SocketModem™

Embedded Data/Fax Global Modem

MT5634SMI-34
MT5634SMI-92

Serial Build
Parallel Build
Medical Device Build
Industrial Temperature Build

Developer's Guide

MultiTech®
Systems

SocketModem Developer's Guide
Serial: MT5634SMI-34, MT5634SMI-92
Parallel: MT5634SMI-P-92
Medical Device: MT5634SMI-HV-92, MT5634SMI-P-HV-92
Industrial Temperature: MT5634SMI-ITP-92, MT5634SMI-P-ITP-92

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Revisions

Revision Level	Date	Description
A	08/09/02	First release. Includes global configuration and V.92 protocol.
B	06/19/03	Add V.34 documentation.

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Chapter 1 – Product Description and Specifications

Introduction

Multi-Tech's SocketModem creates communication-ready devices by integrating data/fax/voice functionality into a single product design. The SocketModem is a space-efficient (1" × 2.5"), embedded modem that provides V.92/56K communication. The complete, ready-to-integrate modem dramatically reduces development time and costs for system designers. The SocketModem complies with global Telecom requirements, can be shipped worldwide, and is globally configurable.

This guide provides the hardware, software, testing and troubleshooting information needed to effectively integrate the SocketModem into your equipment. It also provides:

- commands a developer can use to configure and control a data/fax/voice modem and
- result codes the modem issues in response to the commands.

Fax Commands Documents

Two separate fax command documents along with an informational fax document are available on CD and from Multi-Tech. They are also available on the Multi-Tech Web site, or you can contact OEM Sales at:

oemsales@multitech.com
(800) 972-2439.

Product Description

The MT5634SMI SocketModem is used for integrating data and fax communications:

- It 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 serial interface
- It is available with an 8-bit parallel interface.
- It supports the ITU-T V.92 protocol.

Two SocketModem kits are available, one for serial and the other for parallel. The serial kit allows you to plug in the SocketModem and use it as a serial modem for testing, programming, and evaluation. The parallel kit turns the parallel module into an ISA modem. Each kit includes one development board with an RS-232 DB-25 connector, wall power adapter, RJ-11 jack, and RS-232 cable.

Features Matrix

Model	Build Option	Serial Interface	Parallel Interface (16C550)	v.92/56K Max. Data Speed	V.34/33.6K Max. Data Speed	V.17 Fax Class 1, 1.0, and Class 2	Fax Class 2.0 and 2.1	V.42 Error Correction	V.42bis Data Compression	DTMF Detection	Distinctive Ring	Voice Record and Playback
MT5634SMI	MT5634SMI-92	X		X		X	X	X	X	X	X	X
	MT5634SMI-P-92		X	X		X	X	X	X	X	X	X
	MT5634SMI-HV-92	X				X	X	X	X	X	X	X
	MT5634SMI-P-HV-92		X			X	X	X	X	X	X	X
	MT5634SMI-IT-92	X		X		X	X	X	X	X	X	X
	MT5634SMI-P-IT-92		X	X		X	X	X	X	X	X	X
	MT5634SMI-34	X			X	X						

Note: **SMI-92** indicates a serial build.

SMI-P-92 indicates a parallel V.92 build.

SMI-HV-92 indicates a serial V.92 high voltage medical device build.

SMI-P-HV-92 indicates a parallel V.92 high voltage medical build.

SMI-IT-92 indicates a serial V.92 industrial temperature build.

SMI-P-IT-92 indicates a parallel V.92 industrial temperature build.

SMI-34 indicates a serial V.34 build.

Technical Specifications and Features

The SocketModem meets the following specifications:

Client-to-Server Data Rates	Supports V.92 and V.90 data rates
Client-to-Client Data Rates	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	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
Data Format	Serial, binary, asynchronous (available with parallel interface)
Data Compatibility	V.92, V.34 enhanced, V.34, V.32bis, V.32, V.22bis, V.22; Bell 212A and 103/113, V.21 & V.23
Fax Compatibility	ITU-T "Super" Group 3; Class 1.0, 2.0, 2.1; Group 3, Class 1 and 2, T.4, T.30, V.21, V.27ter, V.29, V.34, V.17, and TIA/EIA TR29.2
Voice Compatibility	IS-101 AT+V commands (no CODEC for speakers/microphone interface)
Error Correction	V.42 (LAP-M or MNP 3–4)
Data Compression	ITU-T V.44 (6:1 throughput); V.42bis (4:1 throughput); MNP 5 (2:1 throughput)
Serial Speeds	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)
Command Buffer	60 characters
Transmit Level	–11 dBm (varies by country setting)
Frequency Stability	±0.01%
Receiver Sensitivity	–43 dBm under worst-case conditions
AGC Dynamic Range	43 dB
Interface	TTL serial or 8-bit parallel interface
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)
DAA Isolation	**MT5634SMI-92** 1500 Vac **MT5634SMI-HV-92 (High Voltage {5V Medical Device} Build Option)** 3000 Vac

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Power Consumption	**Standard** Typical: 245 mA (1.25 W @ 5V DC) Standby or Sleep Mode: 148mA Maximum: 420 mA (2.1 W @ 5.25V DC) **MT5634SMI-IT-92 (Industrial Temperature {3.3V} Build Option)** Typical: 180 mA (0.59 W @ 3.3V DC) Standby or Sleep Mode: 88mA Maximum: 290 mA (1.04 W @ 3.6V DC)
Operating Voltage	**Standard** 5V DC +/- 5% Absolute Maximum Supply Voltage: 6V DC **MT5634SMI-IT-92 (Industrial Temperature {3.3V} Build Option)** 3.3V DC, 180mA Absolute Maximum Supply Voltage: 3.6V DC
Operational Temperature Range	**Standard** 0–+70° C ambient under closed conditions; humidity range 20–90% (non-condensing) **MT5634SMI-IT-92 (Industrial Temperature {3.3V} Build Option)** -40–+85° C ambient under closed conditions; humidity range 20–90% (non-condensing)
Storage Temperature	-50–+100° C
Cleaning	No cleaning/washing due to the manufacturing process used to produce this product
Intelligent Features	fully AT command compatible leased line operation sleep mode autodial, redial pulse or tone dial dial pauses auto answer adaptive line probing automatic symbol and carrier frequency during start-up, retrain, and rate renegotiations DTMF detection call status display, auto-parity and data rate selections keyboard-controlled modem options on-screen displays for modem option parameters remote configuration DTR dialing phone number storage flash memory for firmware updates NVRAM storage for user-defined parameters

Chapter 2 – Mechanical Specifications

Physical Dimensions – All Models

Figure 2–1. Maximum Component Height
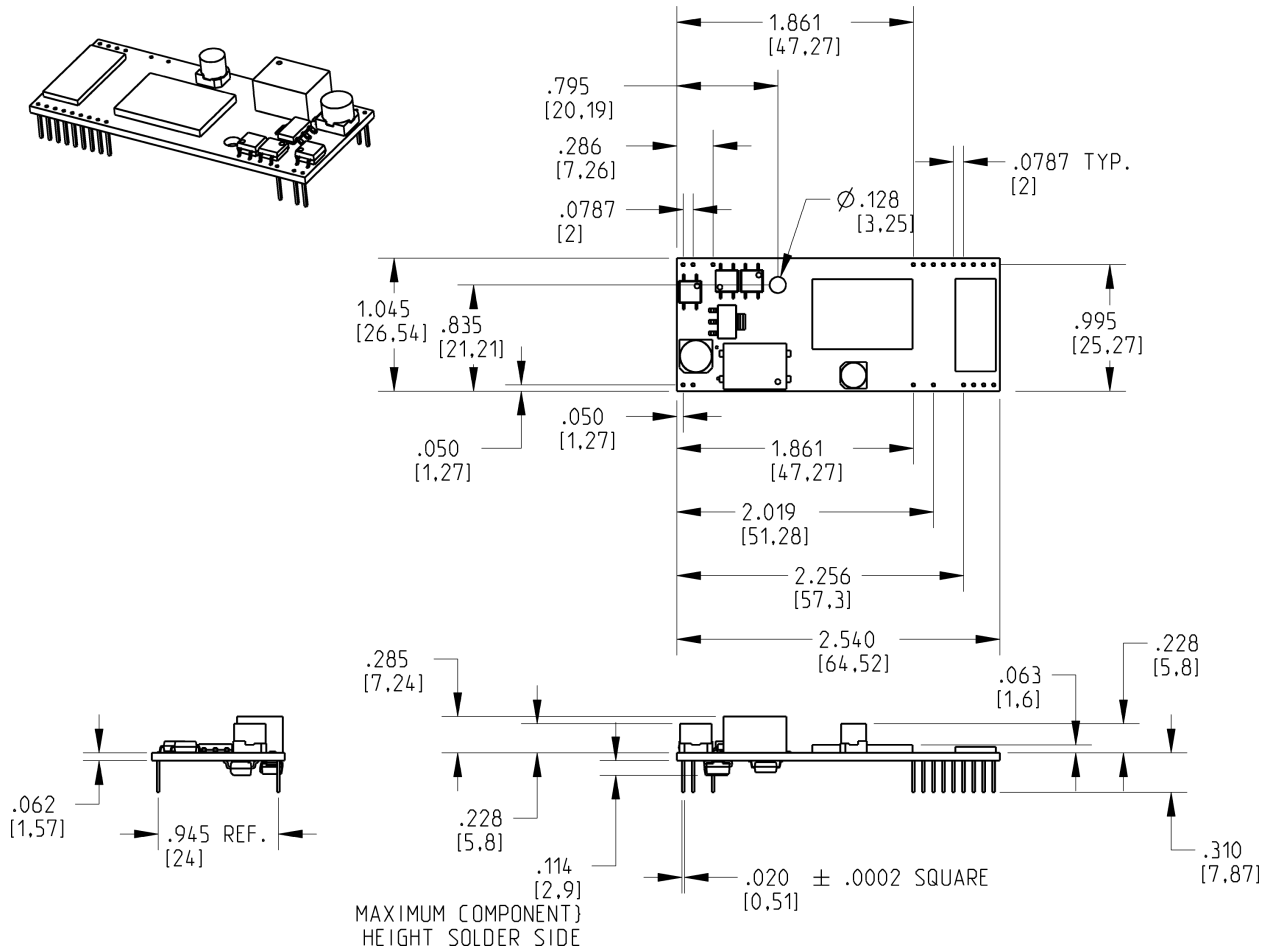
CAUTION: If any component(s) is placed under the SocketModem or if any component(s) should extend to the point where part of it is under the SocketModem, the component(s) must NOT exceed .060 inches in height.

Pin Configurations

The MT5634SMI SocketModem 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.
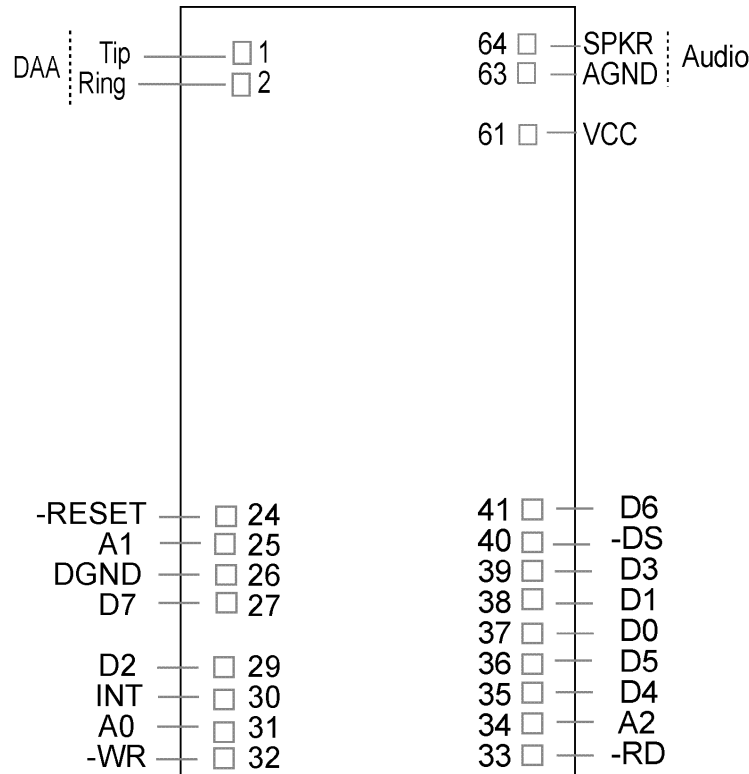
Figure 2–2. Serial SocketModems Pins

Pin Descriptions for Serial SocketModem Devices

Pin #	Signal Name	I/O Type	Description
26	DGND		**Digital Ground**
33	–RTS	I	**Request to Send.** RTS signal is used for hardware flow control.
34	–RXD	O	**Received Data.** 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.
35	–TXD	I	**Transmitted Data.** 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.
36	–RI	O	**Ring Indicate.** –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.
37	–DSR	O	**Data Set Ready.** –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.
38	–CTS	O	**Clear To Send.** –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.
39	–DCD	O	**Data Carrier Detect.** –DCD output is ON (low) when a carrier is detected on the telephone line or OFF (high) when carrier is not detected.
40	–DTR	I	**Data Terminal Ready (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.
41	DGND	GND	
61	VCC	PWR	**+5V or 3.3V Supply** (depends upon model).
63	AGND	GND	**Analog Ground**. Analog ground is tied common with DGND on the SocketModem. To minimize potential ground noise issues, connect audio circuit return to AGND.
64	SPKR		**Speaker Output**. SPKR is a single ended-output. SPKR is tied directly to the CODEC.
LED driver outputs are open-drain inverter-driven (74HCT05) lines with 1.5K ohms pull-up resistors. Max output current 25 mA.			
1	Tip	I/O	**Tip Signal from Telco.**
2	Ring	I/O	**Ring Signal from Telco.**
24	–RESET	I	**Modem Reset (with weak pull-up)**. The active low –RESET input resets the SocketModem logic and returns the AT command set to the original factory defa 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. Reset must be asser for 300 ns.
29	DCDIND	O	**Active High DCD status**.
30	RXIND	O	**Active High RDX status**
31	DTRIND	O	**Active High DTR status**
32	TXDIND	O	**Active High TXD status**

