):

- Connection (originate and answer),
- Waiting and silence detection,
- Data transmission and reception (data transfer),
- HDLC (High-level Data Link Control) data framing/transparency/error detection, and
- Message generation/response.

HDLC is an ISO standard, bit-oriented data communications protocol. HDLC control information is consistently placed, and specific control bit patterns are considerably different than those used as data, providing a largely error-free protocol.

Class 1 Fax Command Summary

The Modem*Module* Fax Class 1 enhancements are implemented with six ***AT+F*** (for Fax) commands. The ***+FTM, +FRM, +FTH, and +FRH*** commands must be entered as the last command in the command string (i.e., the last command on the command line). The ***+FTS*** and the ***+FRS*** commands can be entered anywhere in the command string.

Command	Description
+FCLASS?	Display Current Class
+FCLASS=?	Display Service Class Capabilities
+FCLASS=<>	Select Service Class
+FTS=<time>	Stop tranmission and pause (10 ms intervals, 0-255)
+FTS=?	Display the valid ***+FTS=<time>*** range (0-255)
+FRS=<time>	Wait for silence (10 ms intervals, 0-255)
+FRS=?	Display the valid ***+FRS=<time>*** range
+FTM=<MOD>	Transmit data with specified <MOD> carrier
+FTM=?	Display the valid ***+FTM=<MOD>*** carrier range
+FRM=<MOD>	Receive data with specified <MOD> carrier
+FRM=?	Display the valid ***+FRM=<MOD>*** carrier range
+FTH=<MOD>	Transmit HDLC data with specified <MOD> carrier
+FTH=?	Display the valid ***+FTH=<MOD>*** carrier range
+FRH=<MOD>	Receive HDLC data with specified <MOD> carrier
+FRH=?	Display the valid ***+FRH=<MOD>*** carrier range

If entering multiple commands on the command line, use semicolons between commands. These ***+F*** commands are defined in the following sections. The <MOD> parameter may take on the following values.

Table 3-1. Fax MOD (Modulation) Parameter Values

Value	Modulation	Speed (bps)	Requirements
3	V.21 ch.2	300	required for +FTH & +FRH
24	V.27ter	2400	required for +FTM & +FRM
48	V.27ter	4800	required for +FTM & +FRM
72	V.29	7200	optional
73	V.17	7200	optional
74	V.17 w/st	7200	optional
96	V.29	9600	optional
97	V.17	14400	optional
98	V.17 w/st	14400	optional
121	V.17 or V.33	12000	optional
122	V.17 w/st	12000	optional
145	V.17 or V.33	14400	optional
146	V.17 w/st	14400	optional

All other codes are reserved. "V.17 w/st" indicates V.17 short training (aka, "quick train"). All of the above commands return an *ERROR* result code if entered when the Modem*Module* is on-hook.

Use the command syntax ***+<command>=?*** to ask for the valid range of values supported. For example, if you entered ***+FTH=?***, the Class 1 Modem*Module* would return *3* (a Class 2 Modem*Module* would return *3,24,48,72,73, 74, 96*).

Command: ***+FCLASS? <Enter>***
Function: Display Current Class
Values: 0, 1, 2
Default: 0 (data modem)
Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.
Description: ***+FCLASS?*** requests the current Service Class of the Modem*Module*, as shown below.

Result Code	Meaning
0	indicates a data modem
1	indicates a Service Class 1 (fax/data) modem
2	indicates a non-standard Class 2 modem (based on an early draft of the Class 2.0 standard).

Command: ***+FCLASS=? <Enter>***
Function: Display Service Class Capabilities
Values: 0, 1 (other values are reserved)
Default: 0 (data modem)
Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.
Description: The ***+FCLASS=?*** command displays the set of Service Classes supported by the modem from the list of values (e.g., *0,1* for a modem that supports data communications plus fax Service Class 1). This command returns the service class or classes available with the modem. The modem returns a list of all supported values, separated by commas if more than one class is supported. For example, a modem that supports data communications and Class 1 fax would respond with "*0,1*".

Command: ***+FCLASS=<value> <Enter>***
Function: Select Service Class
Values: 0, 1, 2
Default: 0 (data mode)
Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.
Description: This command configures the Service Class for the modem.

The command options are:

+FCLASS=0	Select Data mode
+FCLASS=1	Select Fax Class 1 operation
+FCLASS=2	Select Fax Class 2 operation

Example: To configure the modem for Class 1 fax operation, enter the command ***AT+FCLASS=1*** and hit Enter. The modem will then accept Class 1 commands.

Command: ***+FTS=<time> <Enter>***
Function: Stop Transmission and Wait
Values: ***<time>*** = 0-255 in 10 ms intervals
Default: 0
Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.
Description: The ***+FTS=*** command causes the modem to stop any transmission, then wait for the amount of time specified by ***<time>***, then send an *OK* result code to the PC. If this command is entered with the modem on-hook, the *ERROR* result code is displayed. The main function of ***+FTS*** is to enforce the 75+/-20 ms of silent time needed between modulation changes.

Note: The ***+FTS=*** command can be entered anywhere in the command string.

Command: ***+FTS=? <Enter>***
Function: Display the wait-for-silent time range
Values: ***<time>*** = 0-255 in 10 ms intervals
Default: 0
Result Codes: the current range of values supported by the modem.
Description: The ***+FTS=?*** command causes the modem to display the valid (supported) range of time intervals specified by the ***+FTS=<time>*** command.

Command: ***+FRS=<time> <Enter>***
Function: Stop Transmission and Wait
Values: <time> = 0-255 in 10 ms intervals
Default: 0
Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.
Description: The ***+FRS=*** command causes the modem to listen for a specified amount of silence on the line, then display an *OK* result code when silence has been present on the line for the amount of time specified. The value <time> is in 10 millesecond intervals. The command terminates when either the specified amount of silent time has been detected, or when the PC sends the modem another character (which is discarded). The modem returns the *OK* result code in either case. If this command is entered with the modem on-hook, the *ERROR* result code is displayed. The main function of the ***+FRS=*** command is to determine when it is safe to reverse the line and start transmitting.

Note: The ***+FRS=*** command can be entered anywhere in the command string.

Command: ***+FRS=? <Enter>***
Function: Display the range of stop-transmission-and-wait period values
Values: ***<time>*** = 0-255 in 10 ms intervals
Default: 0

Result Codes: the current range of values supported by the modem.
Description: The ***+FRS=?*** command causes the modem to display the current set of stop-transmission-and-wait period values supported (specified by the ***+FRS=<time>*** command).

Command: ***+FTM=<MOD> <Enter>***
Function: Transmit data with <MOD> carrier
Values: ***<MOD>*** = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146
Default: 3 (V.21 ch.2 @ 300 bps)
Result Codes: *CONNECT* at start of training pattern transmission; *ERROR* if the parameter value is out of range.
Description: The ***+FTM*** command causes the PC to transmit data using the fax modulation specified in <MOD> (see Table 3-1 for values). The modem displays the *CONNECT* result code, then tranmits the proper training sequence in the selected mode, followed by constant 1 bits until data is received from the PC. The modem buffers data in this mode, using the flow control method defined by the ***&E*** command. When the modem's transmit buffer is emptied, and if the last character transmitted was not a NUL, the modem turns off tranmit carrier, returns to Command mode, and displays the *OK* result code.

Note: The ***+FTM=*** command must be entered as the last command in the command string (i.e., it must be followed by the <Enter> key).

Command: ***+FTM? <Enter>***
Function: Display the range of valid transmit data modulation values
Values: ***<MOD>*** = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146
Default: 3 (V.21 ch.2 @ 300 bps)
Result Codes: the current value supported by the modem.
Description: The ***+FTM?*** command causes the modem to display the current set of accepted modulation for transmit data values (specified by the ***+FTM=<MOD>*** command).

Command: ***+FRM =<MOD> <Enter>***
Function: Facsimile Receive with <MOD> carrier
Values: see Table 3-1 for <MOD> (modulation) values
Default: 3 (V.21 ch.2 @ 300 bps)
Result Codes: *CONNECT, NO CARRIER,* or *+FCERROR*
Description: The ***+FRM=*** command causes the modem to enter fax receive mode using the modulation specified by ***<MOD>*** (refer to Table 3-1 for ***<MOD>*** values). The modem returns to Command mode on loss of carrier, then displays the *NO CARRIER* result code on the PC. When the modem detects the selected carrier, it sends the *CONNECT* message. If a different signal is detected, a *+FCERROR* (Connect Error) is displayed, and the modem returns to Command mode. The modem uses the flow control method defined by the ***&E*** command. If the PC sends any character except DC1 or DC3, the modem enters Command mode, and causes the PC to display the *OK* result code. If this command is entered with the modem on-hook, the *ERROR* result code is displayed.

Note: The ***+FRM=*** command must be entered as the last command in the command string (i.e., it must be immediately followed by the <Enter> key).

Command: ***+FRM=? <Enter>***
Function: Display the valid range of receive data modulation values
Values: ***<MOD>*** = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146
Default: 3 (V.21 ch.2 @ 300 bps)
Result Codes: the current value range supported by the modem.

Description: The ***+FRM=?*** command causes the modem to display the current modulation for receive data spcified by the ***+FRM=<MOD>*** command.

Command: ***+FTH=<MOD> <Enter>***
Function: Transmit HDLC data with <MOD> carrier
Values: see Table 3-1 for <MOD> (modulation) values
Default: 3 (V.21 ch.2 @ 300 bps)
Result Codes: *OK, ERROR, or CONNECT*
Description: The ***+FTH*** command causes the modem to transmit data in HDLC protocol using the selected modulation (see Table 3-1 for modulation <MOD> values). The modem buffers data in HDLC transmit mode, using the configured method of flow control to pause PC data, as necessary. If the PC sends no data for 5 seconds after the *CONNECT* message, the modem turns off its transmit carrier, returns to Command mode, and displays the *OK* message.

Note: The ***+FTH*** command must be entered as the last command in the command string (i.e., it must be immediately followed by the <Enter> key).

Command: ***+FTH=? <Enter>***
Function: Displays the valid range of transmit modulation values
Values: ***<MOD>*** = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146
Default: 3 (V.21 ch.2 @ 300 bps)
Result Codes: the current range of valid values supported by the modem.
Description: The ***+FTH=?*** command causes the modem to display the set of supported transmit modulations specified by the ***+FTH=<MOD>*** command (refer to Table 3-1).

Command: ***+FRH=<MOD> <Enter>***
Function: Receive HDLC data with <MOD> carrier
Values: see Table 3-1 for <MOD> (modulation) values
Default: 3 (V.21 ch.2 @ 300 bps)
Result Codes: *NO CARRIER, +FCERROR, OK*, or *ERROR*
Description: The ***+FRH*** command causes the modem to receive HDLC packet data using the modulation mode selected with <MOD>, then delivers the next frame to the PC. Possible <MOD> values are shown in Table 3-1. If other than an HDLC packet is detected, the modem displays the *+FCERROR* (Connect Error) message, returns to Command mode, then displays the *NO CARRIER* message. If this command is entered with the modem on-hook, the *ERROR* result code is displayed.

Note: The ***+FRH*** command must be entered as the last command in the command string (i.e., it must be immediately followed by the <Enter> key).

Command: ***+FRH=? <Enter>***
Function: Displays the valid range of receive modulation values
Values: ***<MOD>*** = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146
Default: 3
Result Codes: the valid range of values supported by the modem.
Description: The ***+FRH=?*** command causes the modem to display the set of supported receive modulation values (specified by the ***+FRH=<MOD>*** command).

Flow Control

XON/XOFF flow control is used by the Modem*Module* to match the PC-to-modem data rate to the line signaling rate. XON/XOFF flow control is mandatory and RTS/CTS flow control is optional per the Class 1 standard. There is currently no Class 1 command for setting the flow control method, and no means to read the current flow control method in use. The PC is responsible for matching the modem's default flow control method.

Result Codes

Your Class 1 Modem*Module* can respond with the basic set of result codes (*OK, CONNECT, NO CARRIER*, and *ERROR*) with only minor differences in meaning for fax mode.

If the modem detects a data carrier or tone other than that specified by the ***+FRM*** or ***+FRH*** command, it sends a *CONNECT ERROR* (*+FCERROR*) result code to the PC, then returns to Command mode. This will allow the PC to recover by reconfiguring the modem to define the unexpected signal. The *CONNECT ERROR* message has the formats *+FCERROR* (verbose) or *+F4* (terse).

Sample Sessions

This section provides Class 1 Fax send and receive handshaking examples.

Table 3-2. Single-Page Class 1 Transmit Example

Command	Respone	Action by Local Modem	Action by Remote PC
AT+FCLASS=1	OK	Set Class 1	
ATD<string>		Dial and send CNG	Answers
		Look for V.21	Sends CED, V.21
		Detect flags	Sends HDLC flags
	CONNECT	Detect flags	
	<NSF frame>	Get CSI	Send CSI packet
	<DLE><ETX>		Send NSF packet
	OK		
AT+FRH=3			
	CONNECT Detect flags		
	<CSI frame data>	Get CSI	Send CSI packet
	<DKE><ETX>	Get FCS	
	OK	Accept FCS	Check FCS
AT+FRH=3			
	CONNECT	Detect flags	
	<DIS> frame data	Get DIS	Send DIS packet
	<DKE><ETX>	Get CRC	
	OK	Accept FCS Check FCS	
AT+FRH=3	NO CARRIER	Detect loss of carrier	Drop carrier
AT+FTH=3		Send V.21 carrier	Detect carrier
	CONNECT	Send flags	Detect flags
		Send TSI frame	Get TSI frame
<TSI frame data>		Send FCS	
<DLE><ETX>	CONNECT	Send flags	
		Send DCS frame	Send DCS frame
<DCS frame data>		Send FCS, flags	
<DLE><ETX>	OK	Drop carrier	
AT+FTS=8; +FTM=96		Wait 80 msec	
	CONNECT	Send V.29 carrier	Detect carrier
<TCF data pattern>		Send TCF data	Get TCF data
<DLE><ETX>	OK	Drop carrier	
AT+FRH=3		Detect carrier	Send V.21 carrier
	CONNECT	Detect flags	Send flags
	<CFR frame data>	Get CFR frame	Send CFR frame
	<DLE><ETX>	Check FCS	Send CRC
	OK	Accept FCS	
AT+FRH=3	NO CARRIER	Detect loss of carrier	Drop carrier
AT+FTM=96	CONNECT	Send V.29 carrier	Detect carrier
<page image data>		Send page data	Receive page
<DLE><ETX>	OK	Drop carrier	
AT+FTS=8; +FTH=3		Wait 80 msec	
		Send V.21 carrier	Detects carrier
	CONNECT	Send flags	Detects flags
<EOP frame data>		Send EOP frame	Receives EOP
<DLE><ETX>		Send FCS	
	OK	Drop carrier	(Final frame)
AT+FRH=3		Detect carrier	Send V.21 carrier
	CONNECT	Detect flags	Send flags
	<MCF frame data>	Get MCF frame	Send MCF frame
	<DEL><ETX>	Check FCS Send FCS	
	OK	Accept FCS	
AT+FRH=3	NO CARRIER	Detect carrier loss	Drop carrier
AT+FTH=3		Send V.21 carrier	Detects carrier
	CONNECT	Send flags	Detect flags
<DCN packet>		Send DCN frame	Receives DCN
<DLE><ETX>		Send FCS	
	OK	Drop carrier	

ATH0	OK	Hang up	Hangup

Table 3-3. Single-Page Class 1 Answer & Receive Example

Command		Action by Respone	Action by Local Modem	Remote PC
AT+FCLASS=1	OK	Set Class to 1		
	RING	Detect Ringing	Dial, send CNG	
ATA		Off hook,		
		Send CED,	Get CED	
		Send V.21 carrier	Detect carrier	
	CONNECT	Send flags	Detect flags	
<CSIframe data>		Send CSI data	Receive FCS	
<DLE><ETX>		Send FCS		
	CONNECT	Send flags		
<DISframe data>		Send DIS data	Receive DIS	
<DLE><ETX>		Send FCS and flags		
	OK	Drop carrier		
AT+FRH=3		Detect carrier	Sends V.21 carrier	
	CONNECT	Detect flags	Send flags	
	<TSI frame data>	Receive TSI	Send TSI frame	
	<DLE><ETX>	Receive FCS	Send FCS	
	OK	Accept FCS		
AT+FRH=3	CONNECT			
	<DCS packet data>	Receive DCS	Send DCS frame	
	<DLER><ETX>	Receive FCS	Send FCS	
	OK	Accept FCS		
AT+FRH=3	NO CARRIER	Detect loss of carrier	Drop carrier	
AT+FRM=96			Wait 75 msec.	
	CONNECT	Detect carrier	Send V.29 carrier	
	<TCF data>	Receive TCF	Send TCF data	
	<DLE><ETX>	Detect carrier loss	Drop carrier	
	NO CARRIER			
AT+FTH=3		Send V.21 carrier	Detects carrier	
	CONNECT	Send flags	Detects flags	
<CFRframe data>		Send CFR frame	Receives CFR	
<DLE><ETX>		Send FCS		
	OK	Drop carrier		
AT+FRM=96				
	CONNECT	Detect carrier	Send V.29 carrier	
	<page image data>	Receive page	Send page data	
	<DLE><ETX>	Detect carrier loss	Drop carrier	
AT+FRH=3			Wait 75 msec.	
		Detects carrier	Sends V.21 carrier	
	CONNECT	Detects flag	Sends flag	
	<EOP frame data>	Receives EOP	Sends EOP packet	
	<DLE><ETX>	Receives FCS	Send CRC	
	OK	Accepts FTS		
AT+FRH=3	NO CARRIER	Detects loss of carrier	Drops carrier	
AT+FTH=3		Send V.21 carrier	Detect carrier	
	CONNECT	Send flags	Detect flags	
<MCF frame data>		Send MCF frame	Receive MCF frame	
<DLE><ETX>		Send FCS		
	OK	Drop carrier		
AT+FRH=3		Receives carrier	Send V.21 carrier	
	CONNECT	Detects flags	Send flags	
	<DCN frame data>	Receives DCN	Send DCN frame	
	<DLE><ETX>	Receives FCS	Send FCS	
	OK	Accepts FCS		
AT+FRH=3	NO CARRIER	Detect loss of carrier	Drops carrier	
ATH0	OK	Hangs up		

Chapter 4 - Class 2 Fax Commands

Introduction

This chapter provides fax software developers with specific Class 2 fax command protocol information to be used in development with Lucent K56flex modem chip set. It is assumed that users have an understanding of ITU-TSS T.30 and T.4 concepts. The “fax command protocol” is defined here as the set of AT Commands used to control the sending/receiving of faxes. The term “fax” is defined as a specialized file transfer protocol for transferring black and white bit mapped images.

