SocketModem™

Embedded Modem

MT5600SMI Family

MT5600SMI-32
MT5600SMI-L32
MT5600SMI-P32
MT5600SMI-34
MT5600SMI-L34
MT5600SMI-XL34
MT5600SMI-P34
MT5600SMI-PL34
MT5600SMI-92
MT5600SMI-L92
MT5600SMI-XL92
MT5600SMI-P92
MT5600SMI-PL92

Developer's Guide

MultiTech® Systems

SocketModem™ Developer's Guide
MT5600SMI (MT5600SMI-32, MT5600SMI-L32, MT5600SMI-P32, MT5600SMI-34, MT5600SMI-L34, MT5600SMI-XL34, MT5600SMI-P34, MT5600SMI-PL34, MT5600SMI-92, MT5600SMI-L92, MT5600SMI-XL92, MT5600SMI-P92, MT5600SMI-PL92)
PN S000306A, Version A

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Revisions

Revision Level	Date	Description
A	09/04/03	First release.

Patents

This device covered by one or more of the following patents: 6,219,708; 6,031,867; 6,012,113; 6,009,082; 5,905,794; 5,864,560; 5,815,567; 5,815,503; 5,812,534; 5,809,068; 5,790,532; 5,764,628; 5,764,627; 5,754,589; 5,724,356; 5,673,268; 5,673,257; 5,644,594; 5,628,030; 5,619,508; 5,617,423; 5,600,649; 5,592,586; 5,577,041; 5,574,725; 5,559,793; 5,546,448; 5,546,395; 5,535,204; 5,500,859; 5,471,470; 5,463,616; 5,453,986; 5,452,289; 5,450,425; 5,355,365; 5,309,562; 5,301,274
Other Patents Pending.

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Chapter 1 – Product Description and Specifications

Introduction

The Multi-Tech SocketModem creates communication-ready devices by integrating data functionality into a single product design. The SocketModem is a space-efficient (1" × 2.5"), embedded modem that provides V.92 or V.34/33.6K data communication. The complete, ready-to-integrate modem dramatically reduces development time and costs for system designers. The SocketModem complies with telecom requirements, can be shipped worldwide, and is globally configurable.

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

- commands that the developer can use to configure and control a data modem and
- Result codes that the modem issues in response to the commands.

Product Description

The MT5600SMI SocketModem is a standard 64-pin modem used for integrating data communications.

- It is a single-port 3.3V 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.

This Developer's Guide covers all of the MT5600SMI products:

Product	Description	Region
MT5600SMI-32	V.32bis Serial Data/Fax 5V	Global
MT5600SMI-L32	V.32bis Serial Data/Fax 3.3V	Global
MT5600SMI-P32	V.32bis Parallel Data/Fax 5V	Global
MT5600SMI-34	V.34 Serial Data/Fax 5V	Global
MT5600SMI-L34	V.34 Serial Data/Fax 3.3V	Global
MT5600SMI-XL34	V.34 Serial Data/Fax 3.3V	Global
MT5600SMI-P34	V.34 Parallel Data/Fax 5V	Global
MT5600SMI-PL34	V.34 Parallel Data/Fax 3.3V	Global
MT5600SMI-92	V.92 Serial Data/Fax 5V	Global
MT5600SMI-L92	V.92 Serial Data/Fax 3.3V	Global
MT5600SMI-XL92	V.92 Serial Data/Fax 3.3V	Global
MT5600SMI-P92	V.92 Parallel Data/Fax 5V	Global
MT5600SMI-PL92	V.92 Parallel Data/Fax 3.3V	Global

How to Read the Product Codes in the Table Above:

32	V.32bis/14.4K data rate
34	V.34/33.6K data rate
92	V.92/56K data rate
L	3.3 volt power input (default is 5V)
P	Parallel interface (serial is default)
X	Exclude LED pinouts

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Developer's Kit

A Developer's Kit is available. 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 SocketModem, one development board with an RS-232 DB-25 connector, wall power adapter, RJ-11 jack, and RS-232 cable.

Features

- Integrates the controller, data pump, and data access arrangement (DAA) in one module.
- V.92/56K, V.34/33.6K, or V.32bis/14.4Kdata rates
- Backward compatibility with lower speed data standards
- 3.3 Volt or 5 Volt power input options
- Serial or parallel interface
- V.17, V.21, V.27, V.29 Fax
- Fax Class 1 and 1.0
- V.22bis Fast Connect
- FastPOS (V.29)
- Voice send and receive functions
- LED pin output option
- Industry-standard error correction and data compression
- DTMF detection and distinctive ring
- Audio circuit outputs for audio call-progress monitoring
- Three-number storage for automatic dialing capabilities and non-volatile memory (NoVRAM) to store user profiles
- Speaker interface for call progress monitoring
- Full-duplex data transmission over dial-up lines
- Line quality monitoring and retrain
- Line protection circuitry included
- Auto-dial, redial, and auto-answer
- Pulse or tone dial
- Call status display
- Extension pickup detection
- Caller ID detection
- Remote hang-up detection
- Digital PBX detection and protection
- 60-character command line buffering
- AT command compatibility
- Global approvals with a single module design
- Intelligent DAA technology detects line status

Technical Specifications

The SocketModem meets the following specifications:

Data Format	Serial or parallel interface
Data	V.92; V.90, V.34, V.32bis, V.32, V.22bis, V.22, V.23, V.21,Bell 212A & Bell 103
Error Correction	V.42 (LAP-M or MNP 2–4)
Data Compression	V.42bis, MNP 5
Fax	V.17, V.29, V.27ter, V.21 ch.2 Class 1 and 1.0 commands
Modes of Operation	Full duplex over dial-up lines; data mode, command mode, online command mode
Advanced	Extension pickup detection, remote hang-up detection, line-in-use detection, digital PBX detection and protection
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Command Buffer	60 characters
Interface	Serial or 8-bit parallel interface
Telephony/TAM	V.253 commands: V.253 2-bit and 4-bit ADPCM, 8-bit linear PCM, and 4-bit IMA coding 8 kHz sample rate Concurrent DTMF, ring, and Caller ID detection
Weight	0.6 oz. (0.017 kg.)
Dimensions	1.045" × 2.541" × 0.680" (2.65 x 6.45 x 1.7 cm)
Power Consumption	Typical: 115 mA (.38W @ 3.3 V DC); Maximum: 116 mA (.41 W @ 3.47 V DC) Typical: 117 mA (.58 W @ 5 V DC); Maximum: 118 mA (.61 W @ 5.25 V DC)
Operational Temperature	0 to +70° C Humidity Range: 20 to 90% (non-condensing)
Storage Temperature	-10 to +85° C

Sources of Additional Information

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

For additional Multi-Tech information, contact:
http://www.multitech.com for News, Products, Solutions, Support, Manuals and more.
ftp://ftp.multitech.com for Modem Firmware, Modem INFs, Utilities, etc.
oemsales@multitech.com for email technical support.

The Global Engineering Documents Web site manages a collection of more than one million documents from over 460 organizations worldwide: http://global.ihs.com
Phone: 800-854-7179
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Chapter 2 – Mechanical Specifications

Physical Dimensions
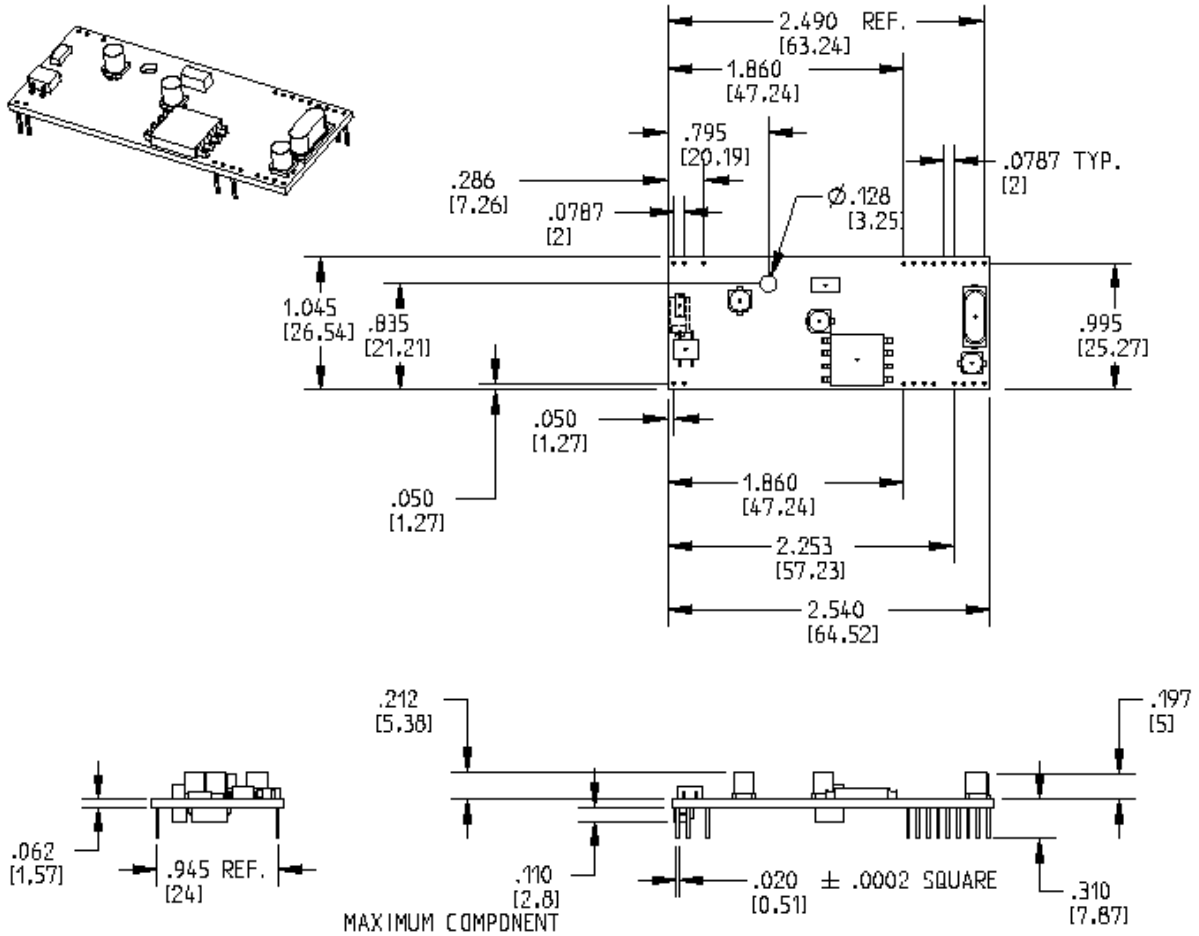
Figure 2–1. Maximum Component Height