The MT5634SMI-P (Parallel) SocketModem uses a 22-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring, and parallel interface.
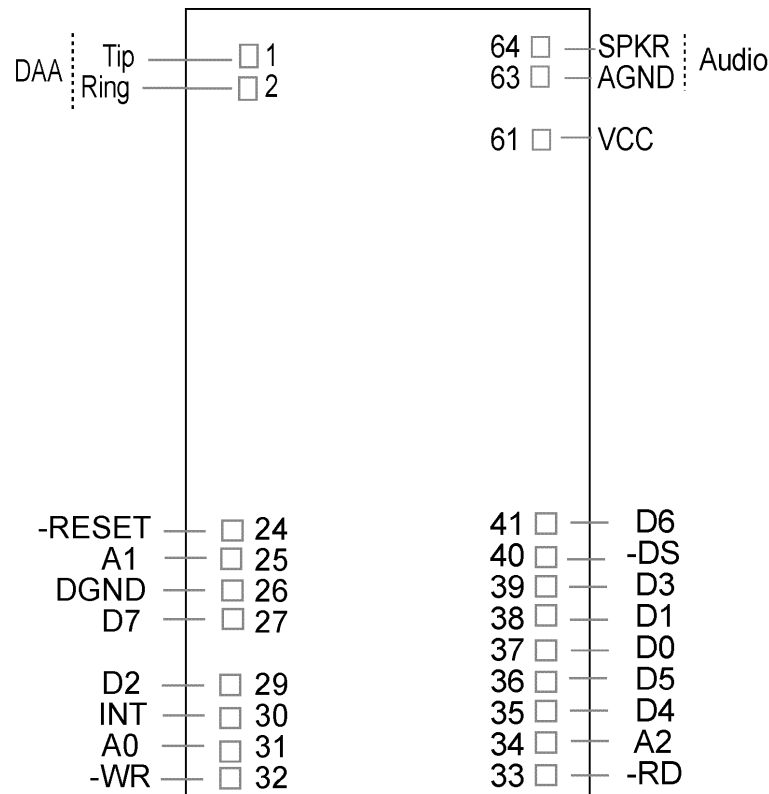
Figure 2–3. Parallel SocketModem Pins

Pin Descriptions for a Parallel SocketModem Device

Pin #	Signal Name	I/O	Description
1	Tip	I/O	**Tip Signal from Telco**
2	Ring	I/O	**Ring Signal from Telco**
24	–RESET	I	**Modem Reset (with weak pull-up).** The active low –RESET input resets the SocketModem logic and returns the AT command set to the original factory default values or to "stored values" in NVRAM. The modem is ready to accept commands within 6.5 seconds of power-on or reset. Reset must be asserted for a minimum of 300 ns.
26	DGND	GND	**Digital Ground**
25, 31, 34	A0, A1, A2	I	**Host Bus Address Lines 0 and 2.** During a host read or write operation, A0 through A2 select an internal 16C450 or 16C550-compatible register. The state of the divisor latch access bit (DLAB) affects the selection of certain registers.
30	INT	O	**Host Bus Interrupt.** INT output is set high when the receiver error flag, receiver data available, transmitter holding register empty, or modem status interrupt have an active high condition. INT is reset low upon the appropriate interrupt service or master reset operation.
32	–WR	I	**Host Bus Write.** –WR is an active low, write control input. When –DS is low, –WR low allows the host to write data or control words into a selected modem register.
33	–RD	I	**Host Bus Read.** –RD is an active low, read control input. When –DS is low, –RD low allows the host to read status information or data from a selected modem register.
40	–DS	I	**Host Bus Device Select.** –DS input low enables the modem for read or write.
61	VCC	PWR	**+5V or 3.3V Supply** (depends upon model).
63	AGND	GND	**Analog Ground.** This is tied common with DGND on the SocketModem. To minimize potential ground noise issues, connect audio circuit return to AGND.
64	SPKR	O	**Speaker Output**. SPKR is a single ended-output. It is tied directly to the CODEC.

Chapter 3 – Electrical Characteristics

Introduction

Electrical characteristics for the 5V Serial SocketModem, 3.3V Serial SocketModem, 5V Parallel SocketModem, and the 3.3V Parallel SocketModem are presented in this chapter.

I/O Electrical Characteristics

5V Serial – Standard (SMI) and Medical Device (SMI-HV) Build Options

5 Vdc Characteristics (TA = 0 °C to 50 °C; VDD = 5 V ± 0.25 V)   VDDMAX = 5.25 V

	Input High	Input Low	Current Drive
Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	Min 3.675 V	Max 1.4 V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 4 V	**Output Low** Max 0.4 V	2 ma
Digital Input Capacitance			**5 PF**

3.3V Serial – Industrial Temperature (SMI-ITP) Build Option

3.3 Vdc Characteristics (TA = -40 °C to 85 °C; VDD = 3.3 V ± 0.3 V)   VDDMAX = 3.6 V

	Input High	Input Low	Current Drive
Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	Min 2.52 V	Max 0.9 V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 2.3 V	**Output Low** Max 0.4 V	2 ma
Digital Input Capacitance			**5 PF**

5V Parallel – Standard (SMI) and Medical Device (SMI-HV) Build Options

5 Vdc Characteristics (TA = 0 °C to 50 °C; VDD = 5 V ± 0.25 V)   VDDMAX = 5.25 V

	Input High	Input Low	Current Drive
Digital Inputs –DS (40)	Min. 3.675 V	Max. 1.4 V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), A2 (34), –WR (32), –RD (33)	**Input High** Min. 3.675 V	**Input Low** Max. 1.4 V	
Digital Input / Output **Output buffer can source 12 mA at 0.4 V** DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27)	**Input High** Min. 3.675 V	**Input Low** Max. 1.4 V	
Digital Output INT (30)	**Output High** Min. 4 V	**Output Low** Max 0.4 V	2 ma
Digital Input Capacitance			**5 PF**

3.3V Parallel – Standard (SMI) and Industrial Temperature (SMI-ITP) Build Options

Electrical characteristics for Parallel MT5634SMI SocketModem devices are presented below.
3.3 Vdc Characteristics (TA = –40 °C to 85 °C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

Digital Inputs	**Input High**	**Input Low**
–DS (40)	Min 2.52 V	Max 0.9 V
Digital Inputs (hysteresis input buffer)	**Input High**	**Input Low**
A0 (31), A1 (25), A2 (34), –WR (32), –RD (33)	Min 2.52 V	Max 0.9 V
Digital Input/Output	**Input High**	**Input Low**
Output buffer can source 12 mA at 0.4 V		
DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27)	Min 2.52 V	Max 0.9 V

Digital Output	**Output High**	**Output Low**	**Current Drive**
INT (30)	Min 2.3 V	Max 0.4 V	2 ma
Digital Input Capacitance			**5 PF**

Timing Requirements

Timing Requirements for Parallel Write

Parameter	Min	Max	Unit
–DS to –WR Setup (low to low)	10	-	ns
A0, A1, A2 to –WR Setup (valid to low)	15	-	ns
–WR Pulse Width (low to high)	40	-	ns
D0–D7 to –WR Setup (valid to high)	30	-	ns
–WR to –DS hold (high to high)	0	-	ns
–WR to A0–A2 Hold (high to invalid)	0	-	ns
–WR to D0–D7 Hold (high to invalid)	0	-	ns
–WR interaccess (high to low)			
Non-MIMIC Accesses	10	-	ns
MIMIC Accesses	110	-	ns

Timing Requirements for Parallel Read

Parameter	Min	Max	Unit
–DS to –RD Setup (low to low)	10	-	ns
A0, A1, A2 to –RD Setup (valid to low)	15	-	ns
–RD Pulse Width (low to high)	40	-	ns
–RD to –DS hold (high to high)	0	-	ns
–RD to A0–A2 Hold (high to invalid)	0	-	ns
–WR interaccess (high to low)			
Non-MIMIC Accesses	10	-	ns
MIMIC Accesses	110	-	ns

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.

Chapter 4 – SocketModem Parallel Interface – A Programmer's Description

SocketModem Parallel Interface Internal Registers

The SocketModem parallel interface is a mimic of a 16C550A UART. It is similar to the MIMIC interface used in the Zilog Z80189. The SocketModem mimic (MMM) takes advantage of this standard interface while replacing the serial to parallel data transfer with a less complicated parallel to parallel data transfer.

The MMM interface controls an 8-bit parallel data transfer which is typically interrupt driven. Interrupts usually indicate one or both of two conditions: (1) the receive (RX) FIFO has either reached a trigger level or time-out condition and needs to be emptied and/or (2) the transmit (TX) FIFO is empty and waiting for more data from the Host. An interrupt can also be triggered by a change in the modem status register (i.e., loss of carrier) or by the occurrence of errors in the line status register (overrun, parity, framing, break detect).

In addition to the receive and transmit FIFOs, there are twelve other control/status registers called the MMM register set which can be accessed through this interface.

SocketModem MIMIC (MMM) Operation

Data flow through MMM is bi-directional. Simultaneously, data can flow from the host through the transmit FIFO to the SocketModem controller, and data can flow from SocketModem controller through the receive FIFO to the Host. In the receive path, 8-bit data is asynchronously received (from the SocketModem controller) by the receive FIFO where it is stored along with associated three error bits. The error bits must arrive (via a SocketModem controller I/O write to MMM shadow line status register) prior to receiving the actual data bits. The error bits are then temporarily stored so they may be written, with associated data bits, to the 11-bit wide RX FIFO.

After every data write, the RX FIFO write pointer is incremented. RX FIFO trigger levels, data ready signal, and time-out counter are checked to see if a Host interrupt needs to be sent. The data ready signal will be activated and MMM sits poised to accept another data word.

We highly recommend the host should read the MMM IIR register to determine the type of interrupt. Then it might check bit 7 of the LSR to see if there are any errors in the data currently residing in the receive FIFO. Finally, it will (1) alternately read a data word through the RX FIFO read pointer and the error bits via the MMM LSR until the FIFO is empty, or (2) read successive data words (knowing there were no errors in the FIFO) until the trigger count is met.

A similar sequence occurs when data flows in the other direction (from host through transmit FIFO), except there is no error bit manipulation/checking involved.

FIFO Operation

The 16-byte transmit and receive data FIFOs are enabled by the FIFO Control Register (FCR) bit-0. You can set the receive trigger level via FCR bits 6/7. The receiver FIFO section includes a time-out function to ensure data is delivered to the external host. An interrupt is generated whenever the Receive Holding Register (RHR) has not been read following the loading of a character or the receive trigger level has been reached.

Receive (RX) FIFO

The RX FIFO can be configured to be 16 words deep and 11 bits wide. Each word in the RX FIFO consists of 8 data bits and 3 error bits. The RX block of the MMM contains read and write pointers and status flag circuitry that need only to be presented with data (for input), reset, read/write control signals, and read/write clock signals. The RX block of the MMM internally manages the FIFO register file and pointers, and it provides simultaneous read/write capability (no contention problems).

The RX block of the MMM provides data (for output), FIFO full flag, FIFO empty flag, and an almost full flag which uses an associated predefined trigger level (obtained from the MMM FCR control register) to signal when the trigger level has been met. Four possible trigger levels may be selected by programming bits 6-7 of the FCR control register.

A typical (interrupt driven) write to the RX block is a two-step process. The MMM micro-controller must first write the 3 error bits to a shadow MMM LSR status register. Next, the micro-controller writes the data to the RX FIFO and during this write operation, the 3 error bits are directly loaded from the LSR shadow register into the bits 8-10 of the selected (11 bit-wide) FIFO register. These error bits represent the parity error, framing error, and break interrupt signals associated with each data work transmission into the receive FIFO. When the receive FIFO is read, these error bits are loaded directly into bits 2-4 of the MMM LSR register.

A2	A1	A0	Register Name	Register Description	Host Access
0	0	0	RBR	Receive Buffer (RX FIFO)	DLAB = 0 R only
0	0	0	THR	Transmit Holding (TX	DLAB = 0 W only
0	0	1	IER	FIFO)	DLAB = 0 R/W
0	1	0	IIR	Interrupt Enable	DLAB = X R only
0	1	0	FCR	Interrupt Identification	DLAB = X W only
0	1	1	LCR	FIFO Control	DLAB = X R/W
1	0	0	MCR	Line Control	DLAB = 0 R/W
1	0	1	LSR	Modem Control	DLAB = X R only
1	1	0	MSR	Line Status	DLAB = X R only
1	1	1	SCR	Modem Status	DLAB = 0 R/W
				Scratch pad	
0	0	0	DLL	LSB of Divisor Latch	DLAB = 1 R/W
0	0	1	DLM	MSB of Divisor Latch	DLAB = 1 R/W
1	1	1	DLX	Divisor Latch	DLAB = 1 R/W
1	0	0	MCX	Status/Control	DLAB = 1 R/W

Note 1* The General Register set is accessible only when DS is a logic 0.
Note 2* The Baud Rate register set is accessible only when DS is a logic 0 and LCR bit-7 is a logic 1.

Time Out Interrupts

The interrupts are enabled by IER bits 0-3. Care must be taken when handling these interrupts. Following a reset the transmitter interrupt is enabled, the SocketModem will issue an interrupt to indicate that transmit holding register is empty. This interrupt must be serviced prior to continuing operations.

The LSR register provides the current singular highest priority interrupt only. A condition can exist where a higher priority interrupt may mask the lower priority interrupt(s). Only after servicing the higher pending interrupt will the lower priority interrupt(s) be reflected in the status register. Servicing the interrupt without investigating further interrupt conditions can result in data errors. When two interrupt conditions have the same priority, it is important to service these interrupts correctly.

Receive Data Ready and Receive Time Out have the same interrupt priority (when enabled by IER bit-3). The receiver issues an interrupt after the number of characters received have reached the programmed trigger level. In this case the MMM FIFO may hold more characters than the programmed trigger level. Following the removal of a data byte, the user should recheck LSR bit-0 for additional characters. A Receive Time Out will not occur if the receive FIFO is empty. The time out counter is reset at the center of each stop bit received or each time the receive holding register (RHR) is read.

Register Functional Descriptions

The following table delineates the assigned bit functions for the twelve internal registers. The assigned bit functions are more fully defined in the following paragraphs.