AT commands are used to control parameters for this file transfer and to initiate a particular action in the fax protocol. They also provide responses to indicate the progress and status of the transfer.

Class 2 Fax Command Implementation

The MultiModems implement an extension to the AT Command set for controlling fax transmission and reception, which is in compliance with EIA proposed standard TIA-592 (August, 1990) as specified by EIA subcommittee TR29.2. It involves a set of new commands, responses and procedures.

Class 2 Fax Commands (EIA SP-2388 August 1990)

The Lucent L56xVCS Chip Set supports fax Class 2 (August ‘90) commands. These commands and short descriptions of the commands are provided below. For more detailed information, refer to the August 1990 proposal.

Note: The EIA SP-2388 August 1990 proposal is being updated and will be made available when completed.

+FAA FAX Auto Answer Enable

Command Syntax: +FAA=<value>

0: Answer as FAX modem of type specified by +FCLASS
2: Automatically determine whether to answer as FAX or data modem

+FAXERR T.30 Session Error Report

Command syntax: +FAXERR
Response syntax: +FAXERR=<value>

0 - 9 Call placement and termination

0: Normal and proper end of connection
1: Ring detected without successful handshake
2: Call aborted, from +FK or <CAN>

10 - 19 Transmit phase A and miscellaneous errors
20 - 39 Transmit phase B hang-up codes

20: Unspecified transmit phase B error
23: COMREC invalid command received
25: DCS sent 3 times without response
27: Failure to train

40 - 49 Transmit phase C hang-up codes

40: Unspecified transmit phase C error

50 - 69 Transmit phase D hang-up codes

52: No response to MPS repeated 3 times
53: Invalid response to MPS
54: No response to EOP repeated 3 times
55: Invalid response to EOP
56: No response to EOM repeated 3 times
57: Invalid response to EOM

70 - 89 Receive phase B hang-up codes

90 - 99 Receive phase C hang-up codes

90: Unspecified receive phase C error

100 - 119 Receive phase D hang-up codes

100: Unspecified receive phase D error

120 - 255 Reserved codes

+FBOR Data Bit Order Selection

Command syntax: +FBOR=<value>

0: Direct bit order for both Phase C data and for Phase B/D data
1: Reversed bit order for Phase C data and direct bit order for Phase B/D data
2: Direct bit order for Phase C data and reversed bit order for Phase B/D data
3: Reversed bit order for both Phase C data and for Phase B/D data

Note: Direct bit order: First bit transferred of each byte on the DTE-DCE link is the first bit transferred in the PSTN data carrier.

Reversed bit order: Last bit transferred of each byte on the DTE-DCE link is the first bit transferred on the PSTN data carrier.

+FCQ Copy Quality Checking

Command syntax: +FCQ=<value>

0: Disables copy quality checking. The modem will generate Copy Quality OK (MCF) responses to complete pages and set +FPTS=1.

+FCR Capability to Receive

Command syntax: +FCR=<value>

0: Indicates the modem will not receive message data.
1: Indicates the modem can receive message data.

+FCTCRTY ECM Retry Count

Command syntax: +FCTCRTY=<value>

0: Disable error correcting mode retries. Error correcting mode is not supported.

+FDCC Fax Capability Parameters

Command syntax: +FDCC=VR,RB,WD,LN,DF,EC,BF,ST

Response syntax: VR,BR,WD,LN,DF,EC,BF,ST

Valid values:

VR: Vertical resolution
0: Normal, 98 lpi
1: Fine, 196 lpi

BR: Bit rate
0: 2400 bits/s V.27ter
1: 4800 bits/s V.27ter
2: 7200 bits/s V.29 or V.17
3: 9600 bits/s V.29 or V.17
4: 12000 bits/s V.33 or V.17
5: 14400 bits/s V.33 or V.17

WD: Page width
0: 1728 pixels in 215 mm

LN: Page length
0: A4, 297 mm
2: Unlimited length

DF: Data compression format
0: 1-D modified Huffman

EC: Error correction
0: Disable ECM

BF: Binary file transfer
0: Disable BFT

ST: Scan time/line

	VR = normal	VR = Fine
0:	0 ms	0 ms
1:	5 ms	5 ms
2:	10 ms	5 ms
3:	10 ms	10 ms
4:	20 ms	10 ms
5:	20 ms	20 ms
6:	40 ms	20 ms
7:	40 ms	40 ms

+FDCS Current Session Results

Command syntax: +FDCS?
Response syntax: +FDCS=VR,BR,WD,LN,DF,EC,BF,ST

Valid values:

VR: Vertical resolution
0: Normal, 98 lpi
1: Fine, 196 lpi

BR: Bit rate
0: 2400 bits/s V.27ter
1: 4800 bits/s V.27ter
2: 7200 bits/s V.29 or V.17
3: 9600 bits/s V.29 or V.17
4: 12000 bits/s V.33 or V.17
5: 14400 bits/s V.33 or V.17

WD: Page width
0: 1728 pixels in 215 mm

LN: Page length
0: A4, 297 mm
2: Unlimited length

DF: Data compression format
0: 1-D modified Huffman

EC: Error correction
0: Disable ECM

BF: Binary file transfer
0: Disable BFT

ST: Scan time/line

	VR = normal	VR = Fine
0:	0 ms	0 ms
1:	5 ms	5 ms
2:	10 ms	5 ms
3:	10 ms	10 ms
4:	20 ms	10 ms
5:	20 ms	20 ms
6:	40 ms	20 ms
7:	40 ms	40 ms

+FDFFC Data Compression Format Conversion

Command syntax: +FDFFC=<value>

0: Disable mismatch checking. The DTE must check the +FDCS:DF subparameter and transfer matching data.

+FDIS Current Session Parameters

Command syntax: +FDIS=VR,RB,WD,LN,DF,EC,BF,ST
Response syntax: VR,BR,WD,LN,DF,EC,BF,ST

Valid values:

VR: Vertical resolution.
0: Normal, 98 lpi
1: Fine, 196 lpi

BR: Bit rate.
0: 2400 bits/s V.27ter
1: 4800 bits/s V.27ter
2: 7200 bits/s V.29 or V.17
3: 9600 bits/s V.29 or V.17
4: 12000 bits/s V.33 or V.17
5: 14400 bits/s V.33 or V.17

WD: Page width.
0: 1728 pixels in 215 mm

LN: Page length.
0: A4, 297 mm
2: Unlimited length

DF: Data compression format.
0: 1-D modified Huffman

EC: Error correction.
0: Disable ECM

BF: Binary file transfer.
0: Disable BFT

ST: Scan time/line.

	VR = normal	VR = Fine
0:	0 ms	0 ms
1:	5 ms	5 ms
2:	10 ms	5 ms
3:	10 ms	10 ms
4:	20 ms	10 ms
5:	20 ms	20 ms
6:	40 ms	20 ms
7:	40 ms	40 ms

+FDR Begin or Continue Phase C Receive Data

Command syntax: +FDR

This command will initiate a transition to Phase C data reception.

+FDT Begin Phase C Data Transmission

Command syntax: +FDT

This command prefixes Phase C data reception.

+FECM Error Correction Mode Control

Command syntax: +FECM=<value>

0: Error correcting mode disabled.

+FET Transmit Page Punctuation

Command syntax: +FET=<ppm>

0: [PPS-]MPS Another page next, same document
1: [PPS-]EOM Another document next
2: [PPS-]EOP No more pages or documents
3: PPS-NULL Another partial page next
4: [PPS-]PRI-MPS Another page, procedure interrupt
5: [PPS-]PRI-EOM Another document, procedure interrupt
6: [PPS-]PRI-EOP All done, procedure interrupt
7: CTC Continue to correct.

This command is used to punctuate page and document transmission, after one or more +FDT commands.

+FK Session Termination

Command syntax: +FK

This command causes the modem to terminate the session in an orderlymanner.

+FLID Local ID String

Command syntax: +FLID="<local ID string>"

Valid values: ASCII string can be up to 20 characters

Response syntax: +FLID=?

Return value: (20),(32 - 127)

+FLNFC Page Length Format Conversion

Command syntax: +FLNFC=<value>

0: Disables mismatch checking. The DTE must check the +FDCS:LN subparameter and transfer matching data.

+FLPL Indicate Document to Poll

Command syntax: +FLPL=<value>

0: Indicates that the DTE has no document to poll.

+FMDL Request Model Identification

Command syntax: +FMDL?

Response value: The information text cannot exceed 2048 characters.

This command causes the modem to send one or more lines of information text which is used to identify the product .

+FMFR Manufacturer Identification

Command syntax: +FMFR

Response value: The information text cannot exceed 2048 characters.

This command causes the modem to send one or more lines of information text which is used to identify the manufacturer.

+FREV Request Product Revision Identification

Command syntax: +FREV?

Response value: The information text cannot exceed 2048 characters.

This command causes the modem to send one or more lines of information text which is used to identify the version, revision level or data, or other pertinent information.

+FPHCTO DTE Phase C Response Time-out

Command syntax: +FPHCTO=<value>

value = 0—255 (100 ms units)

Default value: 30

This value determines how long the modem will wait for a command after reaching the end of data when transmitting in Phase C.

+FPTS Page Transfer Status

Command syntax: +FPTS=<ppr>

1: MCF Page good
2: RTN Page good; retrain requested
3: RTP Page good; retrain requested.

+FRBC Phase C Receive Data Block Size

Command syntax: +FRBC=<value>

0: Stream mode, Phase C data is terminated by <DLE><ETX>.

+FREL Phase C Received EOL Alignment

Command syntax: +FREL=<value>

0: Indicates that EOL patterns are aligned as received (Default).
1: Indicates that the last received bits of EOL patterns are byte aligned by DCE, with necessary zero fill bits inserted. There are two 2-byte patterns:

+FBOR	binary EOL pattern
0	0000xxxx 10000000
1	xxxx0000 00000001

xxxx represents previous data bits, zero bits, or other leading data.

+FSPL Request to Poll

Command syntax: +FSPL=<value>

0: Indicates that the DTE does not want to poll.

+FTBC Phase C Transmit Data Block Size

Command syntax: +FTBC=<value>

0: Stream mode, Phase C data is terminated by <DLE><ETX>.

+FCFR Indicates Confirmation to Receive

Syntax: +FCFR

Usage: Indicates the reception of an acceptable TCF training burst and valid DCS signal from the remotemachine.

+FCON Facsimile Connection Response

Syntax: +FCON

Usage: Indicates connection with a FAX machine. Generated in response to an originate command or answer command.

+FCSI Reports the Remote ID

Syntax: +FCSI:"<CSI ID string>"

Usage: Reports the called station's ID.

+FDCS Reports DCS Frame Information

Syntax: +FDCS:VR,BR,WD,LN,DF,EC,BF,ST

Usage: Reports negotiated parameters for the current session. The subparameters are described in the +FDCS command description.

+FDIS **Reports DIS Frame Information**

Syntax: +FDIS:VR,BR,WD,LN,DF,EC,BF,ST

Usage: Reports remote FAX capabilities and intentions. The subparameters are described in the +FDCS command description.

+FET **Post Page Message Response**

Syntax: +FET:<ppm>

Usage: Generated by the receiving modem after the end of Phase C reception, on receipt of the postpage message from the transmitting station. The <ppm> codes are described in the +FET command description.

+FHNG **Call Termination with Status**

Syntax: +FHNG:<hang-up status code>

Usage: Indicates that the call has been terminated. The <hang-up status code> values are described in the +FAXERR command description.

+FPTS **Receive/Transmit Page Transfer Status**

Syntax: +FPTS:<ppr>

Usage: Reports a <ppr> number representing the copy quality and related post page message. The valid <ppr> values are defined in the +FPTS command description.

+FTSI **Report the Remote ID**

Syntax: +FTSI:"<TSI ID string>"

Usage: Reports the transmitting station's ID.

For More Information

To obtain Data and Fax specifications and standards (e.g., Class 1 documents (EIA/TIA-578), and Class 2 documents - EIA/TIA Project Number 2388, Async Fax DCE Control Standard Service Class 2, TR29.2), contact:

Telecommunications Industry Association (TIA)
2500 Wilson Boulevard
Suite 300
Arlington, VA 22201
Ph: 703-907-7700
http://www.tiaonline.org/

The ITU is the leading publisher of international telecommunication standards. For further information contact *sales@itu.int* or *http://www.itu.int/publications/index.html*

Global Engineering maintains extensive collections of documents from more than 400 standards-developing organizations worldwide, including: TIA/EIA-578 - Class 1 documents, TIA/EIA-592 - Class 2 documents.

EIA TSB 43 (corrections to TIA/EIA-578), EIA SP 2987 (draft of changes to TIA/EIA-578), and CCITT v7.3 - T.1-T.90 standards (including (T.4 and T.30). Contact:

Global Engineering Documents
800-854-7179 (phone)
303-792-2192 (fax)
http://global.ihs.com/

Chapter 5 - Voice +V Commands

Introduction

This chapter describes the ***+V*** command support. The ***+V*** Command standard IS-101 Voice Control Interim Standard for Asynchronous DCE (prepared by the TIA Technical Subcommittee TR29.2 on Facsimile Digital Interface) defines the commands that a PC user may issue to configure and control a voice/fax/data modem, and the responses (result codes) that the voice/fax/data modem may issue in response to those commands.

The ***+V*** commands and responses provide control of the following services:

- Recording and playback of digitized voice,
- generation and detection of DTMF and other tones,
- switching betweeen voice, fax, and data modes, and
- control-related functions.

The Voice mode has four states which correspond to the direction of voice data flow:

1) Voice command state (event reports only; no data transfers),
2) Voice transmit state (digitized, half-duplex voice data transfers from PC to modem),
3) Voice receive state, (digitized, half-duplex voice data transfers from modem to PC), and
4) Voice translation state (full-duplex DCE voice format conver-sion).

The modem supports three levels of voice service: Service Levels A, B, and C. Service Level A provides the lowest level of services. Service level A performs operations and detects events as follows: Voice transmit, Voice receive, and DTMF generation and Single tone generation. The following events (Result Codes) are reported: 3, 4, 5, 6, 9, 10, 18, 19, 23, 25 (refer to Table 2).

Service Level B provides an optionally greater amount of services, providing DTMF and facsimile calling tone detection during voice transmits in addition to Service Level A. Service Level B provides event reporting similar to Service Level A, but with added event reporting states (e.g., fax calling in transmit state in addition to reporting in command state). Service Level C provides the highest service level with the addition of facsimile calling tone and Busy detection during receives, Dial Tone detection, and double-tone detection. An example of event detection in a Service Level C modem is shown below:

AT+VEM=?
"C"
0A000100
0E601800
1A803840
OK

Voice S-Register Summary

Voice mode S-Register changes are outlined below.