Serial Pin Configurations

The serial interface use an 16-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring and serial interface via logic level signals.
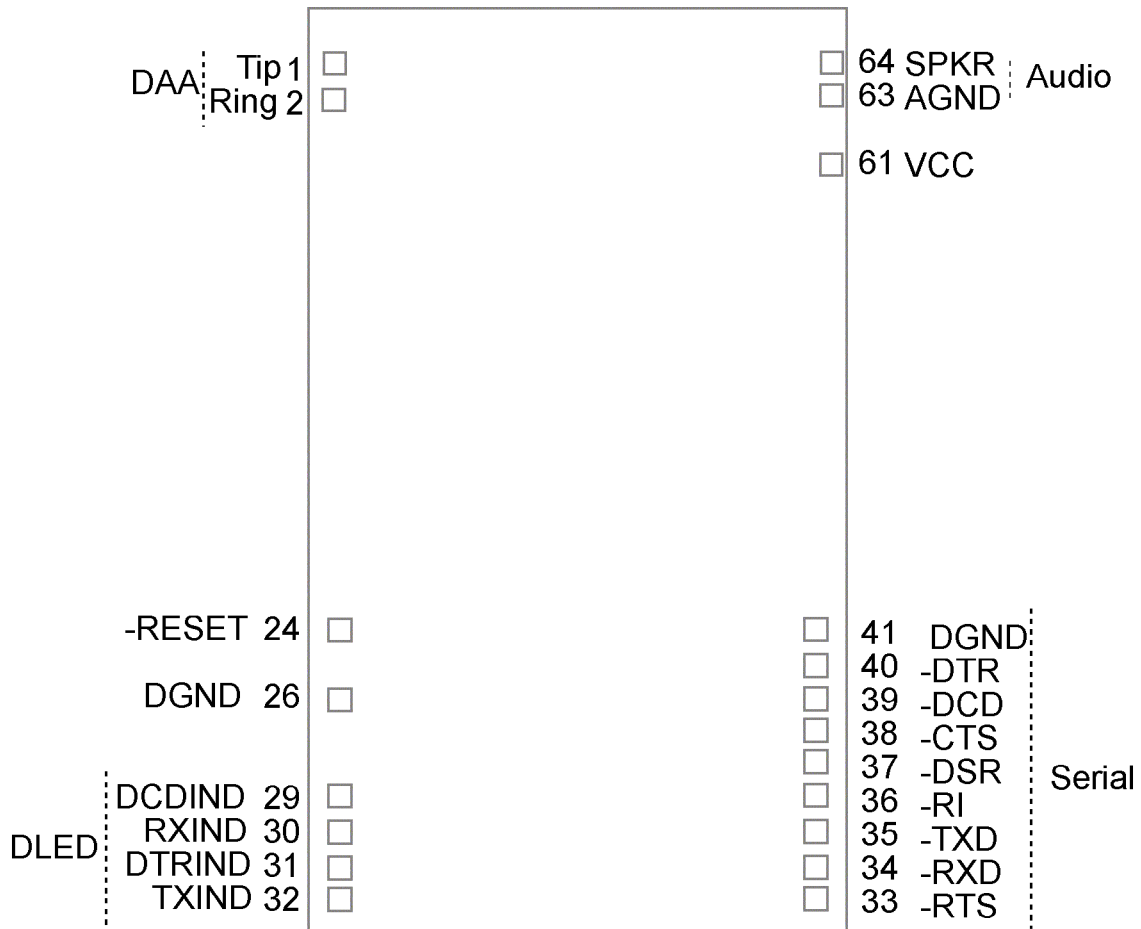
Figure 2–2. Serial SocketModem*s* Pins
Available with or without LED Pins

Pin Descriptions for Serial SocketModem Devices

Pin #	Signal Name	I/O Type	Description
1	Tip	I/O	**Tip Signal from Telco.** Tip connection to the phone line (RJ11 Pin 3). SocketModem is Tip/Ring is polarity insensitive.
2	Ring	I/O	**Ring Signal from Telco.** Ring connection to the phone line (RJ11 Pin 4). SocketModem is Tip/Ring is polarity insensitive.
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. –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 asserted for a minimum of 300 ns.
26	DGND		**Ground**
29	DCDIND		**DCD LED.** Output from 74AC05 with 1500 Ohms pull-up.
30	RXIND		**RX LED.** Output from 74AC05 with 1500 Ohms pull-up.

Pin #	Signal Name	I/O Type	Description
31	DTRIND		**DTR LED.** Output from 74AC05 with 1500 Ohms pull-up.
32	TXIND		**TX LED.** Output from 74AC05 with 1500 Ohms pull-up.
33	–RTS	I	**Request to Send.** RTS signal is used for hardware flow control.
34	–RXD	O	**Received Data.** Used to send data received from the telephone line and also modem responses to the DTE. Modem response take priority over incoming data. When no data is transmitted, the signal is held in mark condition.
35	–TXD	I	**Transmit Data.** The DTE uses this 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 not 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		**Ground.**
61	VCC		**3.3V DC Power.**
63	AGND		**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. One side of a differential AC output coupled through a 6.8K ohm resistor and capacitor. The call progress speaker interface signal is: • Digital speaker output (DSPKOUT); output DSPKOUT is a square wave output in data mode used for call progress or carrier monitoring. This output can be optionally connected to a low-cost on-board speaker, e.g., a sounducer, or to an analog speaker circuit.

Parallel Pin Configurations

The parallel interface 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.
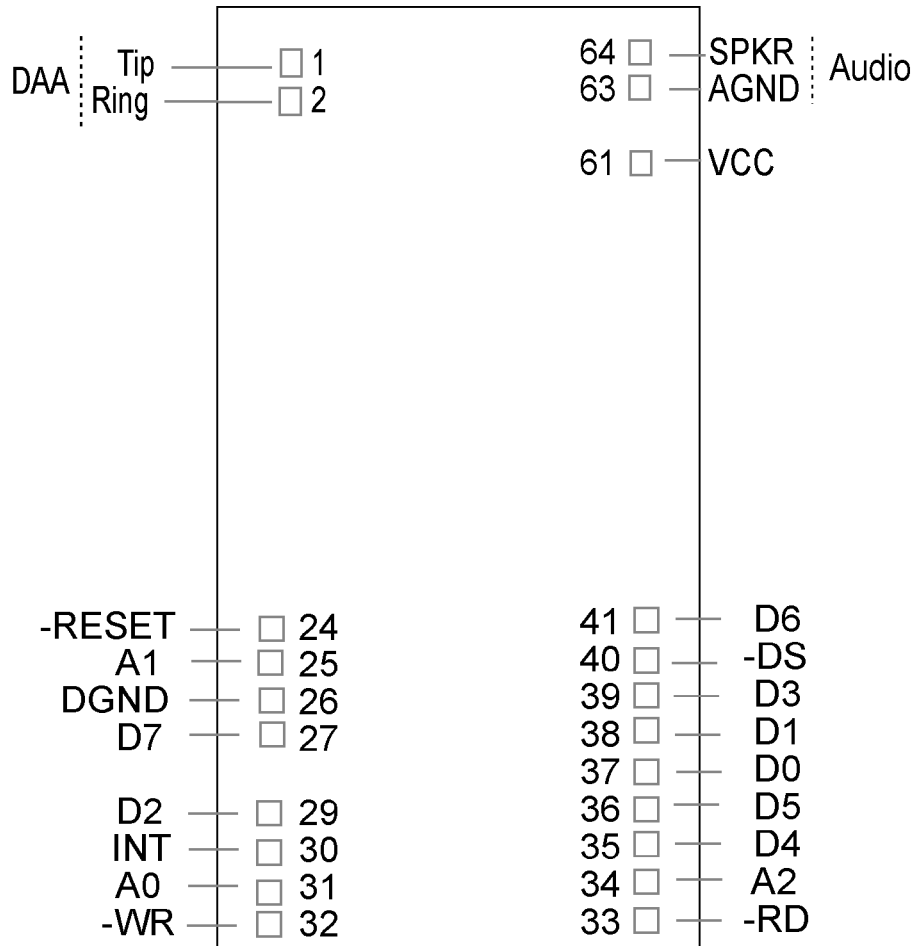