Internal Registers

A2 A1 A0	Register [Default] Note *3	BIT-7	BIT-6	BIT-5	BIT-4	BIT-3	BIT-2	BIT-1	BIT-0
General Register Set: Note 1*									
0 0 0	RBR [XX]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
0 0 0	THR [XX]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
0 0 1	IER [00]	0	0	0	0	Modem Status Interrupt	Receive Line Status interrupt	Transmit Holding Register interrupt	Receive Holding Register interrupt
0 1 0	IIR [XX]	FIFO enable	FIFO enable	0	0	Interrupt ID	Interrupt ID	Interrupt ID	Interrupt Pending
0 1 0	FCR [00]	RX Trigger (MSB)	RX trigger (LSB)	Detect change in FCR	TX FIFO overrun bit	DMA mode select	XMIT FIFO reset	RCVR FIFO reset	FIFO enable
0 1 1	LCR [00]	Divisor latch access (DLAB)	Set break	Stick parity	Even parity	Parity enable	0	Word length bit-1	Word length bit-0
1 0 0	MCR [00]	0	0	0	Loop back	INT enable	OUT 1	-RTS	-DTR
1 0 1	LSR [60]	RX FIFO data error	TX empty THR empty	THR Empty	Break interrupt	Framing error	Parity error	Overrun error	Receive data ready
1 1 0	MSR [X0]	CD	RI	DSR	CTS	Delta -CD	Delta -RI	Delta -DSR	Delta -CTS
1 1 1	SCR [FF]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
Special Register Set: Note *2									
0 0 0	DLL [00]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
0 0 1	DLM [00]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0

Note 1* The General Register set is accessible only when DS is a logic 0.
Note 2* The Baud Rate register set is accessible only when DS is a logic 0 and LCR bit-7 is a logic 1.
Note 3* The value between the square brackets represents the register's initialized HEX value, X = N/A.

RBR Receive Buffer (RX FIFO)

All eight bits are used for receive channel data (host read/data in; host write/data out). The three error bits per byte are copied into bits 2, 3, and 4 of the LSR during each host I/O read; therefore, they are available for monitoring on a per-byte basis.

THR Transmit Holding Register (TX FIFO)

All eight bits are used for transmit channel data (host write/data out; host read/data in).

IER Interrupt Enable

Bits 4–7:	Reserved and will always read 0.
Bits 0-3:	Set by host software only and cleared by software control or host reset.
Bit 3:	Enables modem status IRQ. If bits 0–3 of the MSR are set and this bit is set to 1 (enabled), a host interrupt is generated.
Bit 2:	Enables receive line status IRQ. If bits 1–4 (overrun, parity, framing, break errors) of the LSR are set and this bit is set to a logic 1, a host interrupt is generated.
Bit 1:	Enables transmit holding register IRQ. If bit 5 (transmit holding register empty) of the LSR is set and this bit is set to a 1, a host interrupt is generated.
Bit 0:	Enables received data available IRQ. If bit 0 (data ready) of the LSR is set and this bit is set to a 1, a host interrupt is generated.

IIR Interrupt Identification (Read Only)

Bits 6–7:	(FIFO enabled bits). These bits will read a 1 if FIFO mode is enabled and the 16450 enable bit is 0 (no force of 16450 mode).
Bits 4–5:	Reserved and always read a 0.
Bits 1–3:	Interrupt ID bits.
Bit 0:	Interrupt pending. If logic 0 (in default mode), an interrupt is pending.

When the host accesses IIR, the contents of the register are frozen. Any new interrupts will be recorded, but not acknowledged during the IIR access. This requires buffering bits (0–3, 6–7) during IIR reads.

Bit 3	Bit 2	Bit 1	Priority	Interrupt Source	Interrupt Reset Control
0	1	1	Highest	Overrun, parity, framing, error or break detect bits set by SocketModem Controller	Reading the LSR
0	1	0	2nd	Received data trigger level	RX FIFO drops below trigger level
1	1	0	2nd	Receiver time-out with data in RX FIFO	Read RX FIFO
0	0	1	3rd	TX holding register empty	Writing to TX holding register or reading IIR when TX holding register is source of error
0	0	0	4th	MODEM status: CTS, DSR, RI or DCD	Reading the MSR

FCR FIFO Control

Bits 6–7: Used to determine RX FIFO trigger levels.

Bit 5: Used to detect a change in the FCR.

Bit 4: TX FIFO overrun bit.

Bit 3: DMA mode select. If bit 3 is a 0, the 16450 mode is enabled which does only single-byte transfers. When bit 3 is a 1, it enables a multiple byte (FIFO mode) data transfer.

Bit 2: TX FIFO reset. This will cause TX FIFO pointer logic to be reset (any data in TX FIFO will be lost). This bit is self clearing; however, a shadow bit exists that is cleared only when read by the host, thus allowing the host to monitor a FIFO reset.

Bit 1: RX FIFO reset. This will cause RX FIFO pointer logic to be reset (any data in RX FIFO will be lost). This bit is self clearing; however, a shadow bit exists that is cleared only when read by the host, thus allowing the host to monitor a FIFO reset.

Bit 0: FIFO enable. The host writes this bit to logic 1 to put the block in FIFO mode. This bit must be a 1 when writing other bits in this register or they will not be programmed. When this bit changes state, any data in the FIFOs or the RBR and THR registers will be lost and any pending interrupts are cleared.

Bit 7	Bit 6	16 Deep FIFO Trigger Levels (# of bytes) Default
0	0	1
0	1	4
1	0	8
1	1	14

LCR Line Control

Bit 7: Divisor latch access bit. This bit allows the host, access to the divisor latch. Under normal circumstances, the bit is set to 0 (provides access to the RX and TX FIFOs at address 0). If the bit is set to 1, access to transmitter, receiver, interrupt enable, and modem control registers is disabled. In this case, when an access is made to address 0, the divisor latch least (DLL) significant byte is accessed. Address 1 accesses the most significant byte (DLM). Address 7 accesses the DLX divisor latch register. Address 4 accesses the MCX status/control register.

Bit 6: Used to denote a host-generated set break condition.

Bits 0,1,3,4,5: Used only in parity bit generation for the 7 bit data byte case. Bits 0 and 1 are used for word length select (b0 = 0 and b1 = 1 is used for 7 bit data). Bit 3 is parity enable. Bit 4 is even parity select. Bit 5 is stick parity.

MCR Modem Control

Bits 5–7: Reserved, and will always be 0.

Bit 4: Used for loopback. When a 1, bits 0–3 of the MCR are reflected in modem status register (MSR) as follows: RI <= OUT1, DCD <= OUT2, DSR <= DTR,CTS <= RTS. Emulation of loopback feature of 16550 UART must be done by the host except for the above conditions. Also, when this bit is set, it allows for data loop back. This means the host can write a data word to the TX and immediately read back the same data word from the RX (in a manner similar to the 16550A).

Bit 3: Controls the signal used to 3-state the host interrupt. If 0, then an active-low L33xV output will be set to 0, and this signal will be used to 3-state the host interrupt output pin.

Bits 0–2: Used during LOOP function.

Bit 2: OUT1.

Bit 1: Request to Send (RTS).

Bit 0: Data terminal ready (DTR).

LSR Line Status

Bit 7:   Error in RX FIFO. This bit is always set to 1 if at least one data byte in the RX FIFO has an error. This will clear when there are no more errors in the RX FIFO.

Bit 6:   Transmitter empty. This bit is the same as LSR bit 5 (THRE) in MMM

Bit 5:   Transmitter holding register empty. This bit is set to 1 when either the transmitter holding register has been read (emptied) by the micro-controller (16450 mode) or the TX FIFO is empty (16550 mode). This bit is set to 0 when either the THR or the TX FIFO becomes not empty in 16450 mode. In 16550 mode, it is set to 0 only after the trigger level has been met since the last occurrence of TX FIFO empty. If the transmitter timer is enabled, a shadow bit exists which delays the timer setting this bit to 1. When reading this bit, the micro-controller will not see the delay. Both shadow and register bits are cleared when the host writes to the THR or TX FIFO in 16450 mode. The trigger level must be reached to clear the bit in 16550 (FIFO) mode.

Bits 2–4:   Used for parity error, framing error, and break detect. These bits are written, indirectly, by the micro-controller as follows: The bits are first written to the shadow bit locations when the micro-controller write accesses the LSR. When the next character is written to the receive buffer (RBR) or the RX FIFO, the data in the shadow bits is then copied to the RBR (16450 mode) or RX FIFO (16550 mode). In FIFO mode, bits become available to the host when the data byte associated with the bits is next to be read. In FIFO mode, with successive reads of the receiver, the status bits will be set if an error occurs on any byte. Once the micro-controller writes to the RBR or RX FIFO, the shadow bits are auto cleared. The register bits are updated with each host read.

Bit 1:   Overrun error. This bit is set if the micro-controller makes a second write to RBR before the host reads data in the buffer (16450 mode) or with a full RX FIFO (16550 mode). No data will be transferred to the RX FIFO under these circumstances. This bit is reset when the host reads the LSR.

Bit 0:   Data ready bit. This bit is set to 1 when received data is available, either in the RX FIFO (16550 mode) or the RBR (16450 mode). This bit is set immediately upon the micro-controller writing data to the RBR or FIFO if the receive timer is not enabled, but it is delayed by the timer interval if the receive timer is enabled. For micro-controller read access, a shadow bit exists so that the micro-controller does not see the delay that the host sees. Both bits are cleared to logic 0 immediately upon reading all data in either RBR or RX FIFO.

MSR Modem Status

Bits 4 through 7 of the MSR can also take on the MCR bits 0 through 3 value when in MCR loop mode (i.e. when MCR b4 = 1). The transfer of bits in loop back has a null modem twist (i.e. MCR b0 goes to MSR b5 and MCR b1goes to MSR b4).

Bit 7:   Data carrier detect (DCD) bit.

Bit 6:   Ring indicator (RI) bit.

Bit 5:   Data set ready (DSR) bit.

Bit 4:   Clear to send (CTS) bit.

Bit 3:   Delta data carrier detect pin. This bit is set to a 1 whenever the data carrier detect bit changes state. It is reset when the host reads the modem status register.

Bit 2:   Trailing edge ring indicator bit. This bit is set to 1 on the falling edge of the ring indicator bit. It is reset when the host reads the modem status register.

Bit 1:   Delta data set ready bit. This bit is set to 1 whenever the data set ready changes state. It is reset when the host reads the modem status register.

Bit 0:   Delta clear to send bit. This bit is a one whenever the clear to send bit changes state. It is reset when the host reads the modem status register.

SCR Scratch

The host programmer uses this register for temporary data storage.

DLL Divisor Latch (LSByte)

This register contains low-order byte for the 16-bit clock divider. It is kept to maintain register set compatibility with the 16C550A interface. However, it is not used for clock generation since MMM does not require the generation of a real baud clock.

DLM Divisor Latch (MSByte)

This register contains high-order byte for the 16-bit clock divider. It is kept to maintain register set compatibility with the 16C550A interface. However, it is not used for clock generation, since MMM does not require the generation of a real baud clock.

Programming the Baud Rate Generator Registers DLM (MSB) and DLL (LSB) provides a user capability for selecting the desired final baud rate. The example in the Table below, shows the selectable baud rates available when using a 1.8432 MHz external clock input.

BAUD RATE GENERATOR PROGRAMMING TABLE

Baud Rate	16 x Clock Divisor (Decimal)	DLM Value (HEX)	DLL Value (HEX)
110	1047	04	17
300	384	01	80
600	192	00	C0
1200	96	00	60
2400	48	00	30
4800	24	00	18
9600	12	00	0C
19.2K	6	00	06
38.4K	3	00	03
57.6K	2	00	02
115.2K	1	00	01

Chapter 5 – 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 the characters **AT** must precede each command 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 auto answer 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 (it could be some other key depending on the terminal program) 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. See a table of valid 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; the command interpreter ignores them. 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

Organization of AT Commands on the following pages: 1st, by the initial command character (e.g., &, +, %, etc.) 2nd, alphabetized by the second command character (Except for listing of **AT**).

Command	Description
AT	Attention Code
A	Answer
A/	Repeat Last Command
B*n*	Communication Standard Setting
D*s*	Dial
DS=*y*	Dial Stored Telephone Number
E*n*	Echo Command Mode Characters
F*n*	Echo Online Data Characters
H*n*	Hook Control
I*n*	Information Request
M*n*	Monitor Speaker Mode

N*n*	Modulation Handshake
O*n*	Return Online to Data Mode
P	Pulse Dialing
Q*n*	Result Codes Enable/Disable
S*r=n*	Set Register Value
S*r?*	Read Register Value
T	Tone Dialing
V*n*	Result Code Format
W*n*	Result Code Options
X*n*	Result Code Selection
Z*n*	Modem Reset
&C*n*	Data Carrier Detect (DCD) Control
&D*n*	Data Terminal Ready (DTR) Control
&E*n*	XON/XOFF Pass-Through
&F*n*	Load Factory Settings
&G*n*	V.22bis Guard Tone Control
&K*n*	Flow Control Selection
&L*n*	Leased Line Operation
&P*n*	Pulse Dial Make-to-Break Ratio Selection
&Q*n*	Asynchronous Communications Mode
&S*n*	Data Set Ready (DSR) Control
&T*n*	Loopback Test (V.54 Test) Commands
&V	Display Current Settings
&W*n*	Store Current Configuration
&Z*y=x*	Store Dialing Command
\A*n*	Select Maximum MNP Block Size
\B*n*	Transmit Break
\K*n*	Break Control
\N*n*	Error Correction Mode Selection
\Q*n*	Flow Control Selection
\T*n*	Inactivity Timer
\V*n*	Protocol Result Code
-C*n*	Data Calling Tone
%A	Adaptive Answer Result Code Enable
%B	View Numbers in Blacklist
%C*n*	Data Compression Control
%DC*n*	AT Command Control
%E*n*	Fallback and Fall Forward Control
%H*n*	Direct Connect Enable
%R*n*	Cisco Configuration
%S*n*	Command Speed Response
$EB*n*	Asynchronous Word Length
$D*n*	DTR Dialing
$MB*n*	Online BPS Speed
$SB*n*	Serial Port Baud Rate
#CBA*n*	Callback Attempts
#CBD*n*	Callback Delay
# CBF?	Callback Failed Attempts Display
# CBFR	Callback Failed Attempts Reset
# CBI*n*	Local Callback Inactivity Timer
# CBN*y=n*	Store Callback Password
# CBP*n*	Callback Parity
# CBR*y*	Callback Security Reset
# CBS*n*	Callback Enable/Disable
#P*n*	Set 11-bit Parity
#S*x*	Enter Setup Password
#S=*x*	Store Setup Password
+VDR=*x, y*	Distinctive Ring Report
+++AT<CR>	Escape Sequence
%%%AT<CR>	Remote Configuration Escape Sequence
V.92 Commands	

AT Commands

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:		0 and 15
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, *, #, , 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: **ATDT1028806127853500$123456789**

Command:	**DS=***y*	**Dial Stored Telephone Number**
Values:		*n* = 0–2
Default:		none
Description:		Dial a number previously stored in directory number *y* by the *&Zy=x* command. Example: **ATDS=2**

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
		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:	**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: **Sr=***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: **Sr?**   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: *Zn*   **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, 1, 2
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.
                        &C2   DCD drops on disconnect for time set by S18. It then goes high again (for some PBX phone systems).