S-Register	Description
S0	Automatic answer is disallowed in Voice mode.
S7	Wait for Carrier After Dial. Default is 60 seconds. In Voice mode, S7 contains the maximum amount of time that the modem will wait during Call Origination, all the time detecting for ringbacks, before assuming that the remote station will not go off hook.
S10	Automatic disconnect is disallowed in Voice mode.

Voice Commands

The ***+V*** Voice enhancements are implemented with ***AT+V*** (for Voice) commands, as well as changes to several existing commands.

In general, the modem does not accept Data mode (+FCLASS=0) commands or Fax mode (+FCLASS=1, 2, 2.0) commands when in Voice mode (+FCLASS=8). The set of existing commands that are changed for Voice mode support is outlined below.

Command	Description
A	Disallowed in Voice mode.
D	Causes the modem to Dial assuming ***+VLS=2*** if ***+VLS=0*** when the ***ATD*** command was entered.
H	Values greater than 0 disallowed in Voice mode.
I	Disallowed in Voice mode.
L	Disallowed in Voice mode.
M	Disallowed in Voice mode.
O	Disallowed in Voice mode.
Q	Disallowed in Voice mode.
X	Disallowed in Voice mode.
Z	Reset modem.
&D	***&D1*** is disallowed in Voice mode.
+FCLASS=8	Places the modem in Voice mode.
+FCLASS=	New values are added for Voice mode.
+FCLASS=?	New values are added for Voice mode.

The set of ***+V*** Voice commands that are provided for Voice mode support is outlined below.

Table 1. Voice +V Commands

Command	Description
+VNH=	Automatic Hangup Control
+FMI?	Report Manufacturer's ID
+FMM?	Report Product ID
+FMR?	Report Version Level
+FLO=	Select Flow Control Method
+VIP	Initialize Voice Parametrers
+VRX	Enter Voice Receive State
+VTS	Produce DTMF and Tone Generation in Voice Mode
+VTS=?	Report Frequency Support
+VTX	Start Voice Transmission Process
+VGR=	Set the Gain for Received Voice Samples
+VGT=	Set the Volume for Transmitted Voice Samples
+VIT	Set DTE/DCE Inactivity Timer
+VLS=	Select Analog Source/Destination
+VLS=?	Identify Analog Source/Destination Configuration and Event Reporting Capabilities
+VRA=	Set Ringback Goes Away Timer
+VRN=	Set Ringback Never Appeared Timer
+VSD=	Set Silence Detection Sensitivity
+VSM=	Select Voice Compression Method
+VSM=?	Report Voice Compression Method
+VTD=	Select Default Beep Tone Duration Timer (DTMF/Tone Generation Duration)
+VDR=	Enable/Disable Distinctive Ring (Ring Cadence Reporting)
+VDT=	Control Tone Cadence Reporting
+VEM=	Event Reporting and Masking
+VEM=?	Report Event Reporting and Masking Capabilities
+VBT=	Set Modem Flow Control Assert and Deassert Points

+VBT=?	Report Modem Flow Control Assert and Deassert Points
+VPP=	Enable or Disable Voice Mode Packet Protocol
+VPR=	Select DTE/DCE Interface Rate (Turn Off Autobaud)

These commands are defined in the following sections.

Command: *+FCLASS= <mode> <Enter>*
Function: Select Modem Operating Mode
Values: 0, 1, 2.0, 2, 3-7, 8, 9-15, 16-255
Default: 0
Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.
Description: The ***+FCLASS=*** command selects the MultiModem mode of operation (data, facsimile, or voice), as shown below.

+FCLASS=	**Modem Operating Mode**
0	selects data modem mode
1	selects Service Class 1 (fax/data) modem mode
2.0	selects Class 2.0 fax/data modem mode
2	selects non-standard Class 2 modem
3-7	reserved for other Fax modes
8	selects IS-101 Voice mode
9-15	reserved for other Voice modes
16-255	reserved for future standards

Command: **+FCLASS=8 DTMF Detect**
Values: 8 characters, case sensitive)
Default: n/a
Description: The ***+FCLASS=8*** command is used to detect and control DTMF. using the procedure below:

1. Enter the command ***AT+FCLASS=8 <cr>*** to the modem.
2. Call into modem with phone. A ➢*r* (incoming ring indication) is displayed, followed by *OK* . The modem is now in Online Voice Command mode, allowing DTMF characters to be passed through from the remote phone. The characters are displayed as shown below:

AT+FCLASS=8
OK
➢*R is RING*
➢/➢*1*➢*1*➢*~*

The Data link escape character (➢), and the 'start of DTMF tone shielding' character (¤) are both output once a button is pressed. The DTMF digit will continue to be output along with a ➢ until the button is released, then another ➢ is output along with a 'DTMF transitions to off' (~) character. Silence on the line is indicated with a (➢s) displayed.

DTMF (dual tone multi frequency) is the signal to the phone company that you generate when you press an ordinary telephone's touch keys. In the United States and perhaps elsewhere, it's known as "Touchtone" phone (formerly a registered trademark of AT&T). DTMF has generally replaced loop disconnect ("pulse" or "rotary") dialing. With DTMF, each key you press on your phone generates two tones of specific frequencies. So that a voice can't imitate the tones, one tone is generated from a high-frequency group of tones and the other from a low frequency group. Here are

the signals you send when you press your touchtone phone keys:

Digit	Low frequency	High frequency
1	697 Hz	1209 Hz
2	697	1336
3	697	1477
4	770	1209
5	770	1336
6	770	1477
7	852	1209
8	852	1336
9	852	1477
0	941	1336
*	941	1209
#	941	1477

When any key is pressed, both the high and low tones of of the row are generated, hence the name "dual tone". For example, pressing the '5' button generates the tones 770Hz and 1336Hz. The frequencies were chosen to avoid harmonics (no frequency is a multiple of another, the difference between any two frequencies does not equal any of the frequencies, and the sum of any two frequencies does not equal any of the frequencies).

Dual Tone Multi-frequency (DTMF) was a technique proposed by the phone company to replace "pulse dialing" to make dialing faster and more reliable. In anticipation to adding other "customer services", 6 additional digits were included, totaling 16 digits. Most commercial phones only include 12 digits. Many specialized phones and telephone equipment (such as ADSI phones, PBXes, etc.) utilize all 16 digits. DTMF was first introduced in the 1960s to the general public as "touch tone" dialing. The conversion from "pulse dialing" to "touch tone" dialing took over 20 years in the US. To this date (and in the foreseeable future) all phone companies support pulse dialing, and most phones you buy still allow you to switch to pulse. In the 80s, DTMF found a complete new use as a "key pad" for voice mail and interactive voice response systems. Since these systems have become a way of life now, DTMF has become the most common "man machine" interface. For additional information on DTMF, try the Telecommunications Industry Association's web site at http://www.tiaonline.org/resources/other_links.cfm.

Command: ***AT+FCLASS=?*** ***<Enter>***
Function: Display Service Class Capabilities
Values: 0, 1 (other values are reserved)
Default: 0
Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.
Description: The ***+FCLASS=?*** command displays the set of Service Classes supported by the modem from the list of values (e.g., *0,1* for a modem that supports data comm plus fax Service Class 1). This command returns the service class or classes available with the modem. The modem returns a list of all supported values, separated by commas if more than one class is supported. For example, a modem that supports data communications, Class 1 fax, Class 2 fax, and Voice mode functions would respond with *"0,1, 2.0, 8*".

Command: ***+VNH=<hook><Enter>***
Function: Automatic Hangup Control
Values: 0, 1, 2, 3-255
Default:
Result Codes: *OK* if command accepted; *ERROR* if parameter out of range.
Description: The ***+VNH*** command causes the modem to enable or disable automatic hangups to a varying degree when in Data mode or Fax mode, as shown below:

+VNH=0 Enable automatic hangups as is normal in other non-Voice modes (such as hanging up the phone when the modem does not detect a data carrier within a given time interval).

+VNH=1 Disable automatic hangups in other non-Voice modes
+VNH=2 Disable automatic hangups in other non-Voice modes. The modem performs only a "logical" hangup (i.e., returns the *OK* result code).
+VNH=3-255 Reserved for future standards

Command: ***+FMI?<Enter>***
Function: Report Manufacturer's ID
Values: n/a
Default: n/a
Result Codes: only unsolicited result codes (not the standard AT -type OK result code)
Description: The ***+ FMI?*** command causes the modem to report text consisting of a single line with the modem manufacturer's name (e.g., *Lucent Data/Fax/Voice*), and our address, phone, and fax numbers.

Command: ***+FMM?<Enter>***
Function: Report Product ID
Values:
Default:
Result Codes: only unsolicited result codes (not the standard AT -type OK result code)
Description: The ***+FMM*** command causes the modem to report text consisting of a single line with the modem's name (e.g., *MultiModem*).

Command: ***+FMR?<Enter>***
Function: Report Version Level
Values:
Default:
Result Codes: *OK* or *ERROR*
Description: The ***+FMR*** command causes the modem to report the firmware version number and/or a date code (e.g., *Vs. 2.07 - 2/4/95*).

Command: ***+FLO=<method><Enter>***
Function: Select Flow Control Method
Values: 0, 1, 2, 3-255
Default:
Result Codes: *OK*, or *ERROR*
Description: The ***+FLO?*** command lets you select the method of flow control provided and used by the modem. If ***+FLO=0***, some other method (such as credit flow control) is used. The Xon-Xoff method is required. Xon is the ASCII character <DC1> (11 hex). Xoff is the ASCII character >DC3> (13 hex). CCITT V.24 circuits 106 and 133 are optional flow control methods. If circuits 106 and 133 are not used (***+FLO<>2***), then circuit 106 is held On whenever ***+FCLASS=8***. In Voice mode, circuit 105 has no effect on the state of transmitted data. (Circuit 133 normally reverts to use as circuit 105 (RTS) when not used for Flow Control.)

+FLO=0 Disable Xon-Xoff and 133/105 flow control
+FLO=1 Enable Xon-Xoff flow control in either direction
+FLO=2 Enable CCITT Circuit 133 for flow control of the modem by the PC; use CCITT Circuit 106 for flow control of the PC by the modem.
+FLO=3-255 Reserved for future standards

Command: ***+VIP***
Function: Initialize Voice Parametrers
Values: 0 (optional)
Default: n/a
Result Codes: n/a
Description: The ***+VIP*** command causes the modem to initialize all Voice parameters to the factory default settings.

This command has the same effect as if the PC had issued commands for the individual parameter settings. The ***+VIP*** command has no effect on the ***+FCLASS*** setting. The optional command ***+VIP=0 <Enter>*** provides a selection of default profiles.

Command: ***+VRX***
Function: Enter Voice Receive State
Values: 0, 1, 2-127, 128-255
Default:
Result Codes: values (above) if the modem accepts the command; ERROR if the modem is not connected to an off-hook Telco line, or one non-Telco input device.
Description: The ***+VRX*** command causes the modem to start the voice reception process. The modem starts the process by returning the *CONNECT* result code to the PC. The modem then sends shielded voice data to the PC, in the format previously selected by the ***+VSM*** command.

The modem exits the voice receive state by one of two means: a <DLE><I>, and an Inactivity Timer timeout. During the voice receive, the modem informs the PC of pertinent events, such as Presumed End of Message (Quiet), and Presumed Hangup (Silence) detected, Busy detected, and Dial Tone detected, so that at the discretion of the PC, the PC may terminate the voice receive state. On termination of the voice receive state, the modem returns the OK result code, and then returns to the Voice Command state.

The Inactivity Timer is in effect during the receive operation. If the PC uses this timer and stops the modem from performing unwanted restarts, the PC must assure that ther is data sent from the PC to the modem often enough to refresh the timer. The ***+VRX*** commands are as follows.

+VRX=0	Voice receive operation. This selection does not provide for modem periodical tone production during a voice receive operation. The PC must issue the proper notifications of a record operation in progress by message playbacks to satisfy possible legal requirements.
+VRX=1	Voice receive operation. This selection does not provide for modem periodical tone production during a voice receive operation. The tone frequency and cadence is manufacturer specific.
+VRX=2-127	Reserved for future specification.
+VRX=128-255	Manufacturer specific.

The result code values (0, 1, 2-127, 128-255) are returned if the modem accepts the command. The *ERROR* result code is returned if the modem is not connected to an off-hook Telco line, or one non-Telco input device.

Command: ***+VTS=<string>***
Function: Produce DTMF and Tone Generation in Voice Mode
Values: refer to the IS-101 Spec.
Default: refer to the IS-101 Spec.
Result Codes: refer to the IS-101 Spec.
Description: The ***+VTS*** command causes the modem to produce DTMF tones, single-frequency tones, and optionally, double-frequency tones. This command allows the PC to generate a dial tone, busy, etc. for those modems capable of generating two arbitrary tones. The modem may perform tone detection during the playing of tones. When the modem receives the signal <DLE><!> to abort playing of the tones, the result code *OK* is displayed, and the modem returns to the voice command state.

The Inactivity Timer is in effect during the receive operation. If the PC uses this timer and stops the modem from performing unwanted restarts, the PC must assure that ther is data sent from the PC to the modem often enough to refresh the timer.
Modem support for the second tone generation is optional. The modem produces compliant DTMF tones when processing DTMF tone production codes. The modem does not necessarily produc

The tone generation string consists of elements in a list where each element is separated by commas. Each element can

be:

1) a single ASCII character in the set of 0-9, #, *, and A-D,
2) a string enclosed in square brackets [ ] , or
3) a string enclosed in curly braces { }

The modem interprets item 1 as a DTMF digit with duration set by the ***+VTD*** command. The modem interprets item 2 as a general duual tone and duration selection. The modem interprets item 3 as a DTMF tone with a different duration than that given by the ***+VTD*** command.

Missing parameters are assumed to be the default value. Unspecified values always default to 0 for frequencies, DTMF * for DTMF tones, and ***+VTD*** for duration. The omission of commas (and associated subparameters) are valid.

The quantity in the square brackets consists of a three-element list. The first element is the first frequency, the second element is the second frequency, and the third element is the duration, in 0.01 second intervals. A lsit may contain null elements. For example [3000] means that the modem generates a single tone at 3000 Hz for the default duration. [3000,3300] means that the modem generates a dual tone at 3000 and 3300 Hz for the default duration. [,3300] means that the modem generates a single tone at 3300 Hz for the default duration.

The quantity in the curly braces consists of a two-element list. The first element is the DTMF tone character, and the second element is the tone duration in 0.01 seconds. The DTMF tone characters are listed above. A list may contain null elements. For example, {@} means DTMF tone "2" for the deafult duration. {} means silence for the default duration.

The modem will stop the tone generation at the point in the string where the modem detects a parsing error, encounters an invalid frequency range, encounters a <CR>, or encounters a semi-colon.

The modem returns the *OK* result code if the PC accepts the command. The *ERROR* result code is displayed if the modem encountered an error in parsing the subparameter, or if the selected frequency is out of range.

Example: Using the ***+VTS*** command for tone generation without using any null elements:

AT=VTS=1,2,[1000,1300,50],{*6},{800,1300,50},9

The above string will perform as follows:

1. Play DTMF 1 with a duration given by the ***+VTD*** command.
2. Play DTMF 2 with a duration given by the ***+VTD*** command.
3. Play tone pair at 1000 Hz and 1300 Hz with a duration of 500 ms.
4. Play DTMF * with a duration of 60 ms.
5. Play tone pair at 800 Hz and 1300 Hz with a duration of 500 ms.
6. Play DTMF 9 with a duration given by the ***+VTD*** command.

Refer to the IS-101 Spec for additional information.

Command: ***+VTS=?***
Function: Report Frequency Support
Values: n/a
Default: n/a
Result Codes: *OK* follows the string
Description: The ***+VTS=?*** command reports the current frequency range in the form <*freq1*>,<*freq2*>,<*dur*> , where

<*freq1*> is the first frequency range,

<*freq2*> is the second frequency range, and

<*dur*> is the duration range for the square brackets and curly braces constructs. The units are in 0.01 seconds. The range of valid <*dur*> values is that of the ***+VTD*** command.

Example: In the example below, the modem responds to the ***+VTS=?*** command by reporting that it supports two frequencies, both in the range of 200-3300 Hz, and supports a duration range from 0 to 5 seconds.

AT+VTS=?
(200-3300), (200-3300), (0-500)
OK

Command: ***+VTX***
Function: Start Voice Transmission Process
Values: n/a
Default: n/a
Result Codes: *OK* on completion of transmission; *CONNECT* if the modem accepts the command; *ERROR* if the modem is not connected to at least one off-hook Telco line, or one non-Telco device.
Description: The ***+VTX*** command causes the modem to start the voice transmission process. The PC sends the data in the format of the previously-entered ***+VSM*** command, using the flow control method selected by the ***+FLO*** command. the voice data is buffered to withstand gaps of missing data from the PC. If the modem does not have any current voice data, the modem sends silence over to the analog destination until the PC provides more voice data. The modem returns the *OK* result code and returns to Command mode after the modem has completely transmitted its buffer contents. The Inactivity Timer can be used to terminate the transmit data state, after which the modem returns to Command mode.