Figure 2–3. Parallel SocketModem Pins

Pin Descriptions for a Parallel SocketModem Device

Pin #	Signal Name	I/O	Description
1	Tip	I/O	**Telephone Line Interface – TIP**
2	Ring	I/O	**Telephone Line Interface – RING**
24	–RESET	I	**Modem Reset (CMOS input 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.
25	A1		**Host Bus Address Line 1**
26	DGND	GND	**Digital Ground**
27	D7	O	**Host Bus Data Line 7**
29	D2	O	**Host Bus Data Line 2**
30	INT	O	**Host Bus Interrupt Line, Active High, Resets on Low**
31	A0	I	**Host Bus Address Line 0**

Pin #	Signal Name	I/O	Description
32	–WT	I	**Host Bus Write.** When low, allows host to write to SocketModem.
33	–RD	I	**Host Bus Read.** When low, allows host to read from SocketModem.
34	A2	I	**Host Bus Address Line 2**
35	D4	O	**Host Bus Data Line 4**
36	D5	O	**Host Bus Data Line 5**
37	D0	O	**Host Bus Data Line 0**
38	D1	O	**Host Bus Data Line 1**
39	D3	O	**Host Bus Data Line 3**
40	–CS	I	**Host Bus Chip Select;** active low
41	D6	O	**Host Bus Data Line 6**
61	VCC	PWR	**3.3V or 5V 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, Call Monitor**

Chapter 3 – Electrical Characteristics

Handling Precautions

All electronic devices should 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.

I/O Electrical Characteristics

3.3V Serial SocketModem

3.3V DC Characteristics (TA = 0°C to 70°C; VDD = 3.3 V ± 0.3 V) V_{DDMAX} = 3.6 V

Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	Input High Min 2.0 V	Input Low Max 0.8 V	
Inputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34) 2mA, Z INT = 120 Ω	Output High Min 2.4 V	Output Low Max 0.5 V	
Digital Input Capacitance			50pF

3.3V Parallel SocketModem

Electrical characteristics for Parallel SocketModem devices are presented below.
3.3V DC Characteristics (TA = 0°C to 70°C; VDD = 3.3 V ± 0.3 V) V_{DDMAX} = 3.6 V

Digital Inputs –DS (40)	Input High Min 2.0 V	Input Low Max 0.8 V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), A2 (34), –WR (32), –RD (33) 8mA Z $_{INT}$ = 50Ω 2mA Z $_{INT}$ = 120 Ω	Input High Min 2.0 V	Input Low Max 0.8 V	
Digital Input/Output DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27) 2mA, Z $_{INT}$ = 120 Ω	Input High Min 2.0 V Output High Min 2.4 V	Input Low Max 0.8 V Output Low Max 0.5 V	
Digital Output INT (30) 2mA, Z $_{INT}$ = 120 Ω	Output High Min 2.4 V	Output Low Max 0.5 V	
Digital Input Capacitance			50pF

5V Serial SocketModem

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

Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	Input High Min 3.5 V	Input Low Max .8 V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	Output High Min 4 V	Output Low Max 0.5 V	Current Drive 15 ma
Digital Input Capacitance			5 PF

5V Parallel SocketModem

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

Digital Inputs –DS (40)	Input High Min 2 V	Input Low Max .8 V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), –WR (32), –RD (33)	Input High Min 2 V	Input Low Max .8 V	
Digital Input / Output DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27)	Input High Min 2 V	Input Low Max .8 V	Current Drive 8 ma
Digital Output INT (30)	Output High Min 2.4 V	Output Low Max 0.5 V	Current Drive 8 ma
Digital Input Capacitance			5 PF

Operating Conditions

Parameter	Symbol	Limits	Units
+3.3 V Configuration			
Supply voltage (Pin 61 = +3.3 V)	VDD	+3.13 to +3.47	VDC
Operating ambient temperature	T_A	0 to +70	°C
+5 V Configuration			
Supply voltage (Pin 61 = +5 V)	VDD	+4.75 to +5.25	VDC
Operating ambient temperature	T_A	0 to +70	°C

Absolute Maximum Ratings

Parameter	Symbol	Limits	Units
Supply voltage (Pin 61 = +3.3 V)	VDD	-0.5 to +4.0	VDC
Supply voltage (Pin 61 = +5 V)	VDD	-0.5 to +7.0	VDC
Input voltage	V_{IN}	-0.5 to (VDD +0.5)	VDC
Voltage applied to outputs in high impedance (Off) state	V_{OUT}	+3.13 to +3.47	VDC
Storage temperature	T_{STG}	-40 to +80	°C

Current and Power Requirements

Mode	Typ. Current (mA)	Max. Current (mA)	Typ. Power (mW)	Max. Power (mW)
+3.3 V Configuration (VDD = +3.3 V)				
Normal Mode (Serial interface)	115	116	0.38	0.41
+5 V Configuration (VDD = +5 V)				
Normal Mode (Serial interface)	117	118	0.58	0.61
Normal Mode (Parallel interface)	117	118	0.58	0.61
Test conditions: For Pin 61 = +5 V, VDD = +5 V for typical values; VDD = +5.25 V for maximum values. For Pin 61 = +3.3 V, VDD = +3.3 V for typical values; VDD = +3.47 V for maximum values.				

Parallel Host Bus Timing

Parallel Host Bus Timing Table

Symbol	Parameter	Min	Max	Units
	READ (See Notes)			
^{t}AS	Address Setup	5	-	ns
^{t}AH	Address Hold	10	-	ns
^{t}CS	Chip Select Setup	0	-	ns
^{t}CH	Chip Select Hold	10	-	ns
^{t}RD	RD Strobe Width	45	-	ns
^{t}DD	Read Data Delay	-	25	ns
^{t}DRH	Read Data Hold	5	-	ns
	WRITE (See Notes)			
^{t}AS	Address Setup	5	-	ns
^{t}AH	Address Hold	15	-	ns
^{t}CS	Chip Select Setup	0	-	ns
^{t}CH	Chip Select Hold	10	-	ns
^{t}WT	WT Strobe Width	75	-	ns
^{t}DS	Write Data Setup (see Note 4)	-	20	ns
^{t}DWH	Write Data Hold (see Note 5)	5	-	ns

Notes:

1. When the host executes consecutive Rx FIFO reads, a minimum delay of 2 times the internal CPU clock cycle plus 15 ns (85.86 ns at 28.224 MHz) is required from the falling edge of RD to the falling edge of the next Host Rx FIFO RD clock.
2. When the host executes consecutive Tx FIFO writes, a minimum delay of 2 times the internal CPU clock cycle plus 15 ns (85.86 ns at 28.224 MHz) is required from the falling edge of WT to the falling edge of the next Host Tx FIFO WT clock.
3. ^{t}RD' ^{t}WT = ^{t}CYC $^{+ 15\ ns.}$
4. ^{t}DS is measured from the point at which both CS and WT are active.
5. ^{t}DWH is measured from the point at which either CS and WT become active.
6. Clock Frequency = 28.224 MHz clock.