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:	**&E***n*	**XON/XOFF Pacing Control**
Values:		*n* = 12 or 13
Default:		12
Description:		&E12 Disables XON/XOFF pacing.
		&E13 Enables XON/XOFF pacing.

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:	**&L***n*	**Leased Line Operation**
Values:		*n* = 0, 1, or 2
Defaults:		0
Description:		&L0 The modem is set for standard dial-up operation.
		&L1 The modem is set for leased line operation in originate mode.
		&L2 The modem is set for leased line operation in answer mode.
		Note: For **&L1** and **&L2**, there is a 30-second window between power up and the starting of the leased line handshake. During this time, you can turn off the command, if desired.

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 *&P2* command is available only if the country code is set to 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*.

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Command:	**&S***n*	**Data Set Ready (DSR) Control**
Values:		*n* = 0 or 1
Default:		0
Description:		&S0 DSR is always high (on).
		&S1 DSR goes high only during a connection.

Command:	**&T***n*	**Loopback Test** (**V.54 Test**) **Commands**
Values:		*n* = 0, 1, 3, 6
Default:		None
Description:		The modem can perform selected test and diagnostic functions. A test can be run only when the modem is operating in non-error-correction mode (normal or direct mode). For tests 3 and 6, a connection between the two modems must be established. To terminate a test in progress, the escape sequence (**+++***AT*) must be entered.

&T0   Stops any test in progress.
&T1   Starts a local analog loopback, V.54 Loop 3, test. If a connection exists when this
        command is issued, the modem hangs up. When the test starts, a *CONNECT*
        message is displayed.
&T3   Starts local digital loopback, V.54 Loop 2, test. If no connection exists, *ERROR* is
        returned.
&T6   Initiates a remote digital loopback, V.54 Loop 2, test without self-test. If no connection
        exists, *ERROR* is returned.

Command:	**&V**	**Display Current Settings**
Values:		n/a
Description:		Displays the active modem settings.

Command:	**&W***n*	**Store Current Configuration**
Values:		*n* = 0 or 1
Default:		1
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:	**&Z***y***=***x*	**Store Dialing Command**
Values:		*y* = 0–2
		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 **#CBS** command, a callback security command.

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:	**\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** command. 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:		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 Disables the appending of the protocol result code to the DCE speed.

\V1 Enables 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
Default:		0
Description:		\X0 Modem responds to and discards XON/XOFF characters.
		\X1 Modem responds to and passes XON/XOFF characters.
		Note: This is also controlled via **&E6** and **&E7**.

Command:	**-C**n	**Data Calling Tone**
Values:		n = 0 or 1
Defaults:		1
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:	**%A**	**Adaptive Answer Result Code Enable**
Values:		n = 0 or 1
Default:		0
Description:		The %A command controls whether the DATA or FAX result codes will be sent by the modem. The modem must be in fax mode for this command to work. Also, the modem must be set to **+FAA=1**, which enables the modem to distinguish between a fax and a data call. When these commands are enabled, the modem sends DATA to the computer when it detects data tones, and FAX when it detects fax tones. These strings are used by some servers to select the appropriate communication program.
		%A0 Disables adaptive answer result codes.
		%A1 Enables adaptive answer result codes.

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:	**%H**n	**Direct Connect Enable**
Values:		n = 0, 1
Default:		0
Description:		%H0 Sets callback security to normal operation.
		%H1 All callback security calls will be direct connect regardless of whether the password or phone number has the **-** character.

Command:	**%R**n	**Cisco Configuration**
Values:		n = 0, 1
Default:		0
Description:		%R0 Disables Cisco configuration.
		%R1 Sets **E0**, **Q1**, **&D0**, **\N0**, **$SB9600**, and **%S1** for operation with a Cisco router.

Command:	**%S***n*	**Command Speed Response**
Values:	*n* = 0, 1	
Default:	0	
Description:	%S0 Sets modem to respond to AT commands at all normal speeds.	
	%S1 AT commands accepted at 115200 bps only. Commands at other speeds are ignored.	

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:	**$EB***n*	**Asynchronous Word Length**
Values:	*n* = 0 or 1	
Default:	0	
Description:	$EB0 Enables 10-bit mode.	
	$EB1 Enables 11-bit mode.	

Command:	**$MB***n*	**Online BPS Speed**
Values:	*n* = speed in bits per second	
Default:	28,800	
Description:	$MB75	Selects CCITT V.23 mode
	$MB300	Selects 300 bps on-line
	$MB1200	Selects 1200 bps on-line
	$MB2400	Selects 2400 bps on-line
	$MB4800	Selects 4800 bps on-line
	$MB9600	Selects 9600 bps on-line
	$MB14400	Selects 14400 bps on-line
	$MB19200	Selects 19200 bps on-line
	$MB28800	Selects 28800 bps on-line
	$MB33600	Selects 33600 bps on-line

Command:	**$RP***n*	**Ring Priority vs. AT Command Priority**
Values:	*n* = 0 or 1	
Default:	1	
Description:	$RP0	The AT command will have priority over the ring. S1 will be reset to 0 if an AT command is received. This command is storable to memory.
	$RP1	The ring will have priority over the AT command. S1 will increment even if an AT command and ring are received together and the incoming call will be answered when S1 is equal to S0. **Note:** SocketModems do not detect ring cadence of TelTone telephone line simulators as a valid ring.

Command:	**$SB***n*	**Serial Port Baud Rate**
Values:	*n*= speed in bits per second	
Default:	115200	
Description:	$SB300	Sets serial port to 300 bps
	$SB1200	Sets serial port to 1200 bps
	$SB2400	Sets serial port to 2400 bps
	$SB4800	Sets serial port to 4800 bps
	$SB9600	Sets serial port to 9600 bpst
	$SB19200	Sets serial port to 19200 bps
	$SB38400	Sets serial port to 38400 bps
	$SB57600	Sets serial port to 57600 bps
	$SB115200	Sets serial port to 115200 bps
	$SB230400	Sets serial port to 230400 bps

Command:	**+VDR=x, y**	**Distinctive Ring Report**
Values:		x = 0, 1 Distinctive Ring report control. See description.
		y = 0–255 Minimum ring interval in 100 ms units. See description.
Default:		0, 0
Description:		Enables reporting of ring cadence information to the DTE and specifies the minimum ring cadence that will be reported.

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 DROF=number in units of 100 ms<CR><LF>, and the length of the ring is in the form DRON=number in units of 100 ms<CR> <LF>. The modem may produce a Ring event code after the DRON message if enabled by the y parameter. The y parameter must be set to a value equal to or smaller than the expected ring cadence in order to pass the report to the DTE.

+VDR=0, n/a   Disables Distinctive Ring cadence reporting.

+VDR=1, 0   Enables Distinctive Ring cadence reporting. Other call progress result codes (including RING) are reported as normal.

+VDR=1, >0   Enables Distinctive Ring cadence reporting. The RING result code is reported after the falling edge of the ring pulse (i.e., after the DRON report).

+VDR=?   Displays the allowed values.

+VDR?   Displays the current value.

Command:	**#CBAn**	**Callback Attempts**
Values:		n = 1–255
Default:		4
Description:		Sets the number of callback attempts that are allowed after passwords have been exchanged between modems.

Command:	**#CBDn**	**Callback Delay**
Values:		n = 0–255
Default:		15
Description:		Sets the length of time (in seconds) that the modem waits before calling back the remote modem.

Command:	**#CBF?**	**Callback Failed Attempts Display**
Values:		n/a
Default:		n/a
Description:		Requests the number of failed callback passwords since reset or power-up. This number can be stored to nonvolatile memory using the **&W** command.

Command:	**#CBFR**	**Callback Failed Attempts Reset**
Values:		n/a
Default:		n/a
Description:		Resets the number of failed callback passwords to 0. This does not reset the number stored in nonvolatile memory.

Command:	**#CBIn**	**Local Callback Inactivity Timer**
Values:		n = 1–255
Default:		20
Description:		Sets the time (in minutes) that the modem waits for a command before forcing the user to enter the setup password again.

Command:	**#CBNy=x**	**Store Callback Password**
Values:		y = 0–29
		x = password
Defaults:		None
Description:		Sets the callback security password for the y memory location. The password must have 6 to 10 characters, and cannot include the + or - characters.

Command:	**#CBPn**	**Callback Parity**
Values:		n = 0, 1, or 2
Default:		0
Description:		Sets parity for the callback security messages.
		#CBP0 No parity.
		#CBP1 Odd parity.
		#CBP2 Even parity.

Command:	**#CBRy**	**Callback Security Reset**
Values:		y = 0–29
Default:		None
Description:		Clears the password and phone number in the y memory location.

Command:	**#CBSn**	**Callback Enable/Disable**
Values:		n = 0, 1, 2, or 3
Default:		0
Description:		#CBS0 Disables callback security.
		#CBS1 Enables local and remote callback security.
		#CBS2 Enables remote callback security only.
		#CBS3 Disables callback security until local hangup or reset.

Command:	**#Pn**	**Set 11-bit Parity**
Values:		n = 0 or 1
Default:		2
Description:		#P0 No parity.
		#P1 Odd parity.
		#P2 Even parity.

Command:	**#Sx**	**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.

Escape AT Commands

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 two optional 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*.

V.92 Commands

Command:	**+MS=**	**Modulation Selection**
Values:		See description.
Defaults:		See description.
Description:		This extended-format command selects modulation, enables or disables automode, and specifies the highest downstream and upstream connection rates using one to four subparameters.
		The command syntax is
		+MS=[mod][,[automode][,[0][,[max_rate][,[0][,[max_rx_rate]]]]]]<CR>
		Subparameters that are not entered retain their current value. Commas separate optional subparameters, and must be inserted to skip a subparameter. Example: +MS=,0<CR> disables automode and keeps all other settings at their current values.
	+MS=?	Reports supported options in the format (list of supported mod values),(list of supported automode values),(0),(list of supported max_rate values),(0),(list of supported max_rx_rate values). Example: +MS: (BELL103, V21, BELL212A, V22, V22B, V23C, V32, V32B, V34, V90, V92), (0, 1), (0), (0-33600), (0), (0-56000)
	+MS?	Reports current options in the format mod, automode, 0, max_rate, 0, max_rx_rate. Example: +MS: V92, 1, 0, 31200, 0, 56000.

Subparameters

mod Specifies the preferred modulation (automode enabled) or the modulation to use in originating or answering a connection (automode disabled). The default is V92.

mod	Modulation	Possible rates (bps)[1]
V92[2]	V92	56000, 54666, 53333, 52000, 50666, 49333, 48000, 46666, 45333, 44000, 42666, 41333. 40000, 38666, 37333, 36000, 34666, 33333, 32000, 30666, 29333, or 28000
V90[3]	V.90	56000, 54666, 53333, 52000, 50666, 49333, 48000, 46666, 45333, 44000, 42666, 41333. 40000, 38666, 37333, 36000, 34666, 33333, 32000, 30666, 29333, or 28000
V34	V.34	33600, 31200, 28800, 26400, 24000, 21600,19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400
V32B	V.32bis	14400, 12000, 9600, 7200, or 4800
V32	V.32	9600 or 4800
V22B	V.22bis	2400 or 1200
V22	V.22	1200
V23C	V.23	1200
V21	V.21	300
Bell212A	Bell 212A	1200
Bell103	Bell 103	300

Notes:
1. See optional *<automode>*, *<max_rate>*, and *<max_RX_rate>* subparameters.
2. Selects V.92 modulation as first priority. If a V.92 connection cannot be established, the modem attempts V.90, V.34, V.32bis, etc.
3. Selects V.90 modulation as first priority. If a V.90 connection cannot be established, the modem attempts V.34, V.32bis, etc.

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automode   An optional numeric value that enables or disables automatic modulation negotiation using V.8 bis/V.8 or V.32 bis Annex A. Automode is disabled if values are specified for the max_rate and max_rx_rate parameters. The options are:

    0 Disable automode
    1 Enable automode (default)

max_rate   An optional number that specifies the highest rate at which the modem may establish an upstream (transmit) connection. The value is decimal coded in units of bps, for example, 33600 specifies the highest rate to be 33600 bps.

    0 Maximum rate determined by the modulation selected in mod (default).

300–33600 Maximum rate value limited by the modulation selected in mod. For valid max_rate values for each mod value, see the following table.

mod value	Valid *max_rate* values (bps)
V92, V90, V34	31200, 28800, 26400, 24000, 21600,19200, 16800, 14400, 12000, 9600, 7200, 4800, 2400
V32B	19200, 16800, 14400, 12000, 9600, 7200, 4800
V32	14400, 12000, 9600, 7200, 4800
V22B	2400
V22, V23C, Bell212A	1200
V21, Bell103	300

max_rx_rate An optional number that specifies the highest rate at which the modem may establish a downstream (receive) connection. The value is decimal coded in units of bps, e.g., 28800 specifies the highest rate to be 28800 bps.

    0 Maximum rate determined by the modulation selected in *mod* (default).

300–56000 Maximum rate value limited by the modulation selected in *mod*. See "Possible rates" in the *mod* table.