Command: ***+VGR=<gain>***
Function: Set the Gain for Received Voice Samples
Values: 0-255
Default:
Result Codes: *OK* if the modem accepts the command; *ERROR* if the parameter is out of range.
Description: The ***+VGR=*** command causes the modem to set the gain for the received voice samples. Receive gain values larger than 128 indicate a larger gain than nominal, and values smaller than 128 indicate a gain smaller than nominal. The modem may limit the receive gain to a narrower range, such as from 120 to 136, or from 120 to 128. The value 0 is reserved for modem automatic gain control (AGC).

Command: ***+VGT=<level>***
Function: Set the Volume for Transmitted Voice Samples
Values:
Default:
Result Codes: *OK* if the modem accepts the command; *ERROR* if the parameter is out of range.
Description: The ***+VGT=*** command causes the modem to set the volume control, either by attenuating or amplifying the signal, for the transmitted voice samples. Values larger than 128 indicate a larger gain than nominal, and values smaller than 128 indicate a gain smaller than nominal. The modem may limit the receive gain to a narrower range, such as from 120 to 136, or from 120 to 128. The value 0 is reserved for modem automatic volume control (AVC).
Warning: the modem will limit the transmit level over the Telco lines, regardless of the current ***+VGT*** setting, to that permitted by CFR FCC Rules Part 68 - Subpart d.

Command: ***+VIT=<timer>***
Function: Set DTE/DCE Inactivity Timer
Values:
Default:
Result Codes: *OK* if the modem accepts the command; *ERROR* if the parameter is out of range.

Description: The ***+VIT*** command sets the modem's initial value for the PC/Modem Inactivity Timer. The permitted range is displayed by the ***+VIT=?*** command. The units are in 1.0 seconds. The PC can disable the Inactivity Timer by using a value of 0 (***+VIT=0***).

The Inactivity Timer serves to ensure that the PC does not leave the modem in a state where it is not accessible by voice-unaware software. The Inactivity Timer is activated when the PC selects the voice fixed-rate. The timer expires if the flow of data from the PC to the modem stops (in both Voice Command mode and Data mode) for aspecified amount of time. When this timer expires, the modem switches to Data mode with autobauding. By switching to autobauding (and Data mode), the PC is allowed voice-unaware software to recover control of the modem in the event of catastrophic failure that does not result in a modem power down. It is recommended that the PC software leave the modem in autobauding (and Data mode), and use the Inactivity Timer only as needed. Leaving the modem in autobauding is an extra measure to prevent confusion from voice-unaware software acessing the modem in Voice mode at a fixed PC/modem interface rate. You can use the H command to switch to autobauding and Data mode automatically. In Voice mode, the modem does not allow the autoanswer feature, since this feature does not allow the PC to set the modem in Voice mode before answering the phone.

Command: ***+VLS=<label>***
Function: Select Analog Source/Destination
Values:
Default:
Result Codes: *OK* if command accepted; *ERROR* if the <*label*> parameter is out of range or if the modem cannot service the <*label*> parameter requested.
Description: The ***+VLS=*** command causes the modem to select one or more source and destination devices for the analog data to be transmitted. The parameter <*label*> is used to identify each of the supported analog source/destination hardware devices. Codes, called "primitives", are provided to describe which voice I/O device(s) are components in a posssible hardware configuration. The codes are grouped to help define and label 16 common hardware configurations. Each code, except "L" and "T" is followed by an ASCII 0 code (20 hex). Two codes can be concatenated to define a possible analog source/destination hardware configuration.

Code	Description
L	Local phone (no number code)
T	Telco line (no number code)
M0	Internal microphone
M1	External microphone
S0	Internal speaker (requires squelch on any microphone activity)
S1	External speaker (requires squelch on any microphone activity)
H0	External microphone and speaker combination (handset or headset)
Zn	Manufacturer specific device (n>0)
Mn	Manufacturer specific extension (n>1)
Sn	Manufacturer specific extension (n>1)
Hn	Manufacturer specific extension (n>0)

The list below contains 16 commonly-used hardware configurations, and the label and codes used to select each configuration.

<label>	Code(s)	Description
0	none	Modem on-hook. Local phone connected to Telco.
1	T	Modem off-hook, and connected to Telco. Local phone provided with power to detect hook condition.
2	L	Modem off-hook. Local phone connected to modem.
3	LT	Modem off-hook. Local phone connected to Telco. Modem connected to Telco.
4	S	Internal speaker connected to the modem. Modem is on-hook. Local phone connected to Telco.
5	ST	Internal speaker connected to Telco. Modem is off-hook. Modem is connected to Telco. Local phone provided with power to detect hook condition.
6	M	Internal microphone connected to modem. Modem is on-hook. Local phone connected to Telco.
7	MST	Internal microphone and internal speaker connected to Telco. Squelching active. Modem is off-hook, and connected to Telco. Local phone provided with power to detect hook condition.
8	S1	External speaker connected to modem. Modem is on-hook. Local phone connected to Telco.

9	S1T	External speaker connected to Telco. Modem is off-hook and connected to Telco. Local phone provided with power to detect hook condition.
10	MS1T	Internal microphone and and external speaker connected to Telco. Squelching active. Modem is off-hook, and connected to Telco. Local phone provided with power to detect hook condition.
11	M1	External microphone connected to modem. Modem is off-hook. Local phone connected to Telco.
12	M1ST	External microphone and internal speaker connected to Telco. Squelching active. Modem is off-hook, and connected to Telco. Local phone provided with power to detect hook condition.
13	M1S1T	External microphone and external speaker connected to Telco. Squelching active. Modem is off-hook, and connected to Telco. Local phone provided with power to detect hook condition.
14	H	External microphone and speaker combination (handset or headset) connected to modem. Modem is off-hook. Local phone connected to Telco.
15	HT	External microphone and speaker combination (headset or handset) connected to modem. Modem is off hook, and connected to Telco. Local phone provided with power to detect hook condition.

Command: +VLS=?

Function: Identify Analog Source/Destination Configuration and Event Reporting Capabilities
Values:
Default:
Result Codes: <label>,<devices>,trasmit event>,<receive event>,<idle event>
Description: The **+VLS=?** command displays the modem's current source and destination device information for the analog data to be transmitted. refer to the +VLS= <label> command for label code and description information. Note that the +VEM command contains more information about event reporting.
Example: In the example below, the modem reports that it supports only a Telco line at Service Level C.

AT+VLS=?
0,"",0A0001000,0E601800,1A803840
1, "T", 0A0001000,0E601800,1A803840
OK

Command: +VRA=<interval>

Function: Set Ringback Goes Away Timer
Values: 0-50 (in 0.10 second increments)
Default: 50
Result Codes: *OK* if the modem accepts the command; *ERROR* if the <*interval*> parameter entered is out of range.
Description: The ***+VRA=*** command sets the amount of time the modem will wait between Ringbacks before the modem can assume that the remote device has gone off-hook. This command does not effect the Quiet Answer **@** dial modifier; the ***+VRA*** command functions the same as the **@** entered at the end of a dial string. Entering ***+VRA=0*** forces the modem to return the *OK* result code immediately after the first Ringback. The parameter <*interval*> refers to the silence interval length between the end of one ring interval and the start of the next ring interval.

Command: +VRN=<interval>

Function: Set Ringback Never Appeared Timer
Values: 0-10 (in 1.0 second increments)
Default: 10
Result Codes: *OK* if the modem accepts the command; *ERROR* if the <*interval*> parameter entered is out of range.
Description: The ***+VRN=*** command sets the amount of time that the modem will wait for Ringback. If the modem does not detect a Ringback within the time period <*interval*>, the modem assumes that the remote device has gone off hook, and returns the *OK* result code. The modem only uses this command in call origination transactions. A ***+VRN=*** setting greater than the S-Register S7 setting means that only the S7 timer is in effect. Entering ***+VRA=0*** forces the modem to return the *OK* result code immediately after dialing

Command: +VSD=<sds>,<sdi>

Function: Set Silence Detection Sensitivity
Values: 0-256 (in 0.1 second intervals)
Default:

Result Codes: *OK* if the modem accepts the command; *ERROR* if one or more of the following apply: 1) the <*sds*> or <*sdi*> parameter entered is out of range, or 2) either of the two parameters are missing from the command string. If an error occurs, the modem retains the previous <*sds*> and <*sdi*> parameter values.

Description: The ***+VSD=*** command sets the silence detection sensitivity and the required period of silence before the modem reports silence detected at the end of a voice receive, either with the *Presumed End of Message* (Quiet) or *Presumed Hangup* (Silence) event reports. The table below outlines the possible combinations of the ***+VSD*** and ***+VSM*** commands using the <*sds*> parameter. An <*sdi*> parameter value of 0 means that long-term silence detection is disabled. (Note that long-term silence detection refers to the use of this function to detect the end of a voice receive (i.e., the user stops talking).

+VSD <sds>	+VSM Silence Compression in Use	+VSM Silence Compression Not Used
0	Use +VSM silence compression setting and algorithm for long-term silence detection.	Use default long-term silence detection level and algorithm.
not 0	Sets long-term silence detection setting independent of presence or use of silence detection, where: <sds> = 128; nominal level of silence detection sensitivity <sds> > 128; more aggressive level of silence detection sensitivity (less sensitive, higher noise levels considered to be silence). <sds> < 128; less aggressive level of silence detection sensitivity (more sensitive, lower noise levels considered to be silence).	

The parameter <*sds*> is used by the PC to select greater amounts of modem silence detection activity; larger values imply that the PC wants the modem to treat noisier conditions as silence. The value entered for <*sds*> has no actual unit of measure. The modem may limit silence detection sensitivity to a more narrow range (e.g., from 120 to 136). A setting of 0 has no meaning.
The parameter <*sdi*> sets the required period of silence before the modem can report silence detected either with the *Presumed End of Message* (Quiet) or *Presumed Hangup* (Silence) event reports. A value of 0 disables modem silence detection, in which case the modem will not report the *Presumed End of Message* (Quiet) or *Presumed Hangup* (Silence) event reports.

Command: ***+VSM=<cml>,<vsr>,<scs>,<sel>***
Function: Select Voice Compression Method
Values: (see individual parameter descriptions)
Default: (see individual parameter descriptions)
Result Codes: *OK* if the modem accepts the command; *ERROR* if one or more of the following apply: 1) the *any* parameter entered is out of range, or 2) any of the four parameters are missing from the command string. If an error occurs, the modem retains the previous <*sds*> and <*sdi*> parameter values.
Description: The ***+VSM=*** command sets the modem to a specified voice compression method, silence compression sensitivity, and voice sampling rate. The modem can maintain a different event detection capability for each compression method. This command allows the PC to set the amount of silence compression appropriate to a particular situation or application. For example, you may want to record your welcome message with the lowest amount of silence removal, with the goal of reducing distortion, meanwhile recording other messages with a more assertive silence removal, to limit disk space used for recording purposes.

The parameter meanings are described below.
<*cml*> is used by the PC to select a compression method. The valid range of values is from 128-256. The range of values from 0-127 is reserved for future standards.

<*vsr*> is used to select the modem voice sampling rate from the set of those supported. The unit of measure is samples per second. See the ***+VSM=?*** command for the list of sampling rates supported by the modem.

<*scs*> has different meanings in voice transmit and voice receive modes. In voice receive, the PC uses <*scs*> to select greater amounts of compression activity; larger <*scs*> values mean that the PC wants the modem to treat noisier conditions as silence. There is no unit of measure for this parameter; it merely represents a number in a range. A value of 0 disables modem silence compression.

In voice transmit mode, the PC signals the modem that the data stream was recorded with silence compression by selecting a non-zero value from within the valid range (the same value as receive). Unpredicatable results can occur if you 1) enable silence compression for transmitting a voice data stream that was not recorded with silence compression enabled, or 2) you disable silence compression for transmitting a voice data stream that was recorded with silence compression enabled. You can modify the silence expansion with the <*sel*> parameter. The range of valid values is 0-255. The modem may limit silence compression sensitivity to a narrower range (e.g., 120-128). A setting of <*scs*>*=0* disables silence compression.

<*sel*> is used to modify the amount of silence expansion. This parameter represents the minimum amount of silence that the modem will expand a period of silence that was previously deleted with a non-zero <*sel*> parameter. A setting of <*sel*>*=0* means the modem will not modify the silence expansion. The valid range of values is ____ - ____ in 0.1 second increments. The modem ignores the <*sel*> parameter if the <*scs*> parameter is 0 (silence compression disabled).

Command: ***+VSM=?***
Function: Report Voice Compression Method
Values:
Default:
Result Codes: *OK*
Description: The ***+VSM=?*** command reports several compression method identifiers in one of two ways: either 1) a compression method (for PCM coding) from the table below, or 2) a co-operative identifier (non-PCM coding) used with other manufacturer's equipment.
Example: the following shows an inquiry about the modem support of compression and other data. In this example, the modem reports that it supports two compression methods.

AT+VSM=?
128,"SIGNED PCM",12,0,(7200-8000,11025),(127-129),(0-50)
132,"ADPCM/AQ",2,40,(7200),(128),(0-50)

The compression method identifiers for PCM coding display the general classification of the compression method in the form <cmid>.

Non-PCM coding reports the compression method identifiers in the form <*cmid*>/<*author*>, where <*cmid*> is the general classification of the compression method and <*author*> is the source of the method. The source <*author*> may be a proprietary method or it may reference a published standard. Each field is limited to 20 characters. The ***+VXT*** command is used to start a translation to or from a particular manufacturer's proprietary voice datastream format to an unsigned (non-PCM) format.

Identifier	**Description**
Signed PCM	Linear PCM sampling using twos complement signed numbers
Unsigned PCM	Linear PCM sampling using unsigned numbers
A-Log/Author	Compression using a-law
U-Log/Author	Compression using u-law
DPCM/Author	Differential Pulse Coded Modulation
DPCMAQ/Author	Differential Pulse Coded Modulation with Adaptive Quantizier
ADPCM/Author	Adaptive Differential Pulse Coded Modulation
VSELP/Author	Vector Sum Exited Linear Predictor
RELP/Author	Residual Exited Linear Predictor
CELP/Author	Codebook Exited Linear Predictor
CVSD/Author	Continuusly Variable Slope Delta Modulation
TDHS/Author	Time Domain Harmonic Distortion
ADM/Author	Adaptive Delta Modulation
DM/Author	Delta Modulation
APC/Author	Adaptive Predictive Coding
ATC/Author	Adaptive Transform Coding
SBC/Author	Sub-Band Coding
GSM/Author	Regular Pulse Exitation Long-term Predictor (RPELTP)
LPC/Author	Linear Predictive Coding

EAPDPCM/Author Embeded Bit ADPCM
MP-LPC/Author Multipulse LPC
LSLTCQ Least Squares Lattice Trellis Coded Quantization
IS-101 does not make any provisions for standard compression modifiers.

Command: ***+VTD=<dur>***
Function: Select Default Beep Tone Duration Timer (DTMF/Tone Generation Duration)
Values:
Default:
Result Codes: *OK* if the modem accepts the command; *ERROR* if the parameter is out of range.
Description: The **+VTD=** command causes the modem to set the default DTMF/tone generation duration used with the ***+VTS*** command. This command does not affect the ***ATD*** command settings. The <*dur*> parameter range is given by the ***+VTD=?*** command, in units of 0.01 seconds. A setting of ***+VTD=0*** specifies a manufacturer-specific time interval.

Command: ***+VDR=<enable>,<report>***
Function: Enable/Disable Distinctive Ring (Ring Cadence Reporing)
Values: see "Description"
Default:
Result Codes: *OK* if the modem accepts the command; *ERROR* if the parameter is out of range.
Description: The ***+VDR*** command causes the modem to enable or disable reporting of the ring cadence information, and to control the timing of the Ring event code report if ring cadence reporting is enabled.

This report format is one line per silence period, and one line per ring period. The length of the silence period is in the form *DROF=<number in units of 0.1 seconds><CR><LF>*, and the length of the ring in the form *DRON=<number in units of 0.1 seconds>*. The <*LR*> character is optional. The modem may produce a Ring event code after the DRON message if enabled by the <*report*> parameter. The <*report*> parameter should be set to a value larger than the expected off-times within a single pattern so that the Ring event reports are issued only during the off-times between the complex patterns.