Parallel Host Bus - Read
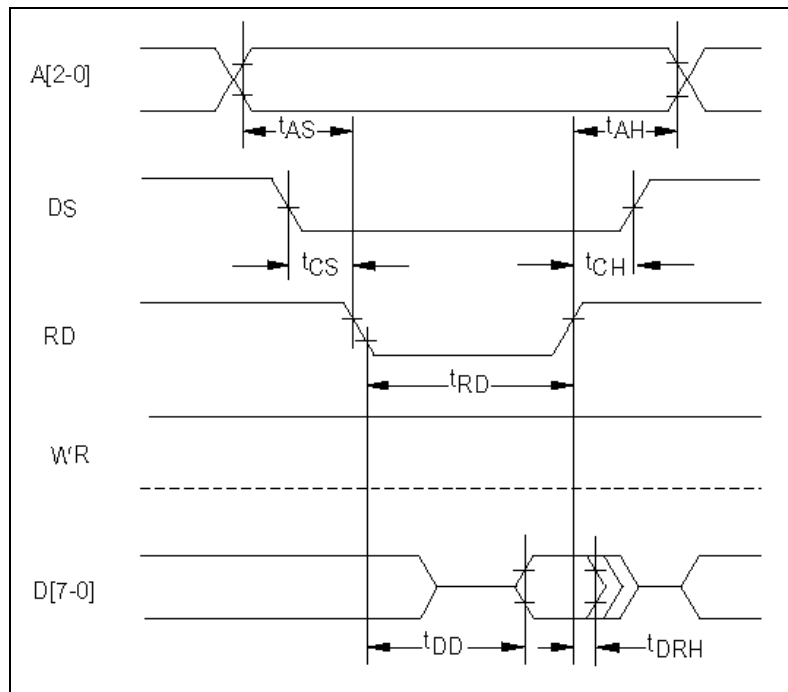
Parallel Host Bus - Write
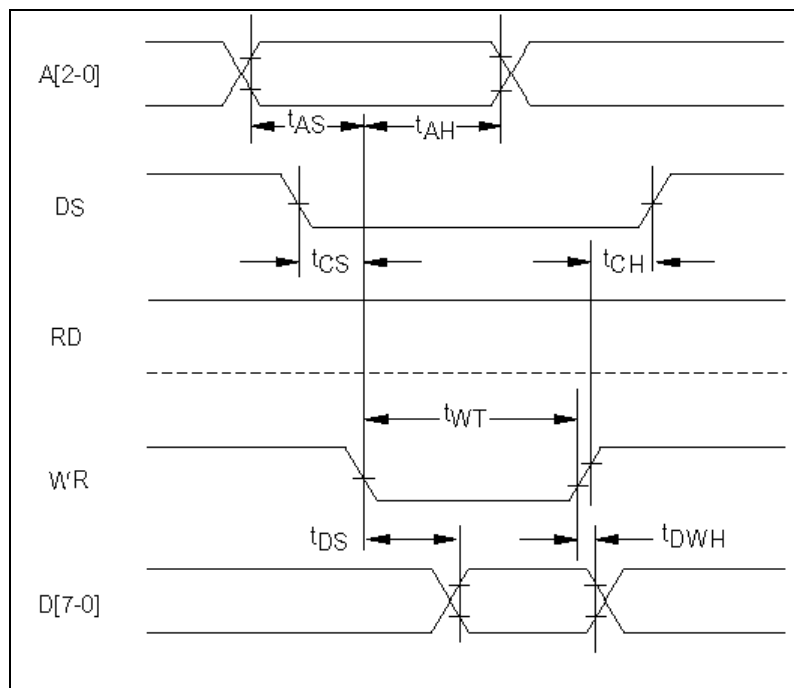
Chapter 4 – SocketModem Parallel Interface – A Programmer's Description

SocketModem Parallel Interface

The modem supports a 16550A interface in parallel interface versions. The 16550A interface can operate in FIFO mode or non-FIFO mode. Non-FIFO mode is the same as the 16450 interface operation. FIFO mode's unique operations are described in this chapter.

Overview

The modem emulates the 16450/16550A interface and includes both a 16-byte receiver data first-in first-out buffer (RX FIFO) and a 16-byte transmit data first-in first-out buffer (TX FIFO).

FIFO Mode Selected
When FIFO mode is selected in the FIFO Control Register (FCR0 = 1), both FIFOs are operative. Furthermore, when FIFO mode is selected, DMA operation of the FIFO can also be selected (FCR3 = 1).

FIFO Mode Not Selected
When FIFO mode is not selected, operation is restricted to a 16450 interface operation.

Receive Data
Received Data is read by the host from the Receiver Buffer (RX Buffer). The RX Buffer corresponds to the Receiver Buffer Register in a 16550A device. In FIFO mode, the RX FIFO operates transparently behind the RX Buffer. Interface operation is described with reference to the RX Buffer in FIFO and non-FIFO modes.

Transmit Data
Transmit Data is loaded by the host into the Transmit Buffer (TX Buffer). The TX Buffer corresponds to the Transmit Holding Register in a 16550A device. In FIFO mode, the TX FIFO operates transparently behind the TX Buffer. Interface operation is described with reference to the TX Buffer in both FIFO and non-FIFO modes.

Note
The parallel interface registers and the corresponding bit assignments are shown in Table 4–1.

Table 4–1. Parallel Interface Registers

Register No.	Register Name	BIT No.							
		7	6	5	4	3	2	1	0
7	Scratch Register (SCR)	Scratch Register							
6	Modem Status Register (MSR)	Data Carrier Detect (DCD)	Ring Indicator (RI)	Data Set Ready (DSR)	Clear to Send CTS)	Delta Data Carrier Detect (DDCD)	Trailing Edge of Ring Indicator (TERI)	Delta Data Set Ready (DDSR)	Delta Clear to Send (DCTS)
5	Line Status Register (LSR)	RX FIFO Error	Transmitter Empty (TEMT)	Transmitter Buffer Register Empty (THRE)	Break Interrupt (BI)	Framing Error (FE)	Parity Error (PE)	Overrun Error (OE)	Receiver Data Ready (DR)
4	Modem Control Register (MCR)	0	0	0	Local Loopback	Out 2	Out 1	Request to Send (RTS)	Data Terminal Ready (DTR)
3	Line Control Register (LCR)	Divisor Latch Access Bit (DLAB)	Set Break	Stick Parity	Even Parity Select (EPS)	Parity Enable (PEN)	Number of Stop Bits (STB)	Word Length Select Bit 1 (WLS1)	Word Length Select Bit 0 (WLSO)
2	Interrupt Identify Register (IIR) (Read Only)	FIFOs Enabled	FIFOs Enabled	0	0	Pending Interrupt ID Bit 2	Pending Interrupt ID Bit 1	Pending Interrupt ID Bit 0	"0" if Interrupt Pending
2	FIFO Control Register (FCR) (Write Only)	Receiver Trigger MSB	Receiver Trigger LSB	Reserved	Reserved	DMA Mode Select	TX FIFO Reset	RX FIFO Reset	FIFO Enable
1 (DLAB = 0)	Interrupt Enable Register (ER)	0	0	0	0	Enable Modem Status Interrupt (EDSSI)	Enable Receiver Line Status Interrupt (ELSI)	Enable Transmitter Holding Register Empty Interrupt (ETBEI)	Enable Received Data Available Interrupt (ERBFI)
0 (DLAB = 0)	Transmitter Buffer Register (THR)	Transmitter FIFO Buffer Register (Write Only)							
0 (DLAB = 0)	Receiver Buffer Register (RBR)	Receiver FIFO Buffer Register (Read Only)							
1 (DLAB = 1)	Divisor Latch MSB Register (DLM)	Divisor Latch MSB							
0 (DLAB = 1)	Divisor Latch LSB Register (DLL)	Divisor Latch LSB							

Register Signal Definitions

IER – Interrupt Enable Register (Addr = 1, DLAB = 0)

The IER enables five types of interrupts that can separately assert the HINT output signal (Table 4–2.). A selected interrupt can be enabled by setting the corresponding enable bit to a 1, or disabled by setting the corresponding enable bit to a 0. Disabling an interrupt in the IER prohibits setting the corresponding indication in the IIR and assertion of HINT. Disabling all interrupts (resetting IER0 – IER3 to a 0) inhibits setting of any Interrupt Identifier Register (IIR) bits and inhibits assertion of the HINT output. All other system functions operate normally, including the setting of the Line Status Register (LSR) and the Modem Status Register (MSR).

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Bits 7-4 **Not used.**
Always 0.

Bit 3 **Enable Modem Status Interrupt (EDSSI).**
This bit, when a 1, enables assertion of the HINT output whenever the Delta CTS (MSR0), Delta DSR (MSR1), Delta TER (MSR2), or Delta DCD (MSR3) bit in the Modem Status Register (MSR) is a 1. This bit, when a 0, disables assertion of HINT due to setting of any of these four MSR bits.

Bit 2 **Enable Receiver Line Status Interrupt (ELSI).**
This bit, when a 1, enables assertion of the HINT output whenever the Overrun Error (LSR1), Parity Error (LSR2), Framing Error (LSR3), or Break Interrupt (LSR4) receiver status bit in the Line Status Register (LSR) changes state. This bit, when a 0, disables assertion of HINT due to change of the receiver LSR bits 1-4.

Bit 1 **Enable Transmitter Holding Register Empty Interrupt (ETBEI).**
This bit, when a 1, enables assertion of the HINT output when the Transmitter Empty bit in the Line Status Register (LSR5) is a 1. This bit, when a 0, disables assertion of HINT due to LSR5.

Bit 0 **Enable Receiver Data Available Interrupt (ERBFI) and Character Timeout in FIFO Mode.**
This bit, when a 1, enables assertion of the HINT output when the Receiver Data Ready bit in the Line Status Register (LSR0) is a1 or character timeout occurs in the FIFO mode. This bit, when a 0, disables assertion of HINT due to the LSR0 or character timeout.

FCR – FIFO Control Register (Addr = 2, Write Only)

The FCR is a write-only register used to enable FIFO mode, clear the RX FIFO and TX FIFO, enable DMA mode, and set the RX FIFO trigger level.

Bits 7-6 **RX FIFO Trigger Level**
FCR7 and FCR6 set the trigger level for the RX FIFO (Receiver Data Available) interrupt.

FCR7	FCR6	RX FIFO Trigger Level (Bytes)
0	0	01
0	1	04
1	0	08
1	1	14

Bits 5-4 Not used

Bit 3 **DMA Mode Select**
When FIFO mode is selected (FCR0 = 1), FCR3 selects non-DMA operation (FCR3 = 0) or DMA operation (FCR3 = 1). When FIFO mode is not selected (FCR0 = 0), this bit is not used (the modem operates in non-DMA mode in 16450 operation).