Command: **+PCW=n**   **Call Waiting Enable**
Values: n = 0, 1, or 2
Default: 2
Description: Controls the action to be taken upon detection of a call waiting tone in V.92 mode. Values specified by this command are not modified when an **AT&F** command is issued.
    +PCW=0 Toggles V.24 Circuit 125 and collects Caller ID if enabled by +VCID
    +PCW=1 Hangs up
    +PCW=2 Ignores V.92 call waiting
    +PCW=? Displays the allowed values
    +PCW?   Displays the current value

Command: **+PIG=n** **PCM Upstream Ignore**
Values: n = 0 or 1
Default: 1
Description: Controls the use of PCM upstream during V.92 operation. PCM upstream allows faster upload speeds to a V.92 server.
    +PIG=0   Disables PCM upstream
    +PIG=1   Enables PCM upstream
    +PIG=?   Displays the allowed values
    +PIG? Displays the current value

Command: **+PMH=n**   **Modem on Hold Enable**
Values: n = 0 or 1
Default: 1
Description: Controls if modem on hold procedures are enabled during V.92 operation. Normally controlled by a modem on hold program. Values specified by this command are not modified when an **AT&F** command is issued.
    +PMH=0 Enables V.92 modem on hold
    +PMH=1 Disables V.92 modem on hold
    +PMH=? Displays the allowed values
    +PMH?   Displays the current value

Command:	**+PMHF V.92 Modem Hook Flash**
Values:	n/a
Default:	n/a
Description:	Causes the DCE to go on-hook for a specified period of time, and then return off-hook for at least a specified period of time. The specified period of time is normally one-half second, but may be governed by national regulations. "ERROR" is returned if MOH is not enabled.

Command:	**+PMHR=n Modem on Hold Initiate**
Values:	n = 0–13
Default:	0
Description:	**+PMHR** is an action command that causes the modem to initiate MOH with the central site modem. It returns the following values to indicate what has been negotiated. Valid only if MOH is enabled and the modem is off-hook or in data mode. Otherwise, ERROR will be returned.

+PMHR=0   Deny MOH request
+PMHR=1   Grant MOH request with 10 second timeout
+PMHR=2   Grant MOH request with 20 second timeout
+PMHR=3   Grant MOH request with 30 second timeout
+PMHR=4   Grant MOH request with 40 second timeout
+PMHR=5   Grant MOH request with   1 minute timeout
+PMHR=6   Grant MOH request with   2 minute timeout
+PMHR=7   Grant MOH request with   3 minute timeout
+PMHR=8   Grant MOH request with   4 minute timeout
+PMHR=9   Grant MOH request with   6 minute timeout
+PMHR=10   Grant MOH request with   8 minute timeout
+PMHR=11   Grant MOH request with 12 minute timeout
+PMHR=12   Grant MOH request with 16 minute timeout
+PMHR=13   Grant MOH request with indefinite timeout
+PMHR=?   Displays the allowed values
+PMHR?   Displays the current value

Command:	**+PMHT=n Modem on Hold Timer**
Values:	n = 0–13
Default:	0
Description:	Determines if the modem will accept a V.92 Modem on Hold (MOH) request and will set the MoH timeout.

+PMHT=0   Deny MOH request
+PMHT=1   Grant MOH request with 10 second timeout
+PMHT=2   Grant MOH request with 20 second timeout
+PMHT=3   Grant MOH request with 30 second timeout
+PMHT=4   Grant MOH request with 40 second timeout
+PMHT=5   Grant MOH request with   1 minute timeout
+PMHT=6   Grant MOH request with   2 minute timeout
+PMHT=7   Grant MOH request with   3 minute timeout
+PMHT=8   Grant MOH request with   4 minute timeout
+PMHT=9   Grant MOH request with   6 minute timeout
+PMHT=10   Grant MOH request with   8 minute timeout
+PMHT=11   Grant MOH request with 12 minute timeout
+PMHT=12   Grant MOH request with 16 minute timeout
+PMHT=13   Grant MOH request with indefinite timeout
+PMHT=?   Displays the allowed values
+PMHT?   Displays the current value

Command:	**+PQC=n** **Quick Connect Control**
Values:	n = 0, 1, 2, or 3
Default:	3
Description:	Controls the V.92 shortened Phase 1 and Phase 2 startup procedures (Quick Connect). When line conditions are stable, quick connect results in shortened connect times; however, significant fluctuation in line conditions from call to call can result in longer connect times, in which case it may be advisable to disable quick connect.

+PQC=0   Enables Short Phase 1 and Short Phase 2 (Quick Connect)
+PQC=1   Enables Short Phase 1
+PQC=2   Enables Short Phase 2
+PQC=3   Disables Short Phase 1 and Short Phase 2
+PQC=?   Displays the allowed values
+PQC?   Displays the current value

Command:	**+VCID=n** **Caller ID Selection**
Values:	n = 0, 1, or 2
Default:	0
Description:	Enables Caller ID detection and configures the reporting and presentation of the Caller ID data that is detected after the first ring. The reported data includes the date and time of the call, the caller's name and number, and a message. Set S0=2.

+VCID=0   Disables Caller ID
+VCID=1   Enables Caller ID with formatted data
+VCID=2   Enables Caller ID with unformatted data
+VCID=?   Displays the allowed values
+VCID?   Displays the currrent value

Command:	**+VDR=x, y** **Distinctive Ring Report**
Values:	x = 0, 1 Distinctive Ring report control. See description.
	y = 0–255 Minimum ring interval in 100 ms units. See description.
Default:	0, 0
Description:	Enables reporting of ring cadence information to the DTE and specifies the minimum ring cadence that will be reported.

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 DROF=number in units of 100 ms<CR><LF>, and the length of the ring is in the form DRON=number in units of 100 ms<CR> <LF>. The modem may produce a Ring event code after the DRON message if enabled by the y parameter. The y parameter must be set to a value equal to or smaller than the expected ring cadence in order to pass the report to the DTE.

+VDR=0, n/a   Disables Distinctive Ring cadence reporting.
+VDR=1, 0   Enables Distinctive Ring cadence reporting. Other call progress result codes (including RING) are reported as normal.
+VDR=1, >0   Enables Distinctive Ring cadence reporting. The RING result code is reported after the falling edge of the ring pulse (i.e., after the DRON report).
+VDR=?   Displays the allowed values.
+VDR?   Displays the currrent value.

Command:	**#CBAn** **Callback Attempts**
Values:	n = 1–255
Default:	4
Description:	Sets the number of callback attempts that are allowed after passwords have been exchanged between modems.

Command:	**#CBDn** **Callback Delay**
Values:	n = 0–255
Default:	15
Description:	Sets the length of time (in seconds) that the modem waits before calling back the remote modem.

Command:	**#CBF?**	**Callback Failed Attempts Display**
Values:		n/a
Default:		n/a
Description:		Requests the number of failed callback passwords since reset or power-up. This number can be stored to nonvolatile memory using the &W command.

Command:	**#CBFR**	**Callback Failed Attempts Reset**
Values:		n/a
Default:		n/a
Description:		Resets the number of failed callback passwords to 0. This does not reset the number stored in nonvolatile memory.

Command:	**#CBIn**	**Local Callback Inactivity Timer**
Values:		n = 1–255
Default:		20
Description:		Sets the time (in minutes) that the modem waits for a command before forcing the user to enter the setup password again.

Command:	**#CBNy=x**	**Store Callback Password**
Values:		y = 0–29
		x = password
Defaults:		None
Description:		Sets the callback security password for the y memory location. The password must have 6 to 10 characters, and cannot include the + or - characters.

Command:	**#CBPn**	**Callback Parity**
Values:		n = 0, 1, or 2
Default:		0
Description:		Sets parity for the callback security messages.
		#CBP0 No parity.
		#CBP1 Odd parity.
		#CBP2 Even parity.

Command:	**#CBRy**	**Callback Security Reset**
Values:		y = 0–29
Default:		None
Description:		Clears the password and phone number in the y memory location.

Command:	**#CBSn**	**Callback Enable/Disable**
Values:		n = 0, 1, 2, or 3
Default:		0
Description:		#CBS0 Disables callback security.
		#CBS1 Enables local and remote callback security.
		#CBS2 Enables remote callback security only.
		#CBS3 Disables callback security until local hangup or reset.

Command:	**#Pn**	**Set 11-bit Parity**
Values:		n = 0 or 1
Default:		2
Description:		#P0 No parity.
		#P1 Odd parity.
		#P2 Even parity.

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

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

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 auto answer completely.
S1	1 ring	0–255	0	Counts the rings that have occurred.
S2	decimal	0–127 128–255	43 (+)	Sets ASCII code for the escape sequence character. 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	35-65*	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	1	0 disables, 1 enables the V.25 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 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 V.90 provides rates of 28,000 to 56,000 bps in increments of 1,333 bps. 0 = V.90 disabled 1 = V.90 auto rate 2 = 28,000 bps 3 = 29,333 bps 4 = 30,666 bps 5 = 32,000 bps 6 = 33,333 bps 7 = 34,666 bps 8 = 36,000 bps 9 = 37,333 bps 10 = 38,666 bps 11 = 40,000 bps 12 = 41,333 bps 13 = 42,666 bps 14 = 44,000 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.
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 hang up	Do not use
S36=1, 3	LAPM or async	Async
S36=4, 6	LAPM, MNP, or hang up	MNP or hang up
S36=5, 7	LAPM, MNP, or async	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 or "sleep mode". A value of zero prevents standby mode; a value of 1–4 sets the value to 5. Standby mode (sleep mode or low power mode) is controlled by **S89**. It programs the number of seconds of inactivity before the modem will go to sleep. The default value is 0. A value of 0 disables standby mode. The modem will wake on an incoming ring or an AT command.
S108	decimal	0–3, 6, 7	6	Selects the 56K digital loss if using the modem through 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

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
9	CONNECT 75	Connected at 75 bps
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
18	CONNECT 57600	Connected at 57600 bps
24*	CONNECT 7200	Connected at 7200 bps
25*	CONNECT 12000	Connected at 12000 bps
28	CONNECT 38400	Connected at 38400 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
71	CONNECT 34000	Connected at 34000 bps
72	CONNECT 36000	Connected at 36000 bps
73	CONNECT 38000	Connected at 38000 bps
74	CONNECT 40000	Connected at 40000 bps
75	CONNECT 42000	Connected at 42000 bps
76	CONNECT 44000	Connected at 44000 bps
77	CONNECT 46000	Connected at 46000 bps
78	CONNECT 48000	Connected at 48000 bps
79	CONNECT 50000	Connected at 50000 bps
80	CONNECT 52000	Connected at 52000 bps
81	CONNECT 54000	Connected at 54000 bps
82	CONNECT 56000	Connected at 56000 bps
83	CONNECT 58000	Connected at 58000 bps
84	CONNECT 60000	Connected at 60000 bps
86	CONNECT 16800	Connected at 16800 bps
87	CONNECT 115200	Connected at 115200 bps
88	DELAYED	Delay is in effect for the dialed number
89	BLACKLISTED	Dialed number is blacklisted
90	BLACKLIST FULL	Blacklist is full
91	CONNECT 230400	Connected at 230400 bps
100	CONNECT 28000	Connected at 28000 bps
101	CONNECT 29333	Connected at 29333 bps
102	CONNECT 30666	Connected at 30666 bps
103	CONNECT 33333	Connected at 33333 bps
104	CONNECT 34666	Connected at 34666 bps
105	CONNECT 37333	Connected at 37333 bps
106	CONNECT 38666	Connected at 38666 bps
107	CONNECT 41333	Connected at 41333 bps
108	CONNECT 42666	Connected at 42666 bps
109	CONNECT 45333	Connected at 45333 bps
110	CONNECT 46666	Connected at 46666 bps

111	CONNECT 49333	Connected at 49333 bps
112	CONNECT 50666	Connected at 50666 bps
113	CONNECT 53333	Connected at 53333 bps
114	CONNECT 54666	Connected at 54666 bps
115	CONNECT 25333	Connected at 25333 bps
116	CONNECT 26666	Connected at 26666 bps

*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 6 - Voice Commands

Introduction

This chapter describes **+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 between voice, fax, and data modes.
- Control-related functions.

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

Voice command state (event reports only; no data transfers).

Voice transmit state (digitized, half-duplex voice data transfers from PC to modem).

Voice receive state, (digitized, half-duplex voice data transfers from modem to PC).

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.

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 ring backs, 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).

Commands That Change for Voice Mode Support

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.

Voice +V Commands Summary

These commands support Voice mode.

Command	Description
+VNH=	Automatic Hang Up Control
+FMI?	Report Manufacturer's ID
+FMM?	Report Product ID
+FMR?	Report Version Level
+FLO=	Select Flow Control Method
+VIP	Initialize Voice Parameters
+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 Ring back Goes Away Timer
+VRN=	Set Ring back 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 De-Assert Points
+VBT=?	Report Modem Flow Control Assert and De-Assert Points
+VPP=	Enable or Disable Voice Mode Packet Protocol
+VPR=	Select DTE/DCE Interface Rate (Turn Off Autobaud)

Voice +V Commands Detail

Command: **+FCLASS= <mode> <Enter>   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 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 Detect and Control DTMF**
Values:	8 characters, case sensitive
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. 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.

Touch Tone Signals

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 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).
For additional information on DTMF, see the Telecommunications Industry Association's web site at http://www.tiaonline.org/resources/other_links.cfm.

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

+VNH=0   Enable automatic hang-ups 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 hang-ups in other non-Voice modes

+VNH=2   Disable automatic hang-ups in other non-Voice modes. The modem performs only a "logical" hang up (i.e., returns the OK result code).

+VNH=3-255   Reserved for future standards

Command:	**+FMI?\<Enter>** **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>** **Report Product ID**
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., SocketModem).

Command:	**+FMR?\<Enter>** **Report Version Level**
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>** **Select Flow Control Method**
Values:	0, 1, 2, 3–255Result 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** **Initialize Voice Parameters**
Values:	0 (optional)
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.