<enable>	***<report>***	**Description**
0	n/a	The modem will not generate ring cadence reports. Other call progress event codes (including Ring) are reported as normal.
1	0	The modem only produces DROF and DRON messages. Other call progress result codes (including *RING*) are reported as normal.
1	non-zero	The modem only produces DROF and DRON messages. The *RING* result code is displayed after the falling edge of the ring pulse (i.e., after the DRON report).
2-255	non-zero	Reserved for future standards.

Example: The example below shows a cadence with an off time of 4.0 seconds, an on time of 0.8 seconds, an off time of 0.4 seconds, and an on time of 0.8 seconds. The *RING* result code is displayed 0.5 seconds after the last DRON message. The command to enable this sample sequence is ***+VDR-1,5*** , as shown below:

<DLE><X>
DROF=40
DRON=8
DROF=4
DRON=8

RING
<DLE><.>
<DLE><X>
DROF=40
DRON=8
DROF=4
DRON=8
RING
<DLE><.>

Command: ***+VDT=<enable>,<report>***
Function: Control Tone Cadence Reporting
Values:
Default:
Result Codes: *OK* if the modem accepts the command; *ERROR* if the parameter is out of range.
Description: The ***+VDT*** command causes the modem to enable or disable reporting of the control tone cadence information in the frequency band used by the Ringback/Remote Ring, Busy, and Reorder/Fast Busy tones (usually in the 300 - 600 Hz range). This reporting is subject to the tone detection restrictions reported by the ***+VLS=?*** command.

The report format is one line per silence period, and one line per ring period. The length of the silence period is in the form *CPOF=<number in units of 0.1 seconds><CR><LF>*, and the length of the ring period is in the form *CPON=<number in units of 0.1 seconds>*. The *<LR>* character is optional.
Warning: the ***+VEM*** command can disable the reporting of this command regardless of the current setting of the ***+VDT=*** command.

<enable>	***<report>***	**Description**
0	n/a	The modem will not generate control tone cadence reports. Control tone event codes are reported as normal.
1	0	The modem only produces DROF and DRON messages. The modem will not report any Ringback/ Remote Ring, Busy, and Reorder/Fast Busy tonesevent codes. Other control tone event codes are reported as normal.
1	non-zero	(for future implementation)
2-255	non-zero	Reserved for future standards.

Example: The example below shows control tone cadence reporting enabled, with an on tone of 2.0 seconds and an off time of 4.0 seconds. The command used to enable the sample sequence is ***+VDT=1***. Note the absence of the Ringback/ Remote Ring, Busy, and Reorder/Fast Tone event reports.

CPOF=40
CPON=20

CPOF=40
CPON=20

CPOF=40
CPON=20

Command: ***+VEM=<mask>***
Function: Event Reporting and Masking
Values: bits 0 - 32 on (i.e., FFFFFFFF8)
Default:
Result Codes: *OK* if the modem accepts this command; *ERROR* if the bit field contains illegal characters.
Description: The ***+VEM=*** command can be used to disable an event report, regardless of the modem's state, or of the modem's analog signal source or destination's configuration. The *<mask>* parameter is a bit field where bit 0 is the most significant bit of an eight-digit hex number. The PC setting of a bit enable event reporting for that event. Bit 0 in the bit field corresponds to Event number 0 (Caller ID) (see Table 2 for the bit field). This mask effects the reporting of the specified event in all modes (Fax, On-line data, AT Command and Voice modes). Events cannot be masked by modes; however, the PC can change the mask each time it changes modes. The modem-detectable events depend on the compression method selected by the ***+VSM*** command. The ***+VEM*** command may effect the reporting capabilities of other ***+V*** commands. The detection of an event may not be possible at all times and for all compression methods. Use the ***+VLS=?*** command to ask which times and for which compression methods (as well as for which analog source/destination selections) events can be detected and reported when not disabled by the ***+VEM*** command.
Example: In the example below, only the *RING* and the *DTMF* event detection reporting:

AT+VEM=18000000
OK

Command: ***+VEM=?***
Function: Report Event Reporting and Masking Capabilities
Values:
Default:
Result Codes:
Description: The ***+VEM=?*** command returns four lines of modem event reporting/masking capability information, followed by the *OK* result code. The first line indicates the Service Level supported by the modem (though the modem may support more than the capabilities displayed). The next three lines report the capability of the Voice Transmit mode, Voice Receive mode, and the Voice Command mode, respectively. Each line is a hex value that is the bitwise OR function across all of the supported compression methods and across all analog source/destination hardware configurations (i.e., all ***+VLS*** settings) for the specified mode. Note that the displayed hex values are not connected to the <*mask*> parameter in the ***+VEM*** and ***+VEM?*** commands.

Interface Configuration Commands

The commands in this section are used to define the interface between the PC and the modem.

Command: ***+VBT=<deassert>,<assert>***
Function: Set Modem Flow Control Assert and Deassert Points
Values: <***assert***> and <***deassert***> are buffer offsets from the start of the buffer. The buffer's first position is 0. The offset units are octets.
Default:
Result Codes: *OK* if the modem accepts the command; *ERROR* if either the <***assert***> or <***deassert***> parameter is greater than the buffer size, or if the <***deassert***> parameter is greater than or equal to the <***assert***> value.
Description: The ***+VBT=*** command is used to set the flow control assert and deassert points inside the modem's internal transmit buffer. As data is sent from the PC to the modem and is stored in the modem's buffer, when the number of octets in the buffer equals the <***assert***> value, the modem asserts flow control to the PC (e.g., turns off CTS circuits, or sends an Xoff character). As the modem removes data from the buffer and processes the data, when the number of octets in the buffer equals the <***deassert***> value, the modem deasserts flow control (e.g., turns on CTS circuits, or sends an XOn character). The modem may inform the PC (using the ***+VBT=?*** command) that the PC does not permit the modifying of the flow control assert and deassert points by returning a single value, not in the range of values, for each control point.

The ***+VBT=*** command controls the amount of "skid" in the modem's voice buffer, where "skid" is the amount of octets that the modem could accept before losing data after the modem asserts an off flow control signal to the PC.

You can use the ***+VBT=*** command to balance performance versus robustness. For example, if the PC knows there are only 16450 UARTs present, a small "skid" is probably sufficient. If there are 16550 UARTs present, a larger "skid" is probably required.

Command: ***+VBT=?***
Function: Report Modem Flow Control Assert and Deassert Points
Values:
Default:
Result Codes:
Description: The ***+VBT=?*** command displays the posssible <***assert***> and <***deassert***> values set by the ***+VBT=*** command, followed by the *OK* result code.
Example: In the example below, the ***+VBT=?*** command is used to ask about the modem's flow control and buffer size ranges. The modem reports that the deassert point is adjustable between 20 and 100 octets, the assert point is adjustable between 150 and 180 octets, and the transmit buffer size is 200 octets.

AT+VBT=?

(20-100) , (150-180) , (200
OK

Command: ***+VPP=<enable>***
Function: Enable or Disable Voice Mode Packet Protocol
Values: 0, 1; (2-255 reserved for future standards)
Default:
Result Codes: *OK* if the modem accepts the command; *ERROR* if the <*enable*> value is out of range.
Description: The ***+VPP=*** command enables and disables the Packet protocol for Voice mode operation, and handles the new unsolicited Voice mode result codes. The Packet protocol is used to detect lost octets on the modem-to-PC serial link, and to recover the lost octets by requesting retransmission. The Packet protocol assumes that 1) that the data corruption is not a problem on the communications link, and 2) that the last octet sent will never be lost due to data overrun (i.e., that the newer octets always overwrite previous octets in the communications input buffer, a common UART design feature). Several PC processes can cause serial input channel neglect for longer than the Protocol time between asynchronous characters (typically less than 521 microseconds), and data loss can occur. If a character is lost in the received data, the playback of the voice data may be impaired or lost. If a character is lost in the final result code, the connection may fail. The Packet protocol permits recovery from such data loss.

Command: ***+VPR=<rate>***
Function: Select DTE/DCE Interface Rate (Turn Off Autobaud)
Values: 0, 1, 2, 3, 4, 5, 6, 7, 8
Default:
Result Codes: *OK* if the modem accepts the command; *ERROR* if the <*rate*> value is out of range.
Description: The **+VPR=** command causes the modem to select between various fixed modem-to-PC interface rates and autobauding. The selected fixed interface rate stays in effect until the modem selects another interface rate or autobauding, or until the modem returns to autobauding on the expiration of the Inactivty Timer. The newly-selected rate takes effect after the modem returns the *OK* result code.

+VPR=0 select autobauding
+VPR=1 select 2400 bps
+VPR=2 select 4800 bps
+VPR=3 select 7200 bps
+VPR=4 select 9600 bps
+VPR=5 select 12000 bps
+VPR=6 select 14400 bps
+VPR=7 select 16800 bps
+VPR=8 select 19200 bps

If the modem claims support for autobauding (***+VPR=0***), it means that the modem can accept AT commands at 2400 bps at all times while in Voice command mode and with ***+VPR=0***.

Flow Control

XON/XOFF flow control is used by the MultiModem to match the PC-to-modem data rate to the line signalling rate, as well as to the requirements of analog conversion of the voice signals and voice data.

In-band, uni-directional XON/XOFF flow control is mandatory. RTS/CTS (V.24 circuits 106 and 133) flow control is optional per the IS-101 standard.

Voice Mode Result Codes

In Voice mode, the modem can detect and report DTMF, detect call progress tone and cadence events, evaluate voice quality, and can monitor telco-related activities. Events can be reported as a single character (Simple or "Terse" reporting), a full-text message (Message or "Verbose" reporting), or as a repeating pattern (Pattern reporting).

Table 2. Voice Mode Result Codes

Terse	Verbose
0	Caller ID Report
1	DID Report
2	Distinctive Ringing
3	RING
4	DTMF Received
5	Receive Buffer Overrun
6	Facsimile Calling (e.g., 1100 Hz)
7	Data Calling (e.g., 1300 Hz)
8	Local Phone On/Off Hook
9	Presumed Hangup (SILENCE) Time-out
10	Presumed End of Message (QUIET) Time-out
11	SIT Tone (CO Standard Information Tones, sent to pay phones)
12	Bong Tone (Calling Card Tone)
13	Loop Current Interruption
14	Loop Current Polarity Reversal
*15**	Call Waiting Beep/Interrupt*
*16**	Distinctive Call Waiting*
*17**	TDD Detected (e.g., 1400/1800 Hz)*
18	Ringback/Remote Ring
19	BUSY
20	DIALTONE
21	Reorder/Fast Busy
22	V.21 Channel 2 7E Flags
23	Transmit Buffer Underrun
24	Extension Phone On/Off Hook
25	Facsimile or Data Answer (e.g., 2100 Hz)
26	Data Answer (e.g., 2225 Hz)
27	Voice Detect
28	Call Waiting Plus Caller ID
29	Stuttered Dialtone
30	Invalid Voice Data Format
31	Lost Data Detected Event
32	Facsimile Answer
33-63	Reserved for future standard
above *63*	Manufacturer specific

* Further study required for final specification.

The TIA/EIA-602 CONNECT result code is disallowed in voice mode.

Unsolicited Voice Mode Result Codes

The form of the unsolicited result codes for voice mode is different from standard modem Command mode result codes. The ***+V*** specification refers to these voice mode result codes as "event detection reports". Event detection reports are provided in simple report format when one character is enough to report an event, such as *RING*. A complex report format is used when one character is not enough to report an event; generally, all multi-character responses.

Complex event reports are in the format <tag> <=> <data> <cr>, where <tag> is the data type, = is the ASCII = sign,

<data> is a specific data instance, and <cr> is ASCII 13 decimal. Table 3 below defines the complex event report tags.

Table 3. Valid Complex Event Report Tags

Tag	Description
TIME	Caller ID Tag in the form TIME=HHMM, where HH is the hour (00-23) and MM is the minute (00-59). All numbers are in ASCII and numbers less than 10 have a leading 0.
DATE	the current date in the format MMDD (where MM is the month 0-12 nad DD is the day 01-31). All numbers are in ASCII and numbers less than 10 have a leading 0.
NMBR	the telephone number of the caller, in the format NMBR=<Number> or P or O (ASCII 4F hex). The P indicates that the calling number information is not available since the originating caller has requested Private service. The O indicates that the calling number information is not available since the caller is outside of the area code.
NAME	the caller's name in the format NAME=<Listing Name>.
MESG	indicates a data item not listed above in Multiple Message Format: MESG=<Data Tag><Length of Message><Data><Checksum> in printable ASCII (to avoid confusion with binary output).
ERRM	Error Tag (used for Caller ID and other uses). Refer to the ***+VCID*** comand.
DRON	Distinctive Ring Cadence On time.
DROF	Distinctive Ring Cadence Off time.
CPON	Control Tone Cadence On time.
CPOF	Control Tone Cadence Off time.
CWON	Call Waiting Cadence On time.
CWOF	Call Waiting Cadence Off time.
ASTB	See Table 4.
SITT	The data value for the SITT tag, in the format <SITT><=><data><cr>, where <data> can mean: ICNT Intercept Tone VCCT Vacant Code Tone REOT Reorder Tone NCDT No Circuit Detected Tone TON4 Fourth SIT Tone Number TON5 Fifth SIT Tone Number TON6 Sixth SIT Tone Number TON7 Seventh SIT Tone Number

In the event of an unrecognized data tag, the MultiModem presents the data item information as printable hex ASCII numbers following the MESG tag. For example:

RING

DATE=0321
TIME=1405
NMBR=5045551234
NAME=DOE JOE
MESG=060342424231

RING

RING

Unformatted Form Reporting

The MultiModem does not display the Caller ID information if it detects a checksum error in the caller ID packet (either SDM or MDM) while in presentation mode. If the MultiModem receives multiple copies of the Caller ID packets, the MultiModem presents all of the packets to the computer. The MultiModem presents all data items and packet control information found in the SDM and MDM packets, except the leading Us (line seizure information) from the presentation. The checksum is included in the presentation. The entire Caller ID packet is prresented in ASCII hex as printable numbers. The characters in the ASCII hex message are in the bit order presented to the MultiModem. The MultiModem does

not insert spaces, <cr>, or <lf> ASCII codes for formatting between the characters of the packet.

The MultiModem does not check the checksum, and it is the computers job to check message validity. Note that this means that the MultiModem presents the Caller ID information even if the MultiModem detects a checksum error in the Caller ID packet (SDM or MDM) in the presentation mode.

The MultiModem presents all of the information in the packet in ASCII hex as printable characters. The MultiModem includes all Mesasage Type Octets, Message Length Octets, Data Octets, and Checksum Octets for the presentation mode.

Voice Mode Shielded Codes

These codes can be sent in either Command mode or Data mode. The DCE may return the event detection reports after the OK result code from the +FCLASS command. One or more simple event detection reports may be embedded within the data portion of a complex event detection report. Table 3 describes voice mode shielded codes. The number in the first column is the ASCII equivalent (in hex). The number in the second column refers to the numbering scheme used in Table 4.

Table 4. Voice Mode Shielded Codes

Shielded Code	Hex	Event Report Description
<DLE>	(10)	Two contiguous <DLE><DLE> codes indicate a single <DLE> in the data stream.
<SUB>	(1A)	<DLE><DLE> in the data stream.
<ETX>	(3)	End Data State; signifies the end of voice data. Can end with Event 9 (Presumed Hangup Timeout), Event 10 (Presumed End of Message), Event 13 (Loop Current Interruption), Event 14 (Loop Curent Polarity Reversal), Event 19 (BUSY), or Event 20 (DIALTONE).
Q	(51)	Data stream shielded Xon character. Used in the ***+VXT*** command to shield XON characters in the full-duplex data stream and in the Packet Protocol. (The ***+VXT*** command is not supported by the MT5634SMI-ITP.)
S	(53)	Data stream shielded Xoff character. Used in the ***+VXT*** command to shield XOFF characters in the full-duplex data stream and in the Packet Protocol.
M	(4D)	Data stream shielded SOH code used for the Packet Protocol.
W	(57)	Data stream shielded ETB code used for the Packet Protocol.
F	(46)	Data stream shielded ACK code used for the Packet Protocol.
U	(55)	Data stream shielded NAK code used for the Packet Protocol.
G	(47)	Data stream shielded ENQ code used for the Packet Protocol.
T	(54)	Timing Mark.
X	(58)	Packet Header for the "Complex Event Detection Report" (additional event data transfers to the DTE).
.	(2E)	Packet Terminator for the "Complex Event Detection Report" (additional event data transfers to the DTE).
/	(2F)	Start of DTMF tone shielding.
~	(7F)	DTMF transitions to off.
R	(52)	Event Number 3 (RING). The <DLE> shielded version of the RING result code.
1	(31)	Event Number 4 (DTMF 1).
2	(32)	Event Number 4 (DTMF 2).
3	(33)	Event Number 4 (DTMF 3).
4	(34)	Event Number 4 (DTMF 4).
5	(35)	Event Number 4 (DTMF 5).
6	(36)	Event Number 4 (DTMF 6).
7	(37)	Event Number 4 (DTMF 7).
8	(38)	Event Number 4 (DTMF 8).
9	(39)	Event Number 4 (DTMF 9).
0	(30)	Event Number 4 (DTMF 0).
A	(41)	Event Number 4 (Extended Keypad DTMF A).
B	(42)	Event Number 4 (Extended Keypad DTMF B).
C	(43)	Event Number 4 (Extended Keypad DTMF C).
D	(44)	Event Number 4 (Extended Keypad DTMF D).
*	(2A)	Event Number 4 (Extended Keypad DTMF E).
#	(23)	Event Number 4 (Extended Keypad DTMF E).
o	(6F)	Event Number 5 (Receive Buffer Overrun).
c	(63)	Event Number 6 (Facsimile Calling).
e	(65)	Event Number 7 (Data Calling).
h	(68)	Event Number 8 (line current break). Local phone goes on hook.
H	(48)	Event Number 8 (line current detected). Local phone goes off hook.
s	(73)	Event Number 9 (Presumed Hangup "SILENCE" Timeout).
q	(71)	Event Number 10 (Presumed End of Message "QUIET" Timeout).
J	(4A)	Event Number 11 (SIT Tone).
$	(24)	Event Number 12 (Bong Tone).
I	(6C)	Event Number 13 (Loop Current Interruption). Ususally indicates a remote hangup.