DMA Operation in FIFO Mode

RXRDY will be asserted with the number of characters in the RX FIFO us equal to or greater than the value in the RX FIFO Trigger Level (IIR0-IIR3 = 4h) or the received character timeout (IIRO-IIR3 = Ch) has occurred. RXTDY will go inactive when there are no more characters in the RX FIFO.

TXRDY will be asserted when there are one or more empty (unfilled) locations in the TX FIFO. **TXRDY** will go inactive when the TX FIFO is completely full.

Non-DMA Operation in FIFO Mode

RXRDY will be asserted when there are one or more characters in the RX FIFO. RXRDY will go inactive when there are no more characters in the RX FIFO.

TXRDY will be asserted when there are no characters in the TX FIFO. TXRDY will go inactive when the character is loaded into the TX FIFO Buffer.

Bit 2 **TX FIFO Reset**
When FCR2 is a 1, all bytes in the TX FIFO are cleared. This bit is cleared automatically by the modem.

Bit 1 **RX FIFO Reset**
When FCR1 is a 1, all bytes in the RX FIFO are cleared. This bit is cleared automatically by the modem.

Bit 0 **FIFO Enable**
When FCR0 is a 0, 16450 mode is selected and all bits are cleared in both FIFOs. When FCR0 is a 1, FIFO mode (16550A) is selected and both FIFOs are enabled. FCR0 must be a 1 when other bits in the FCR are written or they will not be acted upon.

IIR – Interrupt Identifier Register (Addr = 2)

The Interrupt Identifier Register (IIR) identifies the existence and type of up to five prioritized pending interrupts. Four priority levels are set to assist interrupt processing in the host. The four levels, in order of decreasing priority, are Highest: Receiver Line Status, 2: Receiver Data Available or Receiver Character Timeout. 3: TX Buffer Empty, and 4: Modem Status.

When the IIR is accessed, the modem freezes all interrupts and indicates the highest priority interrupt pending to the host. Any change occurring in interrupt conditions are not indicated until this access is complete.

Bits 7-6   **FIFO Mode**
These two bits copy FCR0.

Bits 5-4   **Not Used**
Always 0.

Bits 3-1   **Highest Priority Pending Interrupt**
These three bits identify the highest priority pending interrupt (Table 4-2). Bit 3 is applicable only when FIFO mode is selected; otherwise, bit 3 is a 0.

Bit 0   **Interrupt Pending**
When this bit is a 0, an interrupt is pending; IIR bits 1-3 can be used to determine the source of the interrupt. When this bit is a 1, an interrupt is not pending.

Table 4–2. Interrupt Sources and Reset Control

| Interrupt Identification Register | | | | | Interrupt Set and Reset Functions | | |
Bit 3 (Note 1)	Bit 2	Bit 1	Bit 0	Priority Level	Interrupt Type	Interrupt Source	Interrupt Reset Control
0	0	0	1	—	None	None	—
0	1	1	0	Highest	Receiver Line Status	Overrun Error (OE) (LSR1), Parity Error (PE) (LSR2), Framing Error (FE) (LSR3), or Break Interrupt (BI) (LSR4)	Reading the LSR
0	1	0	0	2	Received Data Available	Received Data Available (LSR0) or RX FIFO Trigger Level (FCR6-FCR7) Reached[1]	Reading the RX Buffer or the RX FIFO drops below the Trigger Level
1	1	0	0	2	Character Timeout Indication[1]	The RX FIFO contains at least 1 character and no characters have been removed from or input to the RX FIFO during the last 4 character times.	Reading the RX Buffer
0	0	1	0	3	TX Buffer Empty	TX Buffer Empty	Reading the IIR or writing to the TX Buffer
0	0	0	0	4	Modem Status	Delta CTS (DCTS) (MSR0), Delta DSR (DDST) (MSR1), Trailing Edge Ring Indicator (TERI) (MSR3), or Delta DCD (DCD) (MSR4)	Reading the MSR
Notes: 1. FIFO Mode only.							

LCR – Line Control Register (Addr = 3)

The Line Control Register (LCR) specifies the format of the asynchronous data communications exchange.

Bit 7   **Divisor Latch Access Bit (DLAB)**
This bit must be set to a 1 to access the Divisor Latch Registers during a read or write operation. It must be reset to a 0 to access the Receiver Buffer, the Transmitter Buffer, or the Interrupt Enable Register.

Bit 6   **Set Break**
When bit 6 is a 1, the Transmit data is forced to the break condition, i.e., space (0) is sent. When bit 6 is a 0, break is not sent. The Set Break bit acts only on the Transmit data and has no effect on the serial in logic.

Bit 5   **Stick Parity**
When Parity is enabled (LCR3 = 1) and stick parity is selected (LCR5 = 1), the parity bit is transmitted and checked by the receiver as a 0 if even parity is selected (LCR4 – 1) or a 1 if odd parity is selected (LCR4 = 0). When the stick parity is not selected (LCR3 = 0), parity is transmit and checked as determined by the LCR3 and LCR4 bits.

Bit 4   **Even Parity Select (EPS)**
When parity is enabled (LCR3 = 1) and stick parity is not selected (LCR5 = 0), the number of 1s transmitted or checked by the receiver in the data word bits and parity bit is either even (LCR4 = 1) or odd (LCR4 = 0).

Bit 3   **Enable Parity (PEN)**
When bit 3 is a 1, a parity bit is generated in the serial out (transmit) data stream and checked in the serial in (receive) data stream as determined by the LCR4 and LCR5 bits. The parity bit is located between the last data bit and the first stop bit.

Bit 2   **Number of Stop GBITS (STB)**
This bit specifies the number of stop bits in each serial out character. If bit 2 is a 0, one stop bit is generated regardless of word length. If bit 2 is a 1 and 5-bit word length is selected, one and one-half stop bits are generated. If bit 2 is a 1 and 6-, 7-, or 8-bit word length is selected, two stop bits are generated. The serial in logic checks the first stop bit only, regardless of the number of stop bits selected.

Bit 1-0   **Word Length Select (WLS0 and WLS1)**
These two bits specify the number of bits in each serial in or serial out character. The encoding of bits 0 and 1 is:

Bit 1	Bit 0	Word Length
0	0	5 Bits (Not supported)
0	1	6 Bits (Not supported)
1	0	7 Bits
1	1	8 Bits

MCR – Modem Control Register (Addr = 4)

The Modem Control Register (MCR) controls the interface with modem or data set.

Bit 7-5   Not used
Always 0

Bit 4   Local Loopback
When this bit is set to a 1, the diagnostic mode is selected and the following occurs:
1. Data written to the Transmit Buffer is looped back to the Receiver Buffer.
2. The DTS (MCR0), RTS (MCR1), Out1 (MCR2), and Out2 (MCR3) modem control register bits are internally connected to the DSR (MSR5), CTS (MSR4), RI (MSR6), and DCD (MSR7) modem status register bits, respectively.

Bit 3   Output 2
When this bit is a 1, HINT is enabled. When this bit is a 0, HINT is in the high impedance state.

Bit 2   Output 1
This bit is used in local loopback (see MCR4).

Bit 1   Request to Send (RTS)
This bit controls the Request to Send (RTS) function. When this bit is a 1, RTS is on. When this bit is a 0, RTS is off.

Bit 0   Data Terminal Ready (DTR)
This bit controls the Data Terminal Ready (DTR) function. When this bit is a 1, DTR is on. When this bit is a 0, DTR is off.

LSR – Line Status Register (Addr = 5)

This 8-bit register provides status information to the host concerning data transfer.

Bit 7   **RX FIFO Error**

In the 16450 mode, this bit is not used and is always 0.

In the FIFO mode, this bit is set if there are one or more characters in the RX FIFO with parity error, framing error, or break indication detected. This bit is reset to a 0 when the host reads the LSR and note of the above conditions exist in the RX FIFO.

Bit 6   **Transmitter Empty (TEMT)**

This bit is set to a 1 whenever the TX Buffer (THR) and equivalent of the Transmitter Shift Register (TRS) are both empty. It is reset to a 0 whenever either the THR or the equivalent of the TSR contains a character.

In the FIFO mode, this bit is set to a 1 whenever the TX FIFO and the equivalent of the TSR are both empty

Bit 5   **Transmitter Holding Register Empty (THRE) [TX Buffer Empty]**

This bit, when set, indicates that the TX Buffer is empty and the modem can accept a new character for transmission. In addition, this bit causes the modem to issue an interrupt to the host when the Transmit Holding Register Empty Interrupt Enable bit (IIR1) is set to 1. The THRE bit is set to a 1 when a character is transferred from the TX Buffer. The bit is reset to 0 when a byte is written into the TX Buffer by the host.

In the FIFO mode, this bit is set when the TX FIFO is empty; it is cleared when at lease one byte is in the TX FIFO.

Bit 4   **Break Interrupt (BI)**

This bit is set to a 1 whenever the received data input is a space (logic 0) for longer than two full word lengths plus 3 bits. The BI is reset when the host reads the LSR.

Bit 3   **Framing Error (FE)**

This bit indicates that the received character did not have a valid stop bit. The FE bit is set to a 1 whenever the stop bit following the last data bit or parity bit is detected as a logic o (space). The FE bit is reset to a 0 when the host reads the LSR.

In the FIFO mode, the error indication is associated with the particular character in the FIFO it applies to. The FE bit set to a 1 when this character is loaded into the RX Buffer.