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Command:	**+VRX**	**Enter Voice Receive State**
Values:	0, 1, 2–127, 128–255	
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><!>, 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 Hang Up (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 there 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>**	**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 there 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 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 dual 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) is 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 0.01second intervals. A list 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

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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 default 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=?**	**Report Frequency Support**
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 lines 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**	**Start Voice Transmission Process**
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>**	**Set the Gain for Received Voice Samples**
Values:	0–255	
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>**	**Set the Volume for Transmitted Voice Samples**
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>**	**Set DTE/DCE Inactivity Timer**
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 a specified 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 accessing 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 auto answer feature, since this feature does not allow the PC to set the modem in Voice mode before answering the phone.

Command:	**+VLS=<label>**	**Select Analog Source/Destination**
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 possible 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 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 Telco. Modem is off hook, and connected to Telco. Local phone provided with power to detect hook condition.

Command:	**+VLS=?**	**Identify Analog Source/Destination Configuration and Event Reporting Capabilities**
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 lines 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>**	**Set Ring Back 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 Ring Back. The parameter <interval> refers to the silence interval length between the end of one ring interval and the start of the next ring interval.	

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Command:	**+VRN=<interval>**	**Set Ring Back Never Appeared Timer**
Values:	0–10 (in 1.0 second increments)	
Default:	10	
Result Codes:	OK if 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 Ring Back. If the modem does not detect a Ring Back 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>**	**Set Silence Detection Sensitivity**
Values:	0–256 (in 0.1 second intervals)	
Result Codes:	OK if 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 is missing from the command string. If an error occurs, 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 Hang Up (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 setting 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 Hang Up (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 Hang Up (Silence) event reports.

Command	**+VSM=<cml>,<vsr>,<scs>,<sel>**	**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 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. 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). Unpredictable 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 0.1second increments. The modem ignores the <sel> parameter if the <scs> parameter is 0 (silence compression disabled).

Command:	**+VSM=?**	**Report Voice Compression Method**
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 limit is 20 characters. The +VXT command starts a translation to or from a particular manufacturer's proprietary voice data stream 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	Code Book Exited Linear Predictor
CVSD/Author	Continuously 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	Embedded Bit ADPCM

MP-LPC/Author   Multi-pulse LPC
LSLTCQ   Least Squares Lattice Trellis Coded Quantization

IS-101 does not make any provisions for standard compression modifiers.

Command:	**+VTD=<dur>** **Select Default Beep Tone Duration Timer (DTMF/Tone Generation Duration)**
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>** **Enable/Disable Distinctive Ring (Ring Cadence Reporting)**
Values:	See the Description
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.

<u>\<enable\></u>	<u>\<report\></u>	<u>Description</u>
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 lines 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>** **Control Tone Cadence Reporting**
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 Ring Back/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.

<u>**<enable>**</u>	<u>**<report>**</u>	<u>**Description**</u>
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 Ring Back/Remote Ring, Busy, and Reorder/Fast Busy tones event 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 lines 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 Ring Back/Remote Ring, Busy, and Reorder/Fast Tone event reports.

```
CPOF=40
CPON=20
CPOF=40
CPON=20
CPOF=40
CPON=20
```

Command:	**+VEM=<mask>**	**Event Reporting and Masking**
Values:	bits 0–32 on (i.e., FFFFFFFF8)	
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 Features Matrix for models that support Caller ID). 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 lines below, only the RING and the DTMF event detection reporting:

```
AT+VEM=18000000
OK
```

Command:	**+VEM=?**	**Report Event Reporting and Masking Capabilities**
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 bit-wise 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>** **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.
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 <de-assert> 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 de-asserts 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=?** **Report Modem Flow Control Assert and Deassert Points**
Description:	The +VBT=? command displays the possible <assert> and <deassert> values set by the +VBT= command, followed by the OK result code.
Example:	In the lines below, the +VBT=? command is used to ask about the modem's flow control and buffer size ranges. The modem reports 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>** **Enable or Disable Voice Mode Packet Protocol**
Values:	0, 1; (2–255 reserved for future standards)
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 the data corruption is not a problem on the communications link, 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>**	**Select DTE/DCE Interface Rate (Turn Off Autobaud)**

Values: 0, 1, 2, 3, 4, 5, 6, 7, 8
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 Inactivity 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 SocketModem to match the PC-to-modem data rate to the line-signaling 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).

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 Hang Up (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	Ring Back/Remote Ring
19	BUSY
20	DIALTONE
21	Reorder/Fast Busy
22	V.21 Channel 2 7E Flags
23	Transmit Buffer Under Run
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 Dial Tone
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.

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 and 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* command.
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 Voice Mode Shielded Codes
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 SocketModem 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
```

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). Voice Mode Shielded Codes Detail

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 Hang Up Timeout), Event 10 (Presumed End of Message), Event 13 (Loop Current Interruption), Event 14 (Loop Current 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 Hang Up "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).
l	(6C)	Event Number 13 (Loop Current Interruption). Usually indicates a remote hang up.
L	(4C)	Event Number 14 (Loop Current Polarity Reversal). May indicate a hang up 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 (Ring Back).
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 Under run).
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 Dial tone).
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/Receive handshaking examples.

Sample Rate Selection and Suggested Compression Method

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 queuing 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 Transmit mode.
CONNECT	The modem agrees.
<Data>	The PC delivers <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.

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 2 seconds.
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;	The DTE selects the Data mode with autobauding, and disables +VPR=0; automatic DCE answering. The DCE waits for a phone call.
+FCLASS=0 S0=0	(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/DCEAT+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>	The DTE strokes the Inactivity Timer.
<DLE> </>	The DCE reports the start of a possible DTMF tone.
<DLE> <5> <DLE> <5>	The DCE reports a DTMF 5 detection for 140 milliseconds (within a 70 millisecond 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

The table 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.

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.

Fax AT Command documents are also posted on the Multi-Tech Web site.

For additional Multi-Tech information, contact:
http://www.multitech.com   for News, Products, Solutions, Support, Documents and more.
email oemsales@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 7 – Fax Commands

Fax commands have been placed in two separate documents:
- **Fax Commands Class 1 and Class 1.0 Developer's Reference Guide**
- **Fax Commands Class 2, 2.0, and 2.1 Developer's Reference Guide**

These documents are available on the CD, on the Multi-Tech FTP site, and as part of a Fax Developer's Kit.

Contact oemsales@multitech.com for more information.

Chapter 8 - Remote Configuration and Country Code Configuration

Remote Configuration

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 SocketModem 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 SocketModem.
2. Send three remote configuration escape characters followed by **AT** and the setup password, and press **Enter**. Example: **%%%ATMTSMODEM**. 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** and pressing **Enter**.
5. Type **ATO** and press **Enter t**o exit remote configuration. You can now break the connection in the normal way.

Setup

Multi-Tech modems are shipped with a default setup password (MTSMODEM). Because anyone who has the User Guide knows the default setup password, 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 can be up 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 further improve 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.

Caution: 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**.
   Note: This command can be executed locally as well as remotely.
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** and press **Enter** to exit remote configuration.

Country Code Configuration

Different countries have different requirements for how modems must function. Therefore, before you use the modem, you must configure it to match the defaults of the country in which you are using it. You can use one of two configuration methods: Using the Global Wizard and Using AT Commands.

Using the Global Wizard Utility

The Global Wizard configuration utility is recommended for computers running Windows 95/98/ME/2000/NT 4.0/XP.

1. Insert the MT5634SMI system CD into the CD-ROM drive. The **Autorun** dialog box appears.
2. Click Initial Setup and Country Selection. The Global Wizard dialog box appears. Click **Next**.
3. View the Global Wizard as it searches for your modem and identifies it. Click **Next**.
4. Select the country in which the modem will be used, and then click **Next**.
5. Review your choice of country. If it is correct, click **Next** to configure the modem.
6. When Global Wizard announces that the parameters have been set, click **Finish** to exit.

Using AT Commands

If you are comfortable using AT commands, you can configure your modem using AT commands. You must enter these commands in your communication program's terminal window.

To configure the modem for a specific country, execute the following AT commands:

Type **AT%T19,0,nn** (*nn* stands for country code). Press **Enter**. **OK** is displayed.

The changes to the country parameters are saved automatically.

To verify that the correct country has been configured, type **ATI9**. The country code is then displayed in decimal format. The following is an example of country, command and result codes.

Country	AT Command (Hexadecimal)	Result Code (Decimal)
Euro/NAM*	AT%T19,0,34 (default)	52
Japan	AT%T19,0,10	16

For a complete listing see Appendix C.

Chapter 9 – Firmware Upgrade Procedure

Introduction

Flash Upgrade Firmware

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 a Windows operating system to update (flash) your modem's firmware.

The *Flash Wizard* utility can be downloaded from Multi-Tech's FTP site and is available on CD.

Multi-Tech's Flash Programming Protocol

Also, included in this chapter is Multi-Tech's Flash Programming Protocol. This information is provided exclusively for the users of Multi-Tech Systems, Inc. modems. Such users Multi-Tech Systems, Inc. modem owners 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.

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</div>

The flash programming protocol is provided "AS IS" without warranty.

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.

Upgrade Steps

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 ME, 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 (or above)
   ```

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 the next step.

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.

    *   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.

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

3. 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.

Multi-Tech Systems, Inc. Flash Programming Protocol

Important:
When interacting with the boot code, it is possible to make the modem inoperable. Use extreme caution.

1. Programming the Modem

There are two ways to start flash programming a modem. It can be programmed
1. From "AT" mode
2. 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 100 milliseconds of power up. If the M's are not received within 100 milliseconds, then the modem starts up normally. If the AT*FS command is used, then you have 1 second (1000mS) to perform the handshake.
D		Sent at 19200 baud.
	M	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
[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
[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.
[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 000
2.2	ATI1 -	returns boot code version number M.mmn where M = unique code for each different platform that has boot code mm = version number of boot code n = version letter of the boot code Examples: 2.05e, 2.12d
	ATI4-	Boot code date and time.

3. Other Programming Concerns

1. The values programmed into Addresses 0000h, 0001h and 0002h should always be forced to C3h 00 01 (i.e., 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.

2. Addresses 0100h-01FFh through 70000h-7FFFFh should not be allowed to be programmed under normal circumstances, as this is the main body of the boot up code.

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

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

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

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.

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.
8-9	Record Type	"00"	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 A – Mechanical Details

Serial Test/Demo Board Components

On/Off

S1

Power Jack

J7

On/Off

J1

14 25
13

DB25

U3

P3 JP3

Normal/High Speed Jumper
Default: Normal
Use Normal Setting for
Serial Port Speed of
230Kbps or below.
Use High Speed Setting
for Speeds Above 230Kbps

RJ11
(Phone Jack)

C52 J2 C53
5 2

F1 F2

FID2

3.3V / 5V
Jumper
Default: 3.3V

JP6 3.3V
5V

LED17 LED10 LED14 LED12
LED15 LED16 LED11 LED13

SocketModem
Placement

J4 J11

DS1

J5 J12

Speaker
On
Off

JP1 P1

Value

Volume Pot

S3

Reset Switch

FID1

LED6 LED7 LED8 LED9

FID3

Figure A–1. Serial Test/Demo Board

5V / 3.3V Jumper – JP1

This JP1 Jumper provides for selection of either 5 volt or 3.3-volt operation.

Warning – Be sure to set the 5V/3.3V jumper to match the requirements of your SocketModem. If this jumper is set incorrectly, damage to the SocketModem and/or the Test/Demo card could result.

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 SocketModem. The transformer connector is keyed to prevent improper connection to the Test/Demo board.

Serial Test/Demo Board Block Diagram
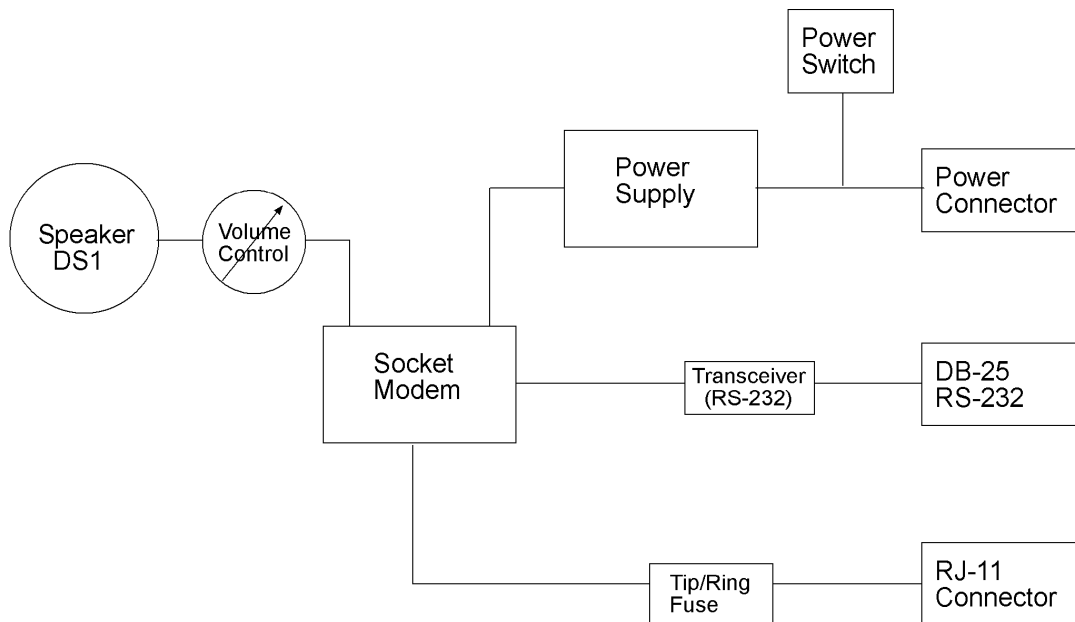
Figure A–2. Serial Test/Demo Board Block Diagram

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 SocketModem. The transformer connector is keyed to prevent improper connection to the Test/Demo board.