L	(4C)	Event Number 14 (Loop Current Polarity Reversal). May indicate a hangup or a receive, depending on CO implementation.
w	(77)	Event Number 15 (Call Waiting/Beep Interrupt).
t	(74)	Event Number 17 (TDD Detected - 1400/1800).
r	(72)	Event Number 18 (Ringback).
b	(62)	Event Number 19 (BUSY). May be repeatedly sent.
d	(64)	Event Number 20 (DIALTONE). May be repeatedly sent.
K	(4B)	Event Number 21 (Reorder/Fast Busy).
F	(46)	Event Number 22 (V.21 Channel 2 7E flags).
u	(75)	Event Number 23 (Transmit Buffer Underrun).
p	(70)	Event Number 24 (Line voltage increase - extension phone goes on hook).
P	(50)	Event Number 24 (Line voltage increase - extension phone goes off hook).
a	(61)	Event Number 25 (Facsimile or Data Answer.
f	(66)	Event Number 26 (Data Answer).
V	(56)	Event Number 27 (Voice Detection). A high confidence of voice.
v	(76)	Event Number 27 (Voice Detection). A low confidence of voice.
i	(69)	Event Number 29 (Stuttered Dialtone).
E	(45)	Event Number 30 (Invalid Voice Data Format. Voice data is incompatible with selected Voice Compression Methods.
Y	(59)	Event Number 31 (Lost Data Detected Event).
m	(6d)	Event Number 32 (Facsimile Answer).
%	(25)	Event Number 63 (manufacturer specific).
&	(26)	Event Number 48 (manufacturer specific).
'	(27)	Event Number 49 (manufacturer specific).
(	(28)	Event Number 50 (manufacturer specific).
)	(29)	Event Number 51 (manufacturer specific).
all other 7-bit ASCII		Reserved for future use.

Sample Sessions

This section provides Voice mode send and receive handshaking examples.

Table 5. Suggested Compression Method and Sample Rate Selection

Command	Response
AT+VSM=?	The PC inquires about the compression methods and bits-per-sample options. The modem reports two compression methods: **1**) PCM, twelve bits per sample, timing marks, sampling rates of 7200-8000 and 11025, three levels of silence compression sensitivity, and silence clip to 0.5 seconds; **2**) the same as 1 above, but without silence compression; 3) ADPCM, two bits per sample, timing marks, sampling rate of 7200, no silence compression, and no silence clip. 128, "SIGNED PCM", 12, 40, (7200-8000, 11025), (127-129), (0-50) 129, "SIGNED PCM", 12, 0, (7200-8000, 11025), (0), (0) 132, "ADPCM/AQ", 2, 40, (7200), (0), (0) OK
AT+VSM=128	The PC selects the first compression method with the intent of queying the event detection capabilities of the modem.
OK	The modem agrees.
AT+VEM=?	Checks the modem event detection capability for the first compression method.
"C" 0A000100 0E601800 1A803840 OK	The modem reports Service Level C.
AT+VSM=132	Selects the second compression method with the intent of querying the event detection capabilities of the modem.
OK	The modem agrees.
AT+VEM=?	Checks the modem event detection capability for the second compression method.
"B" 0A000100 04600000 1A803040 OK	The modem reports Service Level B.
AT+VLS?	The modem inquires about what analog source and destinations are available. The modem reports that a microphone and speaker are available: 0, " ", 0A000100, 0E601800, 1A803840 1, " T", 0A000100, 0E601800, 1A803840 4, " S", 0A000100, 0E601800, 1A803840 6, " M", 0A000100, 0E601800, 1A803840 OK
AT+VSD=?	The modem inquires about what end-of-voice receive silence detection capabilities are available.
(127-129), (50-200)	The modem reports that three levels of sensitivity and a time interval between 5.0 and 20.0 seconds.

Some time later, the PC wants to transmit or receive a voice message. The PC selects 1) the first compression method at 7200 sampling rate, enable silence compression with nominal silence sensitivity, and no silence clipping; 2) report all modem-supported event detection; 3) set end of receive silence detection at nominal silence sensitivity setting and for 5.0 seconds:

AT+VSM=128, 7200, 128, 0; +VEM=FFFFFFFF8; +VSD=128, 50

OK	The modem agrees.
AT+VSM=129, 7200, 0, 0	The PC changes its PC/modem interface rate to 38400 bps and selects a compression method with the least sensitive setting, with the goal of playing a message with less distortion, and at 7200 samples per second. (Assume that the PC issued a +VSM=? command earlier.)

OK	The modem agrees.
AT+VLS=4	The modem selects the speaker. The modem had earlier reported that a speaker was available.
OK	The modem agrees.
AT+VTX	The PC selects the Voice Tranmit mode.
CONNECT	The modem agrees.
DATA	THE PC DELEIVERS DLE SHIELDED AND SILENCE COMPRESSED VOICE DATA ACROSS THE PC/MODEM INTERFACE.
DLE ETX	THE PC INDICATES THE END OF THE VOICE DATA STREAM.
OK	The modem indicates it is in Voice Command mode.
AT+VLS=0	The PC deselects all devices.
OK	The modem agrees.
	The PC switches to Data mode, Command mode, and autobauding enabled:
	AT+VIT=0; +VPR=0; +FCLASS=0
OK	The modem agrees.

Table 7. Answer Phone, Play Greeting Message, and Record Message Example

Command	Response
AT+FCLASS=8; AT+VIT=60; +VPR=16	The DCE switches to Voice mode. The DTE selects a fixed DTE-DCE interface rate. The DTE knows from the sample rate selected earlier and the bits-per-sample that the DTE-DCE interface rate should be 38400 bps. The DTE-DCE Inactivity Timer starts with 60 seconds.
OK	DCE agrees (to the old DTE/DCE interface rate).
AT+VSM=129, 7200, 0, 0	DTE changes its DTE/DCE rate to 38400 bps and selects a compression method with the least sensitive setting, with the goal of recording a message with less distortion, and at 7200 samples per second. Assume that the DTE issued a ***+VSM=?*** command earlier.
OK	The DCE agrees.
AT+VSD=127, 20	DTE selects a silence detection period of
AT+VLS=0	DTE selects a silence detection period of 2 seconds with the least sensitive setting (for detecting the end of voice recording).
OK	The DCE agrees.
AT+VIT=0; +FCLASS=0; S0=0	The DTE selects the Data mode with autobauding, and disables +VPR=0; automatic DCE answering. The DCE waits for a phone call (not necessarily in Data mode).
OK	The DCE agrees.
RING	At some time, a remote station calls.
AT+FCLASS=8;	The DCE switches to Voice mode. The DCE selects a fixed AT+VIT=60; DTE/DCE Interface Rate. The DTE knows from the sample AT+VPR=16; rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38400 baud. The DTE/DCE Inactivity Timer starts with a value of 60 seconds.
OK	The DCE agrees (at the old DTE/DCE Interface Rate).

AT+VLS=0	The DTE selects all devices.
OK	The DCE agrees.
AT+VIT=0; +VPR=0; S0=0	The DTE selects Data mode/Command mode with autobauding, and disables automatic DCE answering. The +FCLASS=0; DCE waits for a phone call (not necessarily in Data mode).
AT+FCLASS=8; AT+VPR=16;	The DCE switches to Voice mode. The DCE selects a fixed DTE/DCE AT+VIT=60; Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38400 baud. The DTE/DCE Inactivity Timer starts with a value of 60 seconds.
OK	The DCE agrees (at the old DTE/DCE Interface Rate).
<DLE> <R>	The DCE selects another ring (at 38400 bps).
AT+VLS=2	The DCE answers the phone.
OK	The DCE indicates that it is in Voice Command mode.
AT+VTX	The DTE selects Voice Transmit mode.
CONNECT	The DCE agrees.
<Data>	The DTE plays the welcome message.
<DLE> <ETX>	The DTE indicates the end of the data stream.
OK	The DCE indicates that it is in Voice Command mode.
AT+VTS= {933, 0, 12}	The DTE annotates the greeting message with a 1.2 sec. beep.
OK	The DCE is ready for another Voice command.
AT+VSM=132, 7200, 0, 0	The DTE selects a low bit compression scheme to save disk space.
OK	The DCE agrees.
AT+VRX	The DTE selects the Voice Receive mode.
CONNECT	The DCE agrees.
<Data>	The DCE delivers <DLE> shielded and silence-compressed voice data across the DTE/DCE interface.
<DLE> <NUL> <DLE> </>	The DTE strokes the Inactivity Timer. The DCE reports the start of a possible DTMF tone.
<DLE> <5> <DLE> <5>	The DCE reports a DTMF 5 detection for 140 milleseconds (within a 70 millesecond resolution).
<DLE> <->	The DCE reports the end of the DTMF 5 detection. For this example, DTMF 5 means "finish with the voice message, and switch to fax mode".
<DLE> <!>	The DTE wishes to end the record by sending an abort command.
<DLE> <ETX>	The DCE indicates the end of the Voice data stream, and returns to Voice Command mode.
AT+VNH=1	The DTE selects to disable automatic hang-ups while in Service Class 2 +VIT=0 (+FSK command result codes in Telco on-hook). The DTE switches the +FCLASS=2 DCE to Service Class 2 fax mode.
OK	The DCE agrees.
ATA	The DCE starts the fax receive process.

DTE/DCE Interface Rates

Table 7 below indicates the anticipated modem-to-computer interface rates for both the 7.2 bits-per-sample rate and the 8 bits-per-sample rate.

Table 7. Projected DTE/DCE Interface Rates for 7.2/8K Hz Sample Rates

Bits per Sample	Projected DTE/DCE I/F Rate @ 7.2K Hz	Projected DTE/DCE I/F Rate @ 8K Hz Sample Rate
0.50	4800	9600
1	9600	19200
2	19200	19200
3	38400	38400
4	38400	57600
5	57600	57600
6	57600	115200
7	115200	115200
8	115200	115200
9	115200	115200
10	115200	115200
11	115200	115200
12	115200	Fast
13	Fast	Fast

Related Manuals

For information on Multi-Tech modem installation, AT commands, S-Registers, and testing, refer to the applicable user manual that came with your Multi-Tech modem. Multi-Tech manuals and other resources are on the Multi-Tech web page at http://www.multitech.com.

For additional Multi-Tech information, contact:
http://www.multitech.com for News, Products, Solutions, Support, Documents and more.

ftp://ftp.multitech.com/ for Modem Firmware, Modem INFs, Manuals, Utilities, etc.

mailto:support@multitech.com for email technical support.

Additional Information

Telecommunications Industry Association (TIA) - the TIA represents the telecommunications industry in association with the EIA.
Contact the TIA at
2500 Wilson Boulevard
Suite 300
Arlington, VA 22201
http://www.tiaonline.org

Global Engineering Documents manages a collection of more than one million documents from over 460 organizations worldwide:
http://global.ihs.com
Phone: 800-854-7179
Fax: 303-792-2192

The ITU is the leading publisher of telecommunication technology, regulatory and standard information, with over 4,000 titles in printed form, on CD-ROM and Online at
http://www.itu.int/publications/ .

Chapter 6 - Remote Configuration

Introduction

Remote configuration is a network management tool that allows you to configure modems anywhere in your network from one location. With password-protected remote configuration, you can issue AT commands to a remote MT5634*SMI* for maintenance or troubleshooting as if you were on-site.

Basic Procedure

The following steps are valid regardless of whether the connection is established by the local or the remote Multi-Tech modem.

1. Establish a data connection with a remote MT5634*SMI* modem.
2. Send three remote configuration escape characters followed by **AT** and the setup password, and press ENTER. Example: **%%%ATMTSMODEM<CR>**. You have four tries to enter the correct password before being disconnected. If the password is correct, the remote modem responds with **OK.**
3. You can now send AT commands to configure the remote modem.
4. When you have finished configuring the remote modem, save the new configuration by typing **AT&W0<CR>**, then type **ATO<CR>** to exit remote configuration. You can then break the connection in the normal way.

CAUTION: If you hang up while you are in remote configuration mode, it may lock up the remote modem.

Setup

Multi-Tech modems are shipped with a default setup password (MTSMODEM). Because anyone who has an owner's manual knows the default setup password, for security you should change the password and possibly also the remote configuration escape character.

Changing the Setup Password

1. Open a data communications program such as HyperTerminal.
2. In the terminal window, type **AT#SMTSMODEM** (or **AT#Syyyyyy** if you have replaced the MTSMODEM password with yyyyyy) and press ENTER. The modem responds with **OK** if the setup password is correct and **ERROR** if it is wrong.
3. To change the password, type **AT#S=yyyyyy**, where yyyyyy stands for the password, and press ENTER. The password can include any keyboard character and must be one to eight characters long. The modem responds with **OK**.
4. The new password is saved automatically. You can now either enter more AT commands or exit the data communications program. The next time you remotely configure the modem you must use the new setup password.

CAUTION: You can only change the setup password locally; you cannot do it remotely. Also, passwords are case sensitive. The next time you enter the password, it must be in the same case as you set it up.

Changing the Remote Escape Character

To increase security, you can change a remote modem's remote configuration escape character. The remote configuration escape character is stored in register ***S9***. The factory default is 37, which is the ASCII code for the percent character (%). Setting ***S9*** to 0 (zero) disables remote configuration entirely—but if you do this

remotely, you won't be able to change it back remotely!

1. Establish a remote configuration link with the remote modem as described in "Basic Procedure."
2. Type **ATS9=*n***, where *n* is the ASCII code for the new remote configuration escape character, then press ENTER.
3. Save the new value by typing **AT&W** and pressing ENTER.
4. Type **ATO<CR>** to exit remote configuration.

Chapter 7 - Troubleshooting

Introduction

Each time you turn on your modem, it performs an automatic self-test to ensure proper operation. Your modem also has three diagnostic tests: local analog loopback, remote digital loopback, and local digital loopback. These ITU-T V.54 loopback tests isolate telephone circuit and transmission problems.

In a loopback test, data from your computer loops through the circuits of your modem and/or a remote modem before it appears on your monitor. When the loop has been completed, the data on your PC's monitor should match the original data.

The local analog loopback test allows you to verify that the modem's transmitter and receiver circuits are functioning properly.

The local digital loopback allows you to verify that the local computer or terminal, the two modems, and the transmission line between them are functioning properly.

The remote digital loopback test allows you to verify that the remote computer or terminal, the remote modem, the serial ports, the telephone line, and the local modem are functioning properly.

Note: All loopback tests operate at all speeds except 300 bps.

Local Analog Loopback Test (V.54 Loop 3)

In this test, data from your computer or terminal is sent to your modem's transmitter, converted into analog form, looped back to the modem's receiver, converted into digital form, and then sent to your monitor for verification. No connection to the phone line is required.

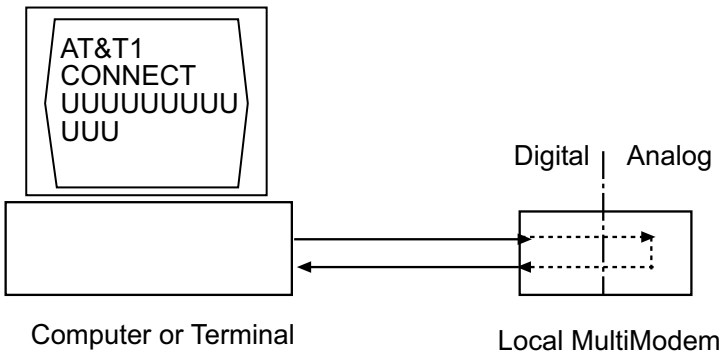

Figure 6-1. Local analog loopback test.