Bit 2   **Parity Error (PE)**

This bit indicates that the received data character in the RX Buffer does not have the correct even or odd parity, as selected by the Even Parity Select bit (LCR4) and the Stick Parity bit (LCR5). The PE bit is reset to a 0 when the host reads the LSR.

In the FIFO mode, the error indication is associated with the particular character in the FIFO it applies to. The PE bit set to a 1 when this character is loaded into the RX Buffer.

Bit 1   **Overrun Error (OE)**

This bit is set to a 1 whenever received data is loaded into the RX Buffer before the host has read the previous data from the RX Buffer. The OE is reset to a 0 when the host reads the LSR.

In the FIFO mode, if data continues to fill beyond the trigger level, an overrun condition will occur only if the RX FIFO is full and the next character has been completely received.

Bit 0   **Receiver Data Ready (DR)**

This bit is set to a 1 whenever a complete incoming character has been received and transferred into the RX Buffer. The DR bit is reset to a 0 when the host reads the RX Buffer.

In the FIFO mode, the DR bit is set when the number of received data bytes in the RX FIFO equals or exceeds the trigger level specified in the FCR0-FCR1.

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MSR – Modem Status Register (Addr = 6)

The Modem Status Register (MSR) reports current state and change information of the modem. Bits 4-7 supply current state, and bits 0-3 supply change information. The change bits are set to a 1 whenever a control input form the modem changes state from the last MSR read by the host. Bits 0-3 are reset to 0 when the host reads the MSR or upon reset.

Whenever bits 0, 1, 2, or 3 are set to a 1, a Modem Status Interrupt (IIR0-IIR3 = 0) is generated.

Bit 7   **Data Carrier Detect (DCD)**
This bit indicates the logic state of the DCH# (RLSD#) output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the Out2 bit in the MCR (MCR3).

Bit 6   **Ring Indicator (RI)**
This bit indicates the logic state of the RI# output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the Out1 bit in the MCR (MCR2).

Bit 5   **Data Set Ready (DSR)**
This bit indicates the logic state of the DSR# output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the DTR in the MCR (MCR0).

Bit 4   **Clear to Send (CTS)**
This bit indicates the logic state of the CTS# output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the RTS bit in the MCR (MCR1).

Bit 3   **Delta Data Carrier Detect (DDCD)**
This bit is set to a 1 when the DCD bit changes state since the host last read the MSR.

Bit 2   **Trailing Edge of Ring Indicator (TERI)**
This bit is set to a 1 when the RI bit changes from a 1 to a 0 state since the host last read the MSR.

Bit 1   **Delta Data Set Ready (DDSR)**
This bit is set to a 1 when the DSR bit has changed since the host last read the MSR.

Bit 0   **Delta Clear to Send (DCTS)**
This bit is set to a 1 when the CTS bit has changed since the MSR the host last read the MSR.

RBX – RX Buffer (Receiver Buffer Register) (Addr = 0, DLAB = 0)

The RX Buffer (RBR) is a read-only register at location 0 (with DLAB = 0). Bit 0 is the least significant bit of the data and is the first bit received.

THR – TX Buffer (Transmitter Holding Register) (Addr = 0, DLAB = 0)

The TX Buffer (THR) is a write-only register at address 0 when DLAB = 0. Bit 0 is the least significant bit and the first bit sent.

Divisor Registers (Addr = 0 and 1, DLAB = 1)

The Divisor Latch LS (least significant byte) and Divisor Latch MS (most significant byte) are two read-write registers at locations 0 and 1 when DLAB = 1, respectively.

The baud rate is selected by loading each divisor latch with the appropriate hex value. Programmable values corresponding to the desired baud rate are listed in Table 4-3.

SCR – Scratch Register (Addr = 7)

The Scratchpad Register is a read-write register at location 7. This register is not used by the modem and can be used by the host for temporary storage.

Divisor Latch (Hex)		Divisor (Decimal)	Baud Rate
MS	LS		
06	00	1536	75
04	17	1047	110
03	00	768	150
01	80	384	300
00	C0	192	600
00	60	96	1200
00	30	48	2400
00	18	24	4800
00	0C	12	9600
00	06	6	19200
00	04	4	28800
00	03	3	38400
00	02	2	57600
00	01	1	115600
00	00	NA	230400

Table 4–3. Programmable Baud Rates

Receiver FIFO Interrupt Operation

Receiver Data Available Interrupt

When the FIFO mode is enabled (FCR0 = 1) and receiver interrupt (RX Data Available) is enabled (IER0 = 1), receiver interrupt operation is as follows:

1. The Receiver Data Available Flag (LSR0) is set as soon as a received data character is available in the RX FIFO. LSR0 is cleared when RX FIFO is empty.
2. The Receiver Data Available Interrupt code (IIR0-IIR4 = 4h) is set whenever the number of received data bytes in the RX FIFO reaches the trigger level specified by FCR6-FCR7 bits. It is cleared whenever the number of received data bytes in the RX FIFO drops below the trigger level specified by FCR6-FCR7 bits.
3. The HINT interrupt is asserted whenever the number of received data bytes in the RX FIFO reaches the trigger level specified by FCR6-FCR7 bits. HINT interrupt is de-asserted when the number of received data bytes in the RX FIFO drops below the trigger level specified by FCR6-FCR7 bits.

Receiver Character Timeout Interrupts

When the FIFO mode is enabled (FCR0 = 1) and receiver interrupt (Receiver Data Available) is enabled (IER0 = 1), receiver character timeout interrupt operation is as follows:

1. A Receiver character timeout interrupt code (IIR0-IIR3 = Ch) is set if at least one received character is in the RX FIFO, the most recent received serial character was longer than four continuous character times ago (if 2 stop bits are specified, the second stop bit is included in this time period), and the most recent host read of the RX FIFO was longer than four continuous character times ago.

Transmitter FIFO Interrupt Operation

Transmitter Empty Interrupt

When the FIFO mode is enabled (FCR0 = 1) and transmitter interrupt (TX Buffer Empty) is enabled (IER0 =1), transmitter interrupt operation is as follows:

1. The TX Buffer Empty interrupt code (IIR0-IIR3 = 2h) will occur when the TX Buffer is empty. It is cleared when the TX Buffer is written to (1 to 16 characters) or the IIR is read.
2. The TX Buffer Empty indications will be delayed 1 character time minus the last stop bit time whenever the following occur: THRE = 1 and there have not been at least two bytes at the same time in the TX FIFO Buffer since the last setting of THRE was set. The first transmitter interrupt after setting FCR0 will be immediate.

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., **+++** to hang up the modem. To return to data mode from online command mode, you must issue the command **ATO**.

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

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

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

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.

Data Commands

The modem will respond to the commands detailed below. Parameters applicable to each command are listed with the command description.

Generic Modem Control Commands

Command: Z	**Soft Reset and Restore Profile**
Description:	Causes the modem to perform a soft reset and restore (recall) the configuration profile. If no value is specified, zero is assumed.
Default:	None
Values:	Number corresponding to the selected profile:
	Z0 Soft reset and restore stored profile 0.
	Z1 Soft reset and restores stored profile 1.
Result Codes:	OK
	Otherwise ERROR

Command: +FCLASS	**Select Active Service Class**
Description:	Selects the active service class (mode).
Default:	0
Defined Values:	+FCLASS=0 Select Data Mode (Section 3) (Default).
	+FCLASS=1 Select Facsimile Class 1 Mode.
	+FCLASS=1.0 Select Facsimile Class 1.0 Mode.
	+FCLASS=8 Select Voice Mode.
	+FCLASS=10 Reserved.
Result Codes:	OK
	Otherwise ERROR
Report Commands:	+FCLASS? Reports Current or Selected Values
	+FCLASS=? Reports Range of Parameters

Command: +VCID	**Caller ID (CID)**
Description:	Controls the reporting and presentation of data associated with the Caller ID services in the Incoming Call Line ID (ICLID) data format for the next call. (U.S. only)
Default:	0
Defined Values:	+VCID0 Disable Caller ID reporting.
	+VCID1 Enables Caller ID with formatted presentation to the DTE. The modem presents the data items in a <Tag><Value> pair format. The expected pairs are date, time, name, and caller code (telephone number).
	+VCID2 Enables Caller ID with unformatted presentation to the DTE.
Report Commands:	+VCID? Reports the Mode
	+VCID=? Reports Range of Parameters

Command: +VRID	**Report Retrieved Caller ID (CID)**
Description:	Reports the data associated with the Caller ID services in the Incoming Caller Line (ICLID) data format for the last received call. U.S. only
Default:	None
Defined Values:	+VRID0 Reports Caller ID with formatted presentation to the DTE. The modem presents the data items in a <Tag><Value> pair format. The expected pairs are date, time, name, and caller code (telephone number).
	+VRID1 Reports Caller ID with unformatted presentation to the DTE.
Report Commands:	+VRID? Reports the Mode