Parallel Test/Demo Board Components
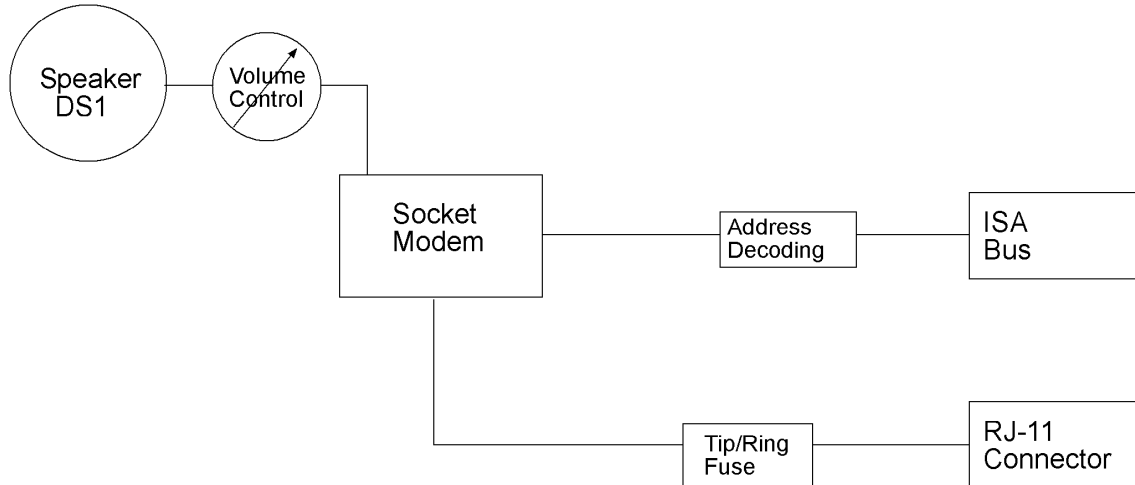
Figure A–4. Parallel Test/Demo Board

Interrupt (IRQ) Select Jumper – JP1

This JP1 Jumper is used to define the modem's IRQ value by shorting a pair of pins together. The factory default setting is IRQ 4 (pins 15 and 16)

I/O Address/COM Port/ IRQ Select Jumpers – JP2 and JP3

Jumpers JP2 and JP3 are used to define the modem's I/O Address, COM Port, and IRQ selections. The factory default setting is E, 3 (I/O Address. 3E8, COM Port 3, and IRQ 4).

Operating Voltage Select Jumper – JP4

The operating voltage factory default setting is 3.3V operation.

Parallel Test/Demo Board Block Diagram
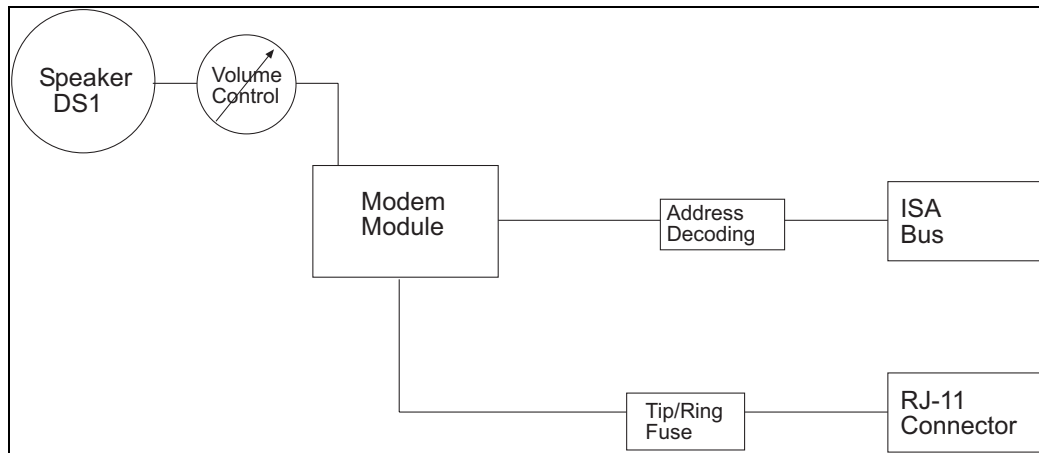
Figure A–4. Parallel Test/Demo Board Block Diagram

Appendix B - Product Approvals, Design Considerations, and Regulatory Information

Safety and EMC Approvals

Safety
EN60950
UL1950
IEC950
AS/NZ3260
CCIB (China)
TS-001

EMC
EN55022
FCC Part 15
Canadian EMC
EN55024
GB4943, GB9254

Telecom Approvals

While this modem can be configured for specific country operation, doing so DOES NOT constitute country approval. This modem is not approved in or configured for operation in all countries. The following list is displays the country approvals as of February 1, 2002.

This information can be deemed reliable, but is not guaranteed. All information is subject to change.

Contact your Multi-Tech Systems, Inc. sales representative or call the world headquarters at 800-328-9717.

Country	Country
Argentina	Russia
Australia	Singapore
Austria	Slovakia
Belgium	South Korea
Brazil	Spain
Canada	Sweden
Chile	Switzerland
China	Taiwan
Cyprus	Turkey
Denmark	United Kingdom
Estonia	United States
Finland	
France	
Germany	
Greece	
Hong Kong	
Hungary	
Iceland	
Indonesia	
Ireland	
Italy	
Japan	
Liechtenstein	
Luxembourg	
Mexico	
Netherlands	
New Zealand	
Norway	
Philippines	
Poland	
Portugal	

Regulatory 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 satisfactorily. Multi-Tech System's recommended vendor products only indicate that the product has been tested in controlled conditions and were found to perform satisfactorily.
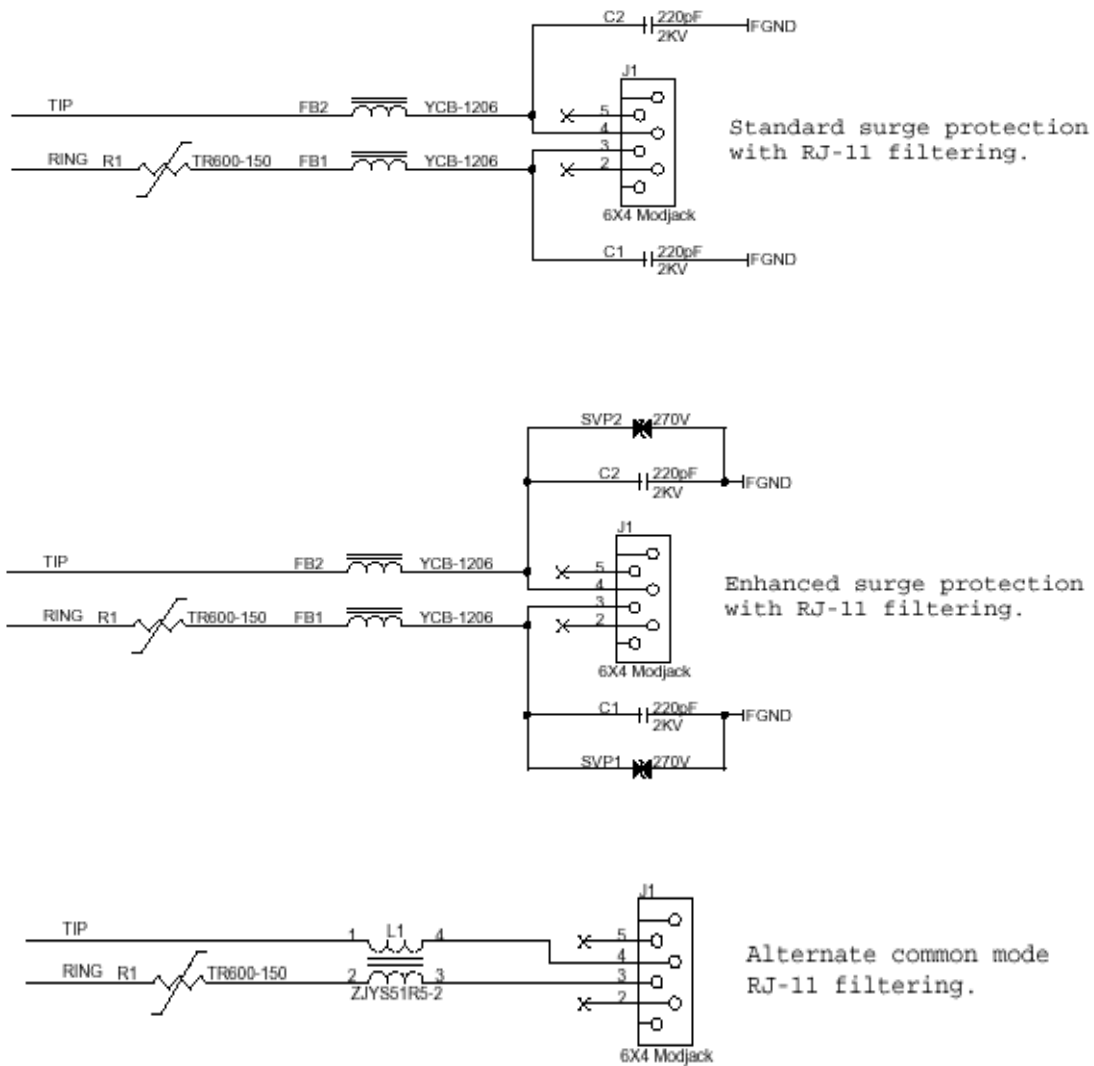
Figure B–1. Main Board Filtering

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 Sidactor

Manufacturer – Teccor Electronics – Part # - P#3100SA
Manufacturer – ST Microelectronics -- Part 1 – SMP100-270

Recommended Ferrite (SMT)

Manufacturer – Associated Component Technology (ACT) – Part # - YCB-1206
Manufacturer – Murata Erie – Part # - BLM31A601SPT

Recommended Ferrite (Thru-Hole)

Manufacturer – Associated Component Technology (ACT) – Part # - WB2-2.OT

Recommended Capacitor

Manufacturer – Murata Erie – Part # - GHM3045X7R221K-GC (Surface mount device) and
                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 # - SS-6446-NF-A431

Recommended Fuse

Manufacturer – RayChem –Part # - TR600-150, TS600-170, or TS600-200
Note: The fuse is also needed to meet UL1950 3rd edition protection against over-voltage from power line crosses.

Common Mode Choke

Manufacturer – TDK – Part # - ZJYS51R5 – 2PT

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.

Note: All safety notices must be added to any User Guide that you produce.

5V Tolerant Inputs for 3.3V Modules

In order to drive the inputs of 3.3V modules from 5V logic, it is recommended to add a 1K series resistor to each of the inputs: TXD, RTS, DTR, and RESET.
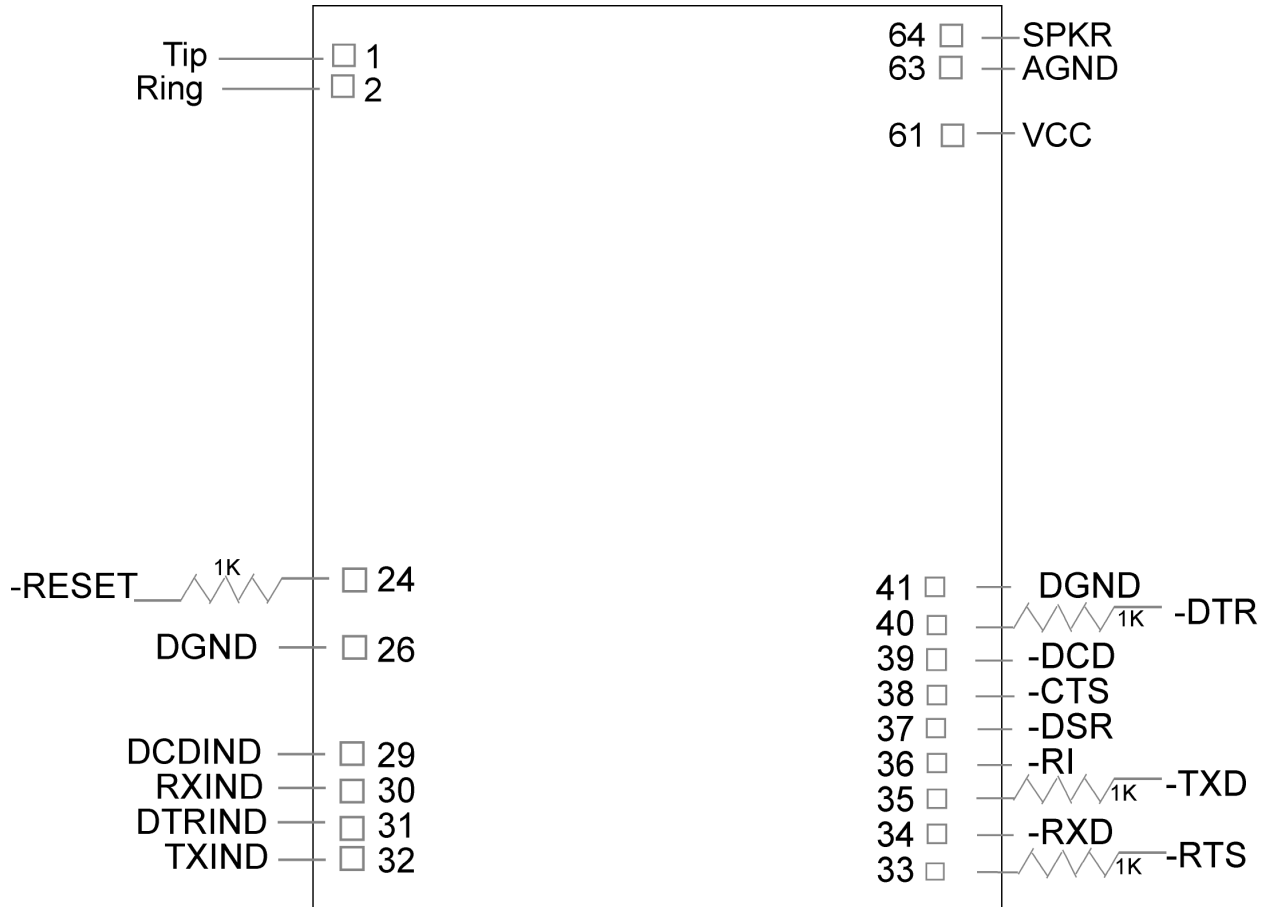
FCC Part 15 Regulation

This equipment has been tested and found to comply with the limits for a **Class B** digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver.
Plug the equipment into an outlet on a circuit different from that to which the receiver is connected.
Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC rules. Operation of this device is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.

WARNING – Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Industry Canada

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.
Cet appareil numérique de la classe B respecte toutes les exigences du Reglement Canadien sur le matériel brouilleur.