Test procedure

1. Connect the modem to your computer. Using your communication program, set the desired baud rate and go into terminal mode.
2. Type **AT&T1** and press ENTER. This places your modem in analog loopback mode in the originate mode. A *CONNECT* message should appear on your display. The modem is now out of command mode and in a pseudo-online mode.
3. Note that the CD LED is on. If you are set for 14,400 bps or higher, a speed LED should be on. If the CD LED is not on, there is a defect in your modem.
4. Enter characters from your keyboard. For this test, typing multiple uppercase *U* characters is a good way to send an alternating test pattern of binary ones and zeros. The characters entered should be displayed on your monitor. The TD and RD LEDs should flash when a character is entered.
5. To exit the test, type the escape sequence **+++AT** and press ENTER. This puts the modem in online command mode. Then type either **AT&T** or **ATH** to return to command mode.
6. Your modem passes this test if the data received on your monitor are the same as the data entered from your keyboard. If different data appear on your monitor, your modem is probably causing the problem, though it could also be your computer. If your modem passes this test, but you are receiving errors while on line, the remote modem or the phone line could be at fault.

Remote Digital Loopback Test (V.54 Loop 2)

The remote digital loopback test tests the phone lines and the circuits of both your modem and a remote modem. In this test, your modem must be on line with another modem that is set up to respond to a request for remote digital loopback. (Note that some modems might not support remote digital loopback or might have it disabled.) Data from your computer or terminal is transmitted through your modem and over the phone line to the remote modem, where it is then looped back to your modem.

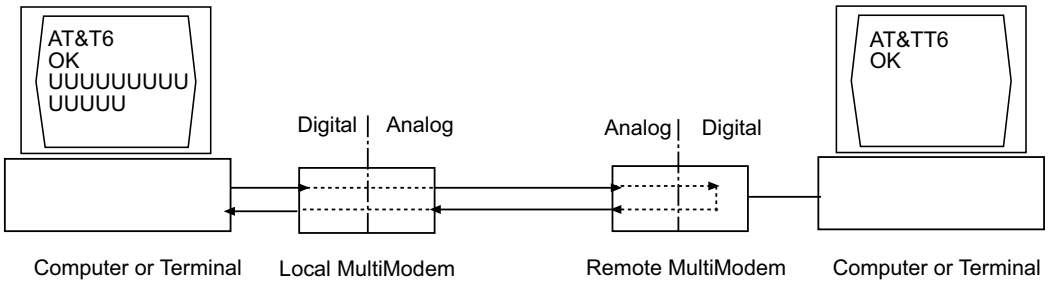

Figure 6-2. Remote digital loopback test.

Test procedure

1. Arrange to have **&T6** set on the remote test modem.
2. Open your communications software and go into terminal mode. Type **AT** and press ENTER; you should get an *OK* message. Type **AT\N** and press ENTER to disable error correction.
3. Dial the remote modem and establish your online connection.
4. Type the escape sequence **+++AT** and press ENTER to bring your modem into online command mode.
5. Type **AT&T6** and press ENTER. The local modem responds to this command by transmitting an unscrambled marking signal, which causes the remote modem to place itself in digital loopback mode. Then the local modem exits online command mode and enters data mode.
6. Enter data from your keyboard. For this test, typing multiple uppercase *U* characters is a good way to send an alternating test pattern of binary ones and zeroes. Data received by the remote modem enters its analog receiver, is converted to digital data, is reconverted into analog, and then is transmitted back to your modem. Your modem passes this test if the data received on your monitor is the same as the data entered from your keyboard.
7. To exit the test, type the escape sequence **+++AT** and press ENTER. This puts the modem in online command mode. The modem should respond with an *OK* message. If you wish to stay on line with the remote modem for normal data transmission, type **AT&T** and press ENTER to exit the test, then type **ATO** and press ENTER to return on line. If you wish to terminate the call, type **ATH** and press ENTER to hang up.

Local Digital Loopback Test (V.54 Loop 2)

The local digital loopback test is identical to the remote digital loopback test with one exception. Instead of using your modem to signal a remote modem to place itself in digital loopback mode, your modem is placed in digital loopback mode while the remote modem is not. Data is entered and transmitted from the remote modem, sent across the phone line to your modem, and looped back to the remote modem.

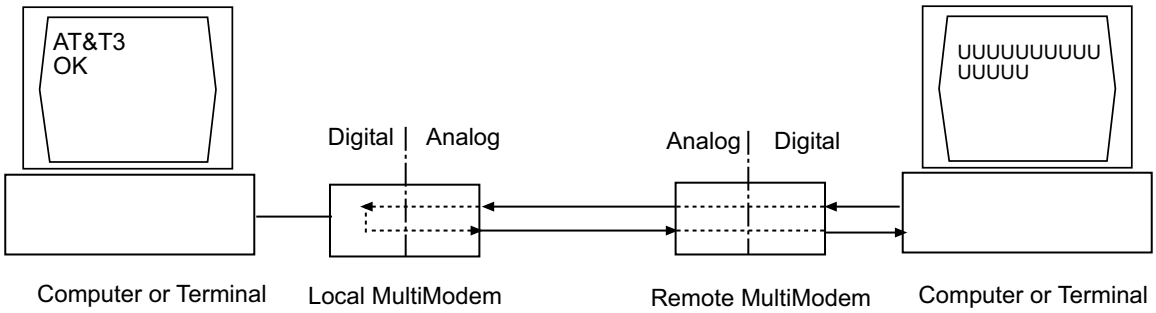

Figure 6-3. Local digital loopback test

Test Procedure

1. Open your communications software and go into terminal mode. Type **AT** and press ENTER; you should get an *OK* message. Type **AT\N** and press ENTER to disable error correction.
2. Dial the remote modem and establish your online connection.
3. Type the escape sequence **+++AT** and press ENTER to bring your modem into online command mode.
4. Type **AT&T3** and press ENTER. Once you receive an *OK* message from your modem (if responses are enabled), your modem is placed in digital loopback mode.
5. Have someone enter data from the remote keyboard. For this test, typing multiple uppercase *U* characters is a good way to send an alternating test pattern of binary ones and zeros. The data received by your modem enters its analog receiver, is converted to digital data, is reconverted into analog, and then is transmitted back to the remote modem. Your modem passes this test if the data received on the remote monitor is the same as the data entered from the remote keyboard.
6. To exit the test, type the escape sequence **+++AT** and press ENTER. This puts the modem in online command mode. The modem should respond with an *OK* message. If you wish to stay on line with the remote modem for normal data transmission, type **AT&T** and press ENTER to exit the test, then type **ATO** and press ENTER to return on line. If you wish to terminate the call, type **ATH** and press ENTER to hang up.

Chapter 8 - Upgrade Procedure

Introduction

Your modem is controlled by semi-permanent software, called firmware, which is stored in flash memory. Firmware is nonvolatile; that is, it remains stored in memory when the modem is turned off. However, either the manufacturer or the user can change the firmware as bugs are repaired or new features are added.

Multi-Tech System's *Flash Wizard* utility can be used in the Windows operating system to update (flash) your modem's firmware.

The *Flash Wizard* utility can be downloaded from Multi-Tech's ftp site.

Upgrade Overview

The upgrade (flash) procedure for the Windows operating system consists of the following steps:

1. Identify the modem's model number and firmware version.
2. Identify the current version of the firmware.
3. Download the upgrade (.HEX) file for your modem.
4. Extract the firmware upgrade (.HEX) file.
5. Install the Flash Wizard.
6. Document your stored parameters.
7. Upgrade the modem's firmware using the .HEX file and the Flash Wizard.
8. Restore your parameters.

Step 1: Identify the Modem Firmware

You must know the model number and firmware version of your Multi-Tech modem to know whether you should update it.

1. Run your favorite terminal program. In Windows 95, Windows 98, Windows NT, or Windows 2000, you may use HyperTerminal.
2. In the program's terminal window, type **AT&F**. Even if you cannot see the **AT&F** command on your screen, be sure to type it completely, and then press **Enter**. The modem should respond **OK**.
3. After the modem responds **OK**, type **ATi** and press **Enter**. Record your results. The model number and firmware version should appear similar to that shown below.

```
LT V.90 1.0 MT5634SMI Data/Fax Modem Version 4.18w
```

Step 2: Identify the Current Version of the Firmware

Identify the current version of the firmware available for your modem on the Multi-Tech web site. If your modem already has the current firmware, there is no need to update it.

1. Using your favorite Web browser, go to Multi-Tech System's support web page. Follow the links to the modem firmware page.
2. Locate your modem model number.
3. Compare the firmware version number for your modem as found in *Step 1: Identify the Modem Firmware*, to the latest firmware version as listed on the web site. If your modem is at the current version, it does not need to be updated.
4. If the current firmware version is greater than the firmware version number found in *Step 1: Identify the Modem Firmware*, your modem has an older firmware version. Continue with *Step 3: Download the Upgrade File*.

Step 3: Download the Upgrade File

At Multi-Tech's Support web page, follow the links to the modem firmware page. Locate the entry for your modem model and click on the upgrade file name to begin downloading the file to a temporary folder on your hard drive.

Step 4: Install the Flash Wizard

Install the Flash Wizard upgrade utility from the temp file on your hard drive.

1. Click on the Flashwiz.exe file in your temp folder. The **Welcome** dialog box displays.
2. Before continuing with the firmware update, exit all Windows programs. Click **Cancel** to quit Setup if you need to close other Windows programs. Close any programs that are running and restart the update Wizard. When you are ready to proceed, click **Next>** to continue.
3. The **Choose Destination Location** dialog box displays. You may click **Browse** and select another folder if you do not want to use the default installation path. Remember the location of the destination folder; you'll need to copy the firmware .Hex file to the same location before using the *Flash Wizard* to update your modem.
   Destination Folder _____
   Click **Next>**.
4. When the program finishes copying files to your computer, the **Setup Complete** dialog box displays indicating that you must restart your computer before using the program.
5. Select **Yes**, then **Finish** to restart your system.

Note: *You must restart your computer to finish the Flash Wizard installation.*

Step 5: Extract the Firmware Upgrade (.Hex) Files

1. When the system restarts, move the upgrade file (downloaded from the web site) to the Flash Wizard utility directory on your computer's hard drive.
2. In Windows, double-click the self-extracting update file. The extracted files include the .HEX file used to update your modem.

Step 6: Document Your Stored Parameters

Before you flash your modem you should record the parameters that are currently stored in your modem so you can reprogram it after flashing.

1. Run your favorite terminal program.
2. In the program's terminal window, type **AT&V** and press **Enter** to list your modem's current parameters.
3. Record your parameters by saving the screens and sending them to your printer.
4. Close the terminal program.

Step 7: Upgrade the Modem's Firmware

CAUTION: *If you are using Windows NT, you must disable Windows RAS and Microsoft Fax Service before upgrading the modem's firmware.*

To disable RAS and your Fax service (Windows NT Only):

1. Click **Start** | **Settings** | **Control Panel**, then double-click **Services**. Select **Remote Access Server** and click **Startup...**. Select **Manual** as the *Start Up Type* and click **OK**.

   If you are using a Fax service in NT, change its *Start Up Type* to **Manual**.
2. Restart your computer.

Using the Flash Wizard

1. Use Windows Explorer to copy the new .Hex file (which you downloaded from the Multi-Tech web site) to the folder in which the *Flash Wizard* program was installed.

2. Click **Start** | **Programs** | **Flash Wizard** to start the firmware update process. The program begins by identifying devices attached to your computer.
3. The Wizard displays a list of installed devices able to be flashed with the update. You may update more than one device in a single procedure. Select the device(s) you'd like to update and click **Next>** to continue.
4. Next, the **Firmware Update Wizard** displays current firmware version information. The top portion of the window provides port, version and country identification for the firmware currently installed on your device(s). The *Hex File* list box displays the firmware versions available for updating your modem.
    a. If your modem's firmware version number matches or is *higher* than the version number listed in the Hex File list, click **Cancel** to end the update process.
    b. If your modem's firmware version number is *lower* than the firmware version shown in the Hex File list, continue with the update process. **Select** the port for the device you are updating. Use the list box to select the latest .Hex file version number for your country and click **Next>**.
5. The **Firmware Update Wizard** displays a progress indicator and begins updating your device(s) with the new firmware version. When the Wizard finishes the update, the progress indicator status changes to *Programming Complete*. Click **Next>** to complete the update.
6. When the update completes, the **Firmware Update Wizard** displays indicating the device has been successfully updated. Click **Finish>** to close the Wizard.
7. You must restart your computer to make the firmware changes effective for your modem.

Note: *If you are using Windows NT, be certain to enable RAS and your fax program when the operating system restarts.*

Step 8: Restore Your Parameters

Your modem has been updated. You can now open your terminal program to reprogram your modem parameters or to confirm the update by typing **ATi** in a terminal window.

Appendix A - Regulatory Agency Compliance

FCC Regulations for Telephone Line Interconnection

1. This equipment complies with Part 68 of the Federal Communications Commission (FCC) rules. On the outside surface of this equipment is a label that contains, among other information, the FCC registration number. This information must be provided to the telephone company.

2. As indicated below, the suitable USOC jack (Universal Service Order Code connecting arrangement) for this equipment is shown. If applicable, the facility interface codes (FIC) and service order codes (SOC) are shown.

3. An FCC-compliant telephone cord and modular plug is provided with this equipment. This equipment is designed to be connected to the telephone network or premises wiring using a compatible modular jack which is Part 68 compliant. See installation instructions for details.

4. The ringer equivalence number (REN) is used to determine the quantity of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in in the devices not ringing in

   response to an incoming call. In most, but not all areas, the sum of the RENs should not exceed five (5.0). To learn the number of devices that may be connected to the line, contact the telephone company to determine the maximum REN for the calling area.

5. If this equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice is not practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

6. The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice in order for you to make necessary modifications in order to maintain uninterrupted service.

7. If trouble is experienced with this equipment (the model of which is indicated below) please contact Multi-Tech Systems, Inc. at the address shown below for details on how to have repairs made. If the trouble is causing harm to the telephone network, the telephone company may request you remove the equipment from the network until the problem is resolved.

8. No repairs are to be made by you. Repairs are to be made only by MultiTech Systems or its licensees. Unauthorized repairs void registration and warranty.

9. This equipment should not be used on party lines or coin lines.

10. If so required, this equipment is hearing-aid compatible.

Manufacturer:	Multi-Tech Systems, Inc.
Trade Name:	Modem*Module*
Model Number:	MT5634SMI
FCC Registration No:	AU7USA-25814-M5-E
Ringer Equivalence:	0.3B
Modular Jack (USOC):	RJ11C or RJ11W (single line)
Service Center in USA:	Multi-Tech Systems, Inc. 2205 Woodale Drive Mounds View, MN 55112 (800) 328-9717 (763) 785-3500 (763) 785-9874 FAX

Canadian Limitations Notice:

NOTICE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada label does not guarantee the equipment will operate to the user's satisfaction.

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

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

The ringer equivalence number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface, The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the ringer equivalence numbers of all the devices does not exceed 5.

This digital apparatus does not exceed Class B limits for radio noise for digital apparatus set ouy in ICES-003 of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe B prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

FCC FAX Update

The Telephone Consumer Protection Act of 1991 makes it unlawful for any person to use a computer or other electronic device to send any message via a telephone fax machine unless such message clearly contains in a margin at the top or bottom of each page or the first page of the transmission, the date and time the message is sent and an identification of the business or other entity, or other individual sending the message and the telephone number of the sending machine or such business, other entity, or individual.

See your fax software manual for setup details.

International Modem Restrictions

Some dialing and answering defaults and restrictions may vary for international modems. Changing settings may cause a modem to become non-compliant with national telecom requirements in specific countries. Also note that some software packages may have features or lack restrictions that may cause the modem to become non-compliant.

European Directives User Guide Statement

The equipment has been approved to [Commission Decision"CTR21"] for pan-European single terminal connection to the Public Switched Telephone Network (PSTN). However, due to differences between the individual PSTNs provided in different countries, the approval does not, of itself, give an unconditional assurance of successful operation on every PSTN network termination point. In the event of problems, you should contact your equipment supplier in the first instance.

This equipment is designed with PSTN networks that accept analog signals. Multi-Tech does not currently know of any interoperating difficulties.

New Zealand Telecom Warning Notice

The grant of a Telepermit for any item of terminal equipment indicates only that Telecom has accepted that the item complies with minimum conditions for connection to its network. It indicates no endorsement of the product by Telecom, nor does it provide any sort of warranty. Above all, it provides no assurance that any item will work correctly in all respects with another item of Telepermitted equipment of a different make or model, nor does it imply that any product is compatible with all of Telecom's network services.