Command: \N   **Operating Mode - Error Correction**
Description: Controls the preferred error-correcting mode to be negotiated in a
                            subsequent data connection. This command is affected by the OEM
                            firmware configuration.
Default: 5
Defined Values: \N0   Selects normal speed buffered mode (disables error-correction
                                   mode). (Forces &Q6.)
                             \N1   Serial interface selected: Selects direct mode and is equivalent to
                                   &M0, Q0 mode of operation. (Forces &Q0.) Parallel interface
                                   selected: Same as \N0.
                             \N2   Selects reliable (error-correction) mode. The modem will first attempt
                                   a LAPM connection and then an MNP connection. Failure to make a
                                   reliable connection results in the modem hanging up. (Forces &Q5,
                                   S36=4, and S48=7.)
                             \N3   Selects auto-reliable mode. This operates the same as \N2 except
                                   failure to make a reliable connection results in the modem falling
                                   back to the speed buffered normal mode. (Forces &Q5, S36=7, and
                                   S48=7.)
                             \N4   Selects LAPM error-correction mode. Failure to make an LAPM
                                   error-correction connection results in the modem hanging up.
                                   (Forces &Q5 and S48=0.) Note: The -K1 command can override the
                                   \N4 command.
                             \N5   Selects MNP error-correction mode. Failure to make an MNP error-
                                   correction connection results in the modem hanging up. (Forces
                                   &Q5, S36=4, and S48=128.)
Result Codes: OK
                            Otherwise ERROR

Command   I   **Identification**
Description: Causes the modem to reports the requested result according to the
                            command parameter.
Default: 4
Defined Values: I0   Reports product code (e.g., 56000).
                             I1   Reports the least significant byte of the stored checksum (e.g.,
                                   12AB).
                             I2   Checks ROM and verifies the checksum. Reports OK or ERROR.
                             I3   Reports ROM Code Revision-Modulation (e.g., 2109-V90).
                             I4   Reports OEM defined identifier string in binary format (default) or
                                   ASCII formats. (e.g.: a007040284C6002F bC60000000
                                   r1005111151012000 3000111170000000).
                             I5   Reports Country Code parameter (see +GCI).
                             I6   Reports modem data pump model and internal code revision.
Result Codes: OK
                            Otherwise ERROR

Command: +GMI   **Request Manufacturer Identification**
Description: Causes the modem to report the modem product manufacturer.
Typical Response: +GMI: Multi-Tech
                            OK

Command   +GMM   **Request Model Identification**
Description: Causes the modem to report the modem product.
Typical Response: +GMM: V92

Command: +GMR   **Request Revision Identification**
Description: Causes the modem to report the modem version, revision level, or date.
                                This is the same as the I3 command.
Typical Response: +GMR: P2109-V90
                                OK

Command: +GCAP   **Request Complete Capabilities List**
Description: This extended-format command causes the modem to transmit one or
                                more lines of information text listing additional capabilities command
                                +<name>s, which is intended to permit the user to identify the overall
                                capabilities of the modem. In particular, if the modem implements a
                                particular modem control standard that uses Extended Syntax Commands,
                                and if that modem control standard includes command(s) that indicate
                                general capabilities, the +<names>(s) of those commands will be reported
                                to the modem in response to a +GCAP command.
Example Responses: +GCAP: +FCLASS, +MS, +ES, +DS, for a data modem that supports all
                                capabilities listed. Where:
                                +MS   +M commands (Modulation Control: +MS and +MR commands)
                                +ES   +E commands (Error Control: +ES, +EB, +ER, +EFCS, +ETBM)
                                +DS   +D commands (Data Compression: +DS and +DR). Manual

Command: +GCI   **Country of Installation**
Description: This extended syntax command selects and indicates the country of
                                installation for the modem. This parameter selects the settings for any
                                operational parameters that need to be adjusted for national regulations or
                                telephone networks. The chapter *Setting Country Codes* for more
                                information.
Default: If the modem is specified for use in only one country, that country code is
                                the default. Otherwise, the default is defined by the OEM. Factory default is
                                B5 (United States).
Report Commands: +GCI?   Reports the current country code.
                                +GCI=?   Displays the list of available country codes.

Command: &F   **Restore Factory Configuration (Profile)**
Description: The modem loads the factory default configuration (profile). The factory
                                defaults are identified for each command and in the S-Parameter
                                descriptions. A configuration (profile) consists of a subset of S-Parameters.
Default: None
Values: &F0   Restore factory configuration 0.
                                &F   Restore factory configuration 1.
Result Codes: OK
                                ERROR if the modem is connected.

Command: &T   **Local Analog Loopback Test**
Description: The modem will perform the local analog loopback test if &T1 is selected. The test can be run only when in an asynchronous operation in non-error-correction mode (normal), e.g., AT&Q6. To terminate the test in progress, the escape sequence must be entered first.
Default: None
Defined Values: &T0   Terminates test in progress. Clears S16.
     &T1   Initiates local analog loopback, V.54 Loop 3. Sets S16 bit 0. If a connection exists when this command is issued, the modem hangs up. The CONNECT XXXX message is displayed upon the start of the test.

Command: &Y   **Designate a Default Reset Profile**
Description: Selects which user profile will be used after a hard reset.
Default: None
Defined Values: &Y0   The modem will use profile 0.
     &Y1   The modem will use profile 1.
Result Codes: OK
     ERROR if <value> > is1 or if NVRAM is not installed or is not operational.

Command: &W   **Store Current Configuration**
Description: Saves the current (active) configuration (profile), including S-Parameters, in one of the two user profiles in NVRAM as denoted by the parameter value. This command will yield an ERROR message if the NVRAM is not installed or is not operational as detected by the NVRAM test.
     The current configuration is comprised of a list of storable parameters illustrated in the **&V** command. These settings are restored to the active configuration upon receiving a **Z** command or at power up (see **&Y** command).
Default: 0
Defined Values: &W0   Store the current configuration as profile 0.
     &W1   Store the current configuration as profile 1.
Result Codes: OK
     Otherwise ERROR

Command   &Z*n*=*x*   **Store Telephone Number**
Description: The modem can store up to four telephone numbers and each telephone number dial string can contain up to 31 digits. (Requires 256-byte NVRAM installed.)
Default: None
Defined Values: <string> Dial string from 0 to 31 characters.
Result Codes: OK For <value> =3, and <string> =31 digits.
     ERROR If <value> > 3, <string> > 31 digits, or if NVRAM is not installed or is not operational.

Command   %7   **Plug and Play Serial Number**
Description: Sets and stores eight serial numbers in hex format used for serial Plug and Play and for ISA Plug and Play which use the Conexant 11596 Plug and Play device. Applicable to Desktop configuration only.
Example: %7<8 hex numbers><same 8 hex numbers>
Result Codes: OK <8 hex numbers><same 8 hex numbers>
     Otherwise ERROR
Report Command: AT"?   Reports the stored serial number, issue.

Command	%8	**Plug and Play Vendor ID and Product Number**

Description: Sets and stores Vendor ID and product number for serial Plug and Play and for ISA Plug and Play which use the Conexant 11596 Plug and Play device. Applicable to Desktop configuration only.

Default: None

Example: %8<3 ASCII characters><4 hex numbers><same 3 ASCII characters><same 4 hex numbers><cr>

Result Codes: OK <3 ASCII characters><4 hex numbers><same 3 ASCII characters><same 4 hex numbers>
Otherwise ERROR

Command	**	**Load Flash Memory**

Description: The linear flash memory uploader allows flash memory connected to the modem external memory bus to be upgraded with revised modem firmware. This process transfers (uploads) the upgraded modem firmware (data) from the host computer to the modem which transfers the data to the flash memory device. The linear flash memory downloader allows the flash memory connected to the modem external memory bus to read and saved. This process transfers (downloads) the current modem firmware (data) to the host computer. Uploading new firmware to the flash memory or downloading existing firmware from the flash memory device is a two-step process.

1. When the AT** command is issued, the modem firmware boot loader is invoked and the user will first load a flash load module (FLM) into the modem's RAM. If the user wishes to upload new firmware to the modem, he should load the uploader FLM. If the user wishes to download existing firmware from the modem, he should load the downloader FLM. In either case, the data transfer is done via an ASCII transfer. The FLM contains the programming algorithm for the flash memory device being programmed and any messages that may be sent during the load process.
2. If the user wishes to upload new firmware to the modem, then he will then load the new modem firmware, which the uploader FLM will then program into the flash memory device. This transfer is done via XMODEM transfer. If the user wishes to download existing firmware from the modem, then he will set up the host PC for XMODEM receive and the downloader FLM will begin to send the existing firmware from the flash memory to the host PC.

Procedure
1. Install in the modem a flash memory programmed with the modem firmware or a blank flash memory.
2. Put the uploader FLM and downloader FLM files and the new modem firmware file (e.g., XmUL003.s37, XmDL003.s37, and 206s4712.S37) in an appropriate directory on the computer's hard disk.
3. Configure the communications application program for a DTE rate of between 9600 bps and 115200 bps and RTS/CTS flow control.
4. Check the modem for response by typing AT.
5. Initiate the download process using the AT** command. The "Download flash code…" message appears upon issuing the AT** command.
6. Perform an ASCII transfer of the FLM file (e.g., XmUL003.s37 for uploading new firmware to the modem or XmDL003.s37 for downloading existing firmware from the modem) from the host computer to the modem RAM using an industry standard communications software or an equivalent process (ensure that all ASCII translation or pacing is turned off).

7. After the FLM has been loaded, if uploading new firmware to the modem, perform an XMODEM upload of the new modem firmware hex file (e.g., 206s4712.S37) from the host computer to the modem RAM using industry standard communications software or an equivalent process. If downloading existing firmware from the modem, using an industry standard communications software or equivalent, put the host PC in XMODEM receive mode.

8. The messages described in Table 5-1 may occur during the uploading process:

Table 5-1. Upload Messages

Message	Description
Device not supported	Displayed if the FLM used does not support the flash memory that is installed on the board.
Wrong S37 format	Displayed if the modem firmware being uploaded is not in Motorola S3 format.
Record error	Displayed if there is an error while either uploading or downloading. If this occurs, the transfer should be aborted, and the user should restart at step .5
Download abort	Displayed if the transfer is aborted before it is finished. If this occurs, the user should restart at step 5.
Erase fail	Displayed if the FLM is unable to erase the flash memory. If this occurs, the user should restart at step 5.
Download error, Re-Load	Displayed if there was an error when uploading or downloading. If this occurs, the user should restart at step 5.
Error, No H/W flow ctl	Displayed if RTS-CTS flow control is not set. If this occurs, the user should restart at step 3.
DTE timeout	Displayed if the DTE has stopped the XMODEM transfer process before it is finished. If this occurs, the user should restart at step 5.
Code doesn't match Hardware	Displayed if the user is attempting to upload a firmware that either not the same model (parallel, serial, etc.), crystal frequency, or size (1Mbit, 2Mbit, etc.) as the firmware that is currently on the board. If this occurs, the FLM will abort and not allow the user to continue.
Device successfully Programmed	Displayed by the FLM at the completion of a successful upload or download then the modem will do a cold start.

The uploader and downloader flash load modules (FLM) have several built in safety mechanisms to reduce the risk of a failed flash upload/download. The FLM will not allow a user to upload a firmware of different model (serial, parallel, etc.) or crystal speed than what is currently in the flash memory. Also, it will not allow the user to upload a firmware that is larger in size than the flash memory itself (e.g., a 2Mbit firmware onto a 1Mbit flash memory). It will, however, allow the user to upload a firmware that is smaller in size than the flash memory, and it will program the firmware with the appropriate offset in order for the firmware to function properly. In the instance that there is a failure during the download or upload process, the modem will be in a "flash rescue mode". In this mode, the modem will respond "OK" to all AT commands, but will only take action on the AT** command, so a new attempt to upload or download can be initiated. When the modem is in the "flash rescue mode" it will only be able to respond to AT commands if the DTE rate has not been changed since the last AT** command was successfully issued, even if the modem is powered off and on.

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DTE-Modem Interface Commands

The parameters defined in this section control the operation of the interface between the DTE and modem.

Command: E   **Command Echo**
Description: The modem enables or disables the echo of characters to the DTE. The
                     parameter value, if valid, is written to S14 bit 1.
Default: 1
Defined Values: E0   Disables command echo.
                     E1   Enables command echo.
Result Codes: OK
                     Otherwise ERROR

Command: Q   **Quiet Result Code Control**
Description: Enables or disables the sending of result codes to the DTE. The parameter
                     value, if valid, is written to S14 bit 2.
Default: 0
Defined Values: Q0   Enables result codes to the DTE.
                     Q1   Disables result codes to the DTE.
Result Codes: OK
                     Otherwise ERROR

Command: V   **Result Code Form**
Description: Selects the sending of short-form or long-form result codes to the DTE.
                     The parameter, if valid, is written to S14 bit 3.
Default: 1
Defined Values: V0   Enables short-form (terse) result codes. Line feed is not issued
                           before a short-form result code.
                     V1   Enables long-form (verbose) result codes.
Result Codes: OK
                     Otherwise ERROR

Command: W   **Connect Message Control**
Description: This command, in conjunction with S95 bits 0, 2, 3, and 5 (bits 2, 3, and 5
                     can be written directly by the host or by the +MR, +ER, and +DR
                     commands, respectively), control the format of CONNECT messages. The
                     actual result code messages reported reflect the W command setting and
                     the S95 bit settings. (Also see +MR, +ER, and +DR commands.) The W
                     parameter value, if valid, is written to S31 bits 2 and 3.
Default: 0
Defined Values: W0   Upon connection, the modem reports only the DTE speed (e.g.,
                           CONNECT 19200). Subsequent responses are disabled.
                     W1   Upon connection, the modem reports the modulation, line speed, the
                           error correction protocol, and the DTE speed, respectively.
                           Subsequent responses are disabled.
                     W2   Upon connection, the modem reports the DCE speed (e.g.,
                           CONNECT 14400). Subsequent responses are disabled.
Result Codes: OK
                     Otherwise ERROR

Command: X   **Extended Result Codes**

Description: Selects the subset of the result code messages used by the modem to inform the DTE of the results of commands. Blind dialing is enabled or disabled by country parameters. If the user wishes to enforce dial tone detection, a "W" can be placed in the dial string (see D command). The information below is based upon the default implementation of the X results table.

If the modem is in facsimile mode (+FCLASS=1, 1.0, or 2), the only message sent to indicate a connection is CONNECT without a speed indication. See the table of Result Codes at the end of this chapter.

Default: 4

Defined Values: X0   Disables reporting of busy tones unless forced otherwise by country requirements; send only OK, CONNECT, RING, NO CARRIER, ERROR, and NO ANSWER result codes. Blind dialing is enabled/disabled by country parameters. If busy tone detection is enforced and busy tone is detected, NO CARRIER will be reported. If dial tone detection is enforced or selected and dial tone is not detected, NO CARRIER will be reported instead of NO DIAL TONE. The value 000b is written to S22 bits 6, 5, and 4, respectively.

X1   Disables reporting of busy tones unless forced otherwise by country requirements; send only OK, CONNECT, RING, NO CARRIER, ERROR, NO ANSWER, and CONNECT XXXX (XXXX = rate). Blind dialing enabled/disabled by country parameters. If busy tone detection is enforced and busy tone is detected, NO CARRIER will be reported instead of BUSY. If dial tone detection is enforced or selected and dial tone is not detected, NO CARRIER will be reported instead of NO DIAL TONE. The value 100b is written to S22 bits 6, 5, and 4, respectively.

X2   Disables reporting of busy tones unless forced otherwise by country requirements; send only OK, CONNECT, RING, NO CARRIER, ERROR, NO DIAL TONE, NO ANSWER, and CONNECT XXXX. If busy tone detection is enforced and busy tone is detected, NO CARRIER will be reported instead of BUSY. If dial tone detection is enforced or selected and dial tone is not detected, NO DIAL TONE will be reported instead of NO CARRIER. The value 01b is written to S22 bits 6, 5, and 4, respectively.

X3   Enables reporting of busy tones; send only OK, CONNECT, RING, NO CARRIER, ERROR, NO ANSWER, and CONNECT XXXX. Blind dialing is enabled/disabled by country parameters. If dial tone detection is enforced and dial tone is not detected, NO CARRIER will be reported. The value 110b is written to S22 bits 6, 5, and 4, respectively.

X4   Enables reporting of busy tones; send all messages. The value 111b is written to S22 bits 6, 5, and 4, respectively.

Result Codes: OK
Otherwise ERROR

Command:	**&C**	**RLSD (DCD) Option**

Description: The modem controls the RLSD output in accordance with the parameter supplied. The parameter value, if valid, is written to S21 bit 5.

Default: 1

Defined Values:
0   RLSD remains ON at all times.
1   RLSD follows the state of the carrier.

Result Codes: OK
Otherwise ERROR

Command:	**&D**	**DTR Option**

Description: Interprets the ON to OFF transition of the DTR signal from the DTE in accordance with the parameter supplied. The parameter value, if valid, is written to S21 bits 3 and 4. Also, see S25.

Default: 2

Defined Values: &D0   DTR drop is interpreted according to the current &Q setting as follows:
&Q0, &Q5, &Q6: DTR is ignored (assumed ON). Allows operation with DTEs, which do not provide DTR.
Q1 DTR drop causes the modem to hang up. Auto-answer is not affected.
&Q2, &Q3 DTR drop causes the modem to hang up. Auto-answer is inhibited.

&D1   DTR drop is interpreted according to the current &Q setting as follows:
&Q0, &Q1, &Q5, &Q6 DTR drop is interpreted by the modem as if the asynchronous escape sequence had been entered. The modem returns to asynchronous Command State without disconnecting.
&Q2, &Q3 DTR causes the modem to hang up Auto-answer is inhibited.

&D2   DTR drop is interpreted according to the current &Q setting as follows:
&Q0 through &Q6 drop caused the modem to hang up. Auto-answer is inhibited.

&D3   DTR drop is interpreted according to the current &Q setting as follows:
&Q0, &Q1, &Q5, &Q6 DTR drop causes the modem to perform a soft reset as if the Z command were received. The &Y setting determines which profile is loaded.
&Q2, &Q3 DTR drop causes the modem to hang up. Auto-answer is inhibited.
If &Q5, &Q6, +FCLASS=1 or +FCLASS=2 is in effect, the action taken is the same as for &Q0.

Command:	**&K**	**Flow Control**

Description: Defines the DTE/DCE (terminal/modem) flow control mechanism. The parameter value, if valid, is written