FCC Part 68 Telecom

1. This equipment complies with part 68 of the Federal Communications Commission 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. The suitable USOC jack (Universal Service Order Code connecting arrangement) for this equipment is shown below. 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 that is Part 68 compliant.

4. The ringer equivalence number (REN) is used to determine the number of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in the device not ringing in response to an incoming call. In most, but not all, areas the sum of the RENs should not exceed 5.0. To be certain of the number of devices that may be connected to the line, as determined by the total RENs, contact the local telephone company.

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 you 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 of 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 Multi-Tech 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	SocketModem
Model Number:	MT5634SMI
FCC Registration No:	AU7-USA-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
	U.S.A.
	(763) 785-3500
	(763) 785-9874 Fax

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 MT5634SMI SocketModem. 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. An Industry Canada label should be attached to the final product as described in the Industry Canada CS-03 section below. A label can be purchased from Multi-Tech or a label printing company available to you. A Multiple Listing (similar to FCC's re-registration) is also an option for Industry Canada labeling.

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.

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.

Fax Branding Statement

The Telephone Consumer Protection Act of 1991 makes it unlawful for any person to use a computer or other electronic device, including fax machines, to send any message unless such message clearly contains the following information:

Date and time the message is sent

Identification of the business or other entity, or other individual sending the message

Telephone number of the sending machine or such business, other entity, or individual

This information is to appear in a margin at the top or bottom of each transmitted page or on the first page of the transmission. (Adding this information in the margin is referred to as *fax branding*.)

Since any number of fax software packages can be used with this product, the user must refer to the fax software manual for setup details. Typically the fax branding information must be entered via the configuration menu of the software.

Canadian Limitations Notice

Notice: 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.

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. 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.

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.

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.

$C\,E$

EMC, Safety, and R&TTE Directive Compliance

The CE mark is affixed to this product to confirm compliance with the following European Community Directives:

• Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility;
   and

• Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits;
   and

• Council Directive 1999/5/EC of 9 March on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

New Zealand Telecom Warning Notice

1. 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 equipment is not capable under all operating conditions of correct operation at the higher speed which it is designated. 33.6 kbps and 56 kbps connections are likely to be restricted to lower bit rates when connected to some PSTN implementations. Telecom will accept no responsibility should difficulties arise in such circumstances.

2. Immediately disconnect this equipment should it become physically damaged, and arrange for its disposal or repair.

3. This modem shall not be used in any manner, which could constitute a nuisance to other Telecom customers.

4. 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.

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

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

7. Some parameters required for compliance with Telecom's Telepermit requirements are dependent on the equipment (PC) associated with this device. The associated equipment shall be set to operate within the following limits for compliance with Telecom's Specifications:

   For repeat calls to the same number:
   - There shall be no more than 10 call attempts to the same number within any 30-minute period for any single manual call initiation, and
   - The equipment shall go on-hook for a period of not less than 30 seconds between the end of one attempt and the beginning of the next attempt.

   For automatic calls to different numbers:
   - The equipment shall be set to ensure that automatic calls to different numbers are spaced such that there is no less than 5 seconds between the end of one call attempt and the beginning of another.
   - For automatically answered incoming calls:
   - The equipment shall be set to ensure that calls are answered between 3 and 30 seconds of receipt of ringing.

8. For correct operation, total of the RN's of all devices connected to a single line at any time should not exceed 5.

South African Notice

This modem must be used in conjunction with an approved surge protection device.

Appendix C – Country Configuration and Result Codes

This information is supplied to illustrate Multi-Tech's country configurations. However, many of these countries are not approved at this point in time. See Appendix B or contact your Multi-Tech sales representative regarding the latest approvals.

Country	Country Config. (hex)	ATI9 Response
Afghanistan	at%t19,0,34	52
Albania	at%t19,0,34	52
Algeria	at%t19,0,34	52
American Samoa	at%t19,0,34	52
Andorra	at%t19,0,34	52
Angola	at%t19,0,34	52
Anguilla	at%t19,0,34	52
Antarctica	at%t19,0,34	52
Antigua & Barbuda	at%t19,0,34	52
Argentina	at%t19,0,34	52
Armenia	at%t19,0,34	52
Aruba	at%t19,0,34	52
Australia	at%t19,0,1	1
Austria	at%t19,0,34	52
Azerbaijan	at%t19,0,34	52
Bahamas	at%t19,0,34	52
Bahrain	at%t19,0,34	52
Bangladesh	at%t19,0,34	52
Barbados	at%t19,0,34	52
Belarus	at%t19,0,34	52
Belgium	at%t19,0,34	52
Belize	at%t19,0,34	52
Benin	at%t19,0,34	52
Bermuda	at%t19,0,34	52
Bhutan	at%t19,0,34	52
Bolivia	at%t19,0,34	52
Bosnia & Herzegowina	at%t19,0,34	52
Botswana	at%t19,0,34	52
Bouvet Island	at%t19,0,34	52
Brazil	at%t19,0,34	52
British Indian Ocean Territory	at%t19,0,34	52
Brunei Darussalam	at%t19,0,34	52
Bulgaria	at%t19,0,34	52
Burkina Faso	at%t19,0,34	52
Burundi	at%t19,0,34	52
Cambodia	at%t19,0,34	52
Cameroon	at%t19,0,34	52
Canada	at%t19,0,34	52
Cape Verde	at%t19,0,34	52
Cayman Islands	at%t19,0,34	52
Central African Republic	at%t19,0,34	52
Chad	at%t19,0,34	52
Chile	at%t19,0,34	52
China	at%t19,0,34	52
Christmas Island	at%t19,0,34	52
Cocos (Keeling) Islands	at%t19,0,34	52
Colombia	at%t19,0,34	52
Comoros	at%t19,0,34	52
Congo	at%t19,0,34	52
Cook Islands	at%t19,0,34	52
Costa Rica	at%t19,0,34	52

Country	Country Config. (hex)	ATI9 Response
Cote D'Ivoire	at%t19,0,34	52
Croatia	at%t19,0,34	52
Cuba	at%t19,0,34	52
Cyprus	at%t19,0,34	52
Czech Republic	at%t19,0,25	37
Denmark	at%t19,0,34	52
Djibouti	at%t19,0,34	52
Dominica	at%t19,0,34	52
Dominican Republic	at%t19,0,34	52
East Timor	at%t19,0,34	52
Ecuador	at%t19,0,34	52
Egypt	at%t19,0,34	52
El Salvador	at%t19,0,34	52
Equatorial Guinea	at%t19,0,34	52
Eritrea	at%t19,0,34	52
Estonia	at%t19,0,34	52
Ethiopia	at%t19,0,34	52
Falkland Islands (Malvinas)	at%t19,0,34	52
Faroe Islands	at%t19,0,34	52
Fiji	at%t19,0,34	52
Finland	at%t19,0,34	52
France	at%t19,0,34	52
France-Metropolitan	at%t19,0,34	52
French Guiana	at%t19,0,34	52
French Polynesia	at%t19,0,34	52
French Southern Territories	at%t19,0,34	52
Gabon	at%t19,0,34	52
Gambia	at%t19,0,34	52
Georgia	at%t19,0,34	52
Germany	at%t19,0,34	52
Ghana	at%t19,0,34	52
Gibraltar	at%t19,0,34	52
Greece	at%t19,0,34	52
Greenland	at%t19,0,34	52
Grenada	at%t19,0,34	52
Guadeloupe	at%t19,0,34	52
Guam	at%t19,0,34	52
Guatemala	at%t19,0,34	52
Guinea	at%t19,0,34	52
Guinea-Bissau	at%t19,0,34	52
Guyana	at%t19,0,34	52
Haiti	at%t19,0,34	52
Heard and Mc Donald Islands	at%t19,0,34	52
Honduras	at%t19,0,34	52
Hong Kong	at%t19,0,30	48
Hungary	at%t19,0,30	48
Iceland	at%t19,0,34	52
India	at%t19,0,30	48
Indonesia	at%t19,0,30	48
Iran	at%t19,0,34	52
Iraq	at%t19,0,34	52
Ireland	at%t19,0,34	52
Israel	at%t19,0,30	48
Italy	at%t19,0,34	52
Jamaica	at%t19,0,34	52
Japan	at%t19,0,10	16
Jordan	at%t19,0,34	52
Kazakhstan	at%t19,0,34	52
Kenya	at%t19,0,34	52
Kiribati	at%t19,0,34	52
Korea-Democratic People's Republic of	at%t19,0,30	48
Korea-Republic of	at%t19,0,34	52
Kuwait	at%t19,0,34	52
Kyrgyzstan	at%t19,0,34	52

Country	Country Config. (hex)	ATI9 Response
Lao People's Democratic Republic	at%t19,0,34	52
Latvia	at%t19,0,34	52
Lebanon	at%t19,0,34	52
Lesotho	at%t19,0,34	52
Liberia	at%t19,0,34	52
Libyan Arab Jamahiriya	at%t19,0,34	52
Liechtenstein	at%t19,0,34	52
Lithuania	at%t19,0,34	52
Luxembourg	at%t19,0,34	52
Macau	at%t19,0,34	52
Macedonian-Former Yugoslav Republic of	at%t19,0,34	52
Madagascar	at%t19,0,34	52
Malawi	at%t19,0,34	52
Malaysia	at%t19,0,30	48
Maldives	at%t19,0,34	52
Mali	at%t19,0,34	52
Malta	at%t19,0,34	52
Marshall Islands	at%t19,0,34	52
Martinique	at%t19,0,34	52
Mauritania	at%t19,0,34	52
Mauritius	at%t19,0,34	52
Mayotte	at%t19,0,34	52
Mexico	at%t19,0,34	52
Micronesia (Federated States of)	at%t19,0,34	52
Moldavia -Republic of	at%t19,0,34	52
Monaco	at%t19,0,34	52
Mongolia	at%t19,0,34	52
Montserrat	at%t19,0,34	52
Morocco	at%t19,0,34	52
Mozambique	at%t19,0,34	52
Myanmar	at%t19,0,34	52
Namibia	at%t19,0,34	52
Nauru	at%t19,0,34	52
Nepal	at%t19,0,34	52
Netherlands	at%t19,0,34	52
Netherlands Antilles	at%t19,0,34	52
New Caledonia	at%t19,0,34	52
New Zealand	at%t19,0,9	9
Nicaragua	at%t19,0,34	52
Niger	at%t19,0,34	52
Nigeria	at%t19,0,34	52
Niue	at%t19,0,34	52
Norfolk Island	at%t19,0,34	52
Northern Mariana Islands	at%t19,0,34	52
Norway	at%t19,0,34	52
Oman	at%t19,0,34	52
Pakistan	at%t19,0,34	52
Palau	at%t19,0,34	52
Panama	at%t19,0,34	52
Papua New Guinea	at%t19,0,34	52
Paraguay	at%t19,0,34	52
Peru	at%t19,0,34	52
Philippines	at%t19,0,30	48
Pitcairn	at%t19,0,34	52
Poland	at%t19,0,30	48
Portugal	at%t19,0,34	52
Puerto Rico	at%t19,0,34	52
Qatar	at%t19,0,34	52
Reunion	at%t19,0,34	52
Romania	at%t19,0,34	52
Russian Federation	at%t19,0,34	52
Rwanda	at%t19,0,34	52
St. Helena	at%t19,0,34	52
Saint Kitts and Nevis	at%t19,0,34	52

Country	Country Config. (hex)	ATI9 Response
Saint Lucia	at%t19,0,34	52
St. Pierre and Miquelon	at%t19,0,34	52
Saint Vincent and the Grenadines	at%t19,0,34	52
Samoa	at%t19,0,34	52
San Marino	at%t19,0,34	52
Sao Tome and Principe	at%t19,0,34	52
Saudi Arabia	at%t19,0,34	52
Senegal	at%t19,0,34	52
Seychelles	at%t19,0,34	52
Sierra Leone	at%t19,0,34	52
Singapore	at%t19,0,30	48
Slovakia	at%t19,0,34	52
Slovenia	at%t19,0,30	48
Solomon Islands	at%t19,0,34	52
Somalia	at%t19,0,34	52
South Africa	at%t19,0,35	53
South Georgia and the South Sandwich	at%t19,0,34	52
Islands	at%t19,0,34	52
Spain	at%t19,0,34	52
Sri Lanka	at%t19,0,34	52
Sudan	at%t19,0,34	52
Suriname	at%t19,0,34	52
Svalbard and Jan Mayen Islands	at%t19,0,34	52
Swaziland	at%t19,0,34	52
Sweden	at%t19,0,34	52
Switzerland	at%t19,0,34	52
Syrian Arab Republic	at%t19,0,34	52
Taiwan-Province of China	at%t19,0,34	52
Tajikistan	at%t19,0,34	52
Tanzania-United Republic of	at%t19,0,34	52
Thailand	at%t19,0,34	52
Togo	at%t19,0,34	52
Tokelau	at%t19,0,34	52
Tonga	at%t19,0,34	52
Trinidad and Tobago	at%t19,0,34	52
Tunisia	at%t19,0,34	52
Turkey	at%t19,0,34	52
Turkmenistan	at%t19,0,34	52
Turks and Caicos Islands	at%t19,0,34	52
Tuvalu	at%t19,0,34	52
Uganda	at%t19,0,34	52
Ukraine	at%t19,0,34	52
United Arab Emirates	at%t19,0,34	52
United Kingdom	at%t19,0,34	52
United States	at%t19,0,34	52
United States Minor Outlying Islands	at%t19,0,34	52
Uruguay	at%t19,0,34	52
Uzbekistan	at%t19,0,34	52
Vanuatu	at%t19,0,34	52
Vatican City State (Holy See)	at%t19,0,34	52
Venezuela	at%t19,0,34	52
Vietnam	at%t19,0,30	48
Virgin Islands (British)	at%t19,0,34	52
Virgin Islands (U.S.)	at%t19,0,34	52
Wallis and Futuna Islands	at%t19,0,34	52
Western Sahara	at%t19,0,34	52
Yemen	at%t19,0,34	52
Yugoslavia	at%t19,0,34	52
Zaire	at%t19,0,34	52
Zambia	at%t19,0,34	52
Zimbabwe	at%t19,0,34	52

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