This device is equipped with pulse dialing, while the Telecom standard is DTMF tone dialing. There is no guarantee that Telecom lines will always continue to support pulse dialing.

Use of pulse dialing, when this equipment is connected to the same line as other equipment, may give rise to 'bell tinkle' or noise and may also cause a false answer condition. Should such problems occur, the user should NOT contact the Telecom Faults Service.

The preferred method of dialing is to use DTMF tones, as this is faster than pulse (decadic) dialing and is readily available on almost all New Zealand telephone exchanges.

Warning Notice: No '111' or other calls can be made from this device during a mains power failure.

This equipment may not provide for the effective hand-over of a call to another device connected to the same line.

Some parameters required for compliance with Telecom's Telepermit requirements are dependent on the equipment (PC) associated with this device. In order to operate within the limits for compliance with Telecom's Specifications, the associated equipment shall be set to ensure that calls are answered between 3 and 30 seconds of receipt of ringing.

If a charge for local calls is unacceptable, the "Dial" button should NOT be used for local calls. Only the 7-digits of the local number should be dialed from your telephone. DO NOT dial the area code digit or the "0" prefix.

Appendix B - Multi-Tech Flash Programming Protocol

Introduction

This appendix describes the protocol by which the modems are flash programmed.

The information in this section is provided for the exclusive use of the users of modems by Multi-Tech Systems, Inc. Such users have the right to use, modify, and incorporate this code into other products provided they include the Multi-Tech Systems, Inc. notice and the associated copyright notice with any such product.

The information in this file is provided "AS IS" without warranty.

1. Programming the Modem

There are two ways to start flash programming a modem. It can be programmed either from "AT" mode or right when the modem powers up.

Below is an example of how a modem is programmed.

DTE	Modem	Comments
AT*FS\r		This effectively "restarts" the modem so that it enters the boot code.
Handshake Sequence		
M's		Many M's are sent (10 milliseconds apart) at 19200 baud.
		This is where the handshake starts if the modem is just powered up
	U	U is sent at 19200 baud if M's are received within 30

		milliseconds of power up (see section 3.6). If the M's are not received within 30 milliseconds, then the modem starts up normally.
D		Sent at 19200 baud
	J|K|M	J if can receive only at 19200 K if can receive only at 19200/3840 M if can receive at 9600/19200/38400/57600/115200
I|J|K|L|M		I if modem will be programmed at 9600 J if modem will be programmed at 19200 K if modem will be programmed at 38400 L if modem will be programmed at 57600 M if modem will be programmed at 115200
	\r\nOK\r\n	Modem is ready to be programmed

Program Sequence

DTE	Modem	Comments
ATFLP\r		Request to the modem to program
	G	Modem is ready for next program packet
[Length High]		High byte of data packet length
[Length Low]		Low byte of data packet length Packet lengths can be up to 4096 bytes in size for most boot code versions (see section 3.5)
[Address High]		High byte of program address
[Address Middle]		Middle byte of program address
[Address Low]		Low byte of program address Addresses are 3 byte values with a range of 00000h-FFFFFh (see sections 3.2 - 3.4)
[Data Bytes]		These are the data bytes to be programmed at the address specified above. They must be the same number of bytes as specified above. (see section 3.1)
[Checksum		This checksum is generated by exclusive ORing together all of the Data Bytes (do not include the Length or Address bytes in that calculation).
	\nOK\r\n \nERROR\r\n	If bytes are programmed and verified. If verify fails or checksum is bad. Retry the block 3 times on an ERROR.
....	....	More of the above sequence until all the data bytes have been sent to the modem.
ATFLEND\r		This ends programming and restarts the modem

2. Other supported boot code commands

2.1. ATI0 - returns 247

2.2. ATI1 - returns boot code version number MM.mm where

MM = unique code for each different platform that has boot code
mm = version number of boot code

2.3. AT*FI - when given in standard AT mode gives the boot code version (same as in section 2.2). See section 3.7.

3. Other programming concerns

3.1. The values programmed into Addresses 0000h, 0001h and 0002h should always be forced to C3h 01h 00h (ie. JP 100h).

This is because the boot code starts at address 100h, while all normal modem code starts at 200h. By allowing 0000h to be programmed to a jump value other than 0100h, the boot code would be bypassed and no further upgrades could occur.

3.2. Addresses 1E0000h through 1FFFFh should not be allowed to be programmed under normal circumstances as this is the main body of the boot up code.

3.3. The packets sent to the modem must be presorted by address and aligned on 128 byte boundaries (ie. each packet must start on an address that is a multiple of 128).

3.4. The packets should also be a minimum of 128 bytes with the non-programmed bytes set to the hex value of FF.

3.5. The packets sent to the modem must not span a 4K boundary (ie. start the packet before it and go over the boundary in the middle of the packet).

3.6. The 10 millisecond delay between M's at the beginning of the handshake is so that the modem can sync up to the start bit. If the M's are sent one right after another, a data bit might be mistaken as a start bit.

3.7. Multi-Tech firmware files are in Intel Hex Format and must be read in and formatted into 128-4096 byte blocks before being sent to the modem.

Refer to the **Intel Hex Format** section below for information about the Intel Hex Format.

Intel Hex Format

An Intel Format Hex File is a text file consisting of “records”, one per line, that start with a “:” character and include only digits 0-9 and letters A-F. There are three different record types: Extended Address Records, Data Records and End of File Records.

Data records contain the actual data that is to be programmed into a device. The address contained in the data record needs to be combined with an extended address (by adding the extended address shifted four bits left to the data record address) to determine the actual programming address for the data. If no extended address record is before a given data record in the file, then the extended address value is assumed to be zero.

The record types are described below:

Data Record

Char Pos	Field Type	Value	Description
1	Record Start	“:”	
2-3	Data Byte Count	“NN”	Maximum value is FF (which is 255 data bytes). Typical is 20h which causes the hex record to fit in 80 columns.
4-7	Address	“XXXX”	Lower 16 bits of 20 bit address, most significant byte first. This must be added to Extended Address left shifted four bits.

Char Pos	Field Type	Value	Description
8-9	Record Type	“02”	Data Record
10+N	Data Bytes	“YY..YY”	The data bytes in hex. Each byte is two characters.
NN+1,2	Checksum	“ZZ”	Zero minus the two’s complement addition of all data hex values.
NN+3,4	End of Line	“\r\n”	Carriage Return followed by a Line Feed

Example Data Record in Intel Format

:2000A0005BB66DDBB66CD8B060C183060D1B366DDBB66DDBB76FDFBF7EFDFBF6EDDBB66DD4

Extended Address Record

Char Pos	Field Type	Value	Description
1	Record Start	“:”	
2-3	Data Byte Count	“02	Always 2 bytes for this record type
4-7	Address	“0000”	Not used for this record type (must be zero)
8-9	Record Type	“02”	Extended Address Record
10-13	Extended Address	“EEEE”	Top 16 bits of 20 bit address, most significant byte first
14-15	Checksum	“ZZ”	Zero minus the two’s complement addition of all data hex values
16-17	End of Line	“\r\n”	Carriage Return followed by a Line Feed

Example Extended Address Record in Intel Format

:020000021000EC

End of File Record

Char Pos	Field Type	Value	Description
1	Record Start	":"	
2-3	Data Byte Count	"00"	Always 2 bytes for this record type
4-7	Address	"0000"	Transfer Address (usually be zero)
8-9	Record Type	"01"	End of File Record
10-11	Checksum	"ZZ"	Zero minus the two's complement addition of all data hex values
12-13	End of Line	"\r\n"	Carriage Return followed by a Line Feed

Example End of File in Intel Format

:00000001FF

Appendix C - Pin Descriptions and Electrical Characteristics

Handling Precautions:
All MOS devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. Although input protection circuitry has been incorporated into the devices to minimize the effect of this static buildup, proper precautions should be taken to avoid exposure to electrostatic discharge during handling and mounting.

Pin Descriptions

Label	* I/O Type	Signal Name / Description
SPKR	O	**Speaker Output**. SPKR is a single ended-output. SPKR is tied directly to the CODEC
AGND	GND	**Analog Ground**. Analog ground is tied common with DGND on the ModemModule. To minimize potential ground noise issues, connect audio circuit return to AGND.
VCC	PWR	**+5V**
DGND	GND	**Digital Ground**
-DTRTTL	I	**Data Terminal Ready (TTL Active Low).** The -DTR input is turned ON (low) by the DTE when the DTE is ready to transmit or receive data. -DTR ON prepares the modem to be connected to the telephone line, and, once connected, maintains the connection. -DTR OFF places the modem in the disconnect state.
-DCDTTL	O	**Data Carrier Detect (CMOS Level, IO=12ma, Active Low).** -DCD output is ON (low) when a carrier is detected on the telephone line or OFF (high) when carrier is not detected.
-CTSTTL	O	**Clear To Send (CMOS Level, IO=12ma, Active Low).** -CTS is controlled by the modem to indicate whether or not the modem is ready to transmit data. -CTS ON, indicates to the DTE that signals presented on TXD will be transmitted to the telephone line. -CTS OFF indicates to the DTE that it should not transfer data across the interface on TXD.
-DSRTTL	O	**Data Set Ready (CMOS Level, IO=12ma, Active Low).** -DSR indicates modem status to the DTE. –DSR OFF (high) indicates that the DTE is to disregard all signals appearing on the interchange circuits except Ring Indicator (-RI). It reflects the status of the local data set, and does not indicate an actual link with any remote data equipment.
-RITTL	O	**Ring Indicate (CMOS Level, IO=12ma, Active Low).** -RI output ON (low) indicates the presence of an ON segment of a ring signal on the telephone line. The modem will no go off-hook when -RI is active; the modem waits for -RI to go inactive before going off-hook.
-TXDTTL	I	**Transmitted Data (TTL Level Active Low).** The DTE uses the -TXD line to send data to the modem for transmission over the telephone line or to transmit commands to the modem. The DTE should hold this circuit in the mark state when no data is being transmitted or during intervals between characters.
-RXDTTL	O	**Received Data (CMOS Level, IO=12ma, Active Low).** The modem uses the RXD line to send data received from the telephone line to the DTE and to send modem responses to the DTE. During command mode, -RXD data presents the modem responses to the DTE. Modem responses take priority over incoming data when the two signals are in competition for -RXD. When no data is transmitted, the signal is held in mark condition.
-RTSTTL	I	**Request to Send (TTL Level Active Low).** RTS signal is used for hardware flow control.

LED driver outputs are open-drain inverter-driven (74HCT05) lines with 1.5K ohms pull-up resistors. Max output current 25 mA.

TXIND	O	**Active High TXD status**
DTRIND	O	**Active High DTR status**
RXIND	O	**Active High RXD status**
DCDIND	O	**Active High DCD status**
-RESET	I	**Modem Reset (TTL level with weak pull-up)**. The active low -RESET input resets the ModemModule logic and returns the AT command set to the original factory default values or to "stored values" in NVRAM. -RESET is tied to VCC through a 400ms time constant circuit for "Power-on-Reset" functionality. The modem is ready to accept commands within 6.5 seconds of power-on or reset.
Ring	I/O	**Ring Signal from Telco**
Tip	I/O	**Tip Signal from Telco**

*** I = Input O = Output**

Electrical Characteristics

Appendix D - Telecom Approvals

While this modem can be configured for specific country operation, doin so DOES NOT constitute country approval. This modem is not approved in, or configured for operation in all countries.

Country	Homologation Required	Hardware Build	Country Config (hex)	ATI9 Response	Homologation Approval Status	
Argentina	Yes	ENI	at%t19,0,34	52	Yes	
Aruba	No	ENI	at%t19,0,34	52	N/A	
Australia	Yes	AU/NZ	at%t19,0,1	1	Yes	
Austria	Yes	ENI	at%t19,0,34	52	Yes	
Bahrain	Yes	ENI	at%t19,0,34	52	No	
Belgium	Yes	ENI	at%t19,0,34	52	Yes	
Brazil	Yes	ENI	at%t19,0,34	52	Yes	
Brunei	Yes	ENI	at%t19,0,34	52	No	
Canada	Yes	ENI	at%t19,0,34	52	Yes	
Cayman Islands	No	ENI	at%t19,0,34	52	N/A	
Chile	Yes	ENI	at%t19,0,34	52	Pending	
China	Yes	ENI	at%t19,0,34	52	No	
Columbia	No	ENI	at%t19,0,34	52	N/A	
Costa Rica	No	ENI	at%t19,0,34	52	N/A	
Croatia	No	ENI	at%t19,0,34	52	N/A	
Czech Republic	Yes	ENI	at%t19,0,25	37	Pending	
Denmark	Yes	ENI	at%t19,0,34	52	Yes	
Ecuador	Yes	ENI	at%t19,0,34	52	No	
Egypt	No	ENI	at%t19,0,34	52	N/A	
Finland	Yes	ENI	at%t19,0,34	52	Yes	
France	Yes	ENI	at%t19,0,34	52	Yes	
Germany	Yes	ENI	at%t19,0,34	52	Yes	
Greece	Yes	ENI	at%t19,0,34	52	Yes	
Guatemala	No	ENI	at%t19,0,34	52	N/A	
Hong Kong	Yes	ENI	at%t19,0,30	48	Yes	
Hungary	Yes	ENI	at%t19,0,30	48	Yes	
Iceland	Yes	ENI	at%t19,0,34	52	Yes	
India	Yes	ENI	at%t19,0,30	48	Pending	
Indonesia	Yes	ENI	at%t19,0,30	48	Pending	
Ireland	Yes	ENI	at%t19,0,34	52	Yes	
Israel	Yes	ENI	at%t19,0,30	48	No	
Italy	Yes	ENI	at%t19,0,34	52	Yes	
Jamaica	No	ENI	at%t19,0,34	52	N/A	
Japan	Yes	ENI	at%t19,0,10	16	Yes	
Luxembourg	Yes	ENI	at%t19,0,34	52	Yes	
Macao	Yes	ENI	at%t19,0,34	52	No	
Malaysia	Yes	ENI	at%t19,0,30	48	Pending	
Mexico	Yes	ENI	at%t19,0,34	52	Yes	
Morocco	Yes	ENI	at%t19,0,34	52	No	
Netherlands	Yes	ENI	at%t19,0,34	52	Yes	
Netherlands Antilles		No	ENI	at%t19,0,34	52	N/A
New Zealand	Yes	AU/NZ	at%t19,0,9	9	Yes	
Norway	Yes	ENI	at%t19,0,34	52	Yes	
Pakistan	No	ENI	at%t19,0,34	52	N/A	
Panama	No	ENI	at%t19,0,34	52	N/A	

Country	Homologation Required	Hardware Build	Country Config (hex)	ATI9 Response	Homologation Approval Status
Peru	No	ENI	at%t19,0,34	52	N/A
Phillipines	Yes	ENI	at%t19,0,30	48	Pending
Poland	Yes	ENI	at%t19,0,30	48	Pending
Portugal	Yes	ENI	at%t19,0,34	52	Yes
Qatar	Yes	ENI	at%t19,0,34	52	No
Romania	Yes	ENI	at%t19,0,34	52	No
Russia	Yes	ENI	at%t19,0,34	52	Pending
Saudi Arabia	No	ENI	at%t19,0,34	52	N/A
Singapore	Yes	ENI	at%t19,0,30	48	Yes
Slovakia	Yes	ENI	at%t19,0,34	52	Yes
Slovenia	Yes	ENI	at%t19,0,30	48	No
South Africa	Yes	ENI	at%t19,0,35	53	Pending
South Korea	Yes	ENI	at%t19,0,30	48	Yes
Spain	Yes	ENI	at%t19,0,34	52	Yes
Sri-Lanka	Yes	ENI	at%t19,0,34	52	No
Sweden	Yes	ENI	at%t19,0,34	52	Yes
Switzerland	Yes	ENI	at%t19,0,34	52	Yes
Trinidad	No	ENI	at%t19,0,34	52	N/A
Turkey	Yes	ENI	at%t19,0,34	52	Pending
Ukraine	Yes	ENI	at%t19,0,34	52	No
United Arab Emirates (Dubai)	Yes	ENI	at%t19,0,34	52	No
United Kingdom	Yes	ENI	at%t19,0,34	52	Yes
United States	Yes	ENI	at%t19,0,34	52	Yes
Uruguay	Yes	ENI	at%t19,0,34	52	No
Venezuela	No	ENI	at%t19,0,34	52	N/A
Vietnam	No	ENI	at%t19,0,30	48	N/A

* Contact Multi-Tech as this information can be deemed reliable, but is not guaranteed. All information is subject to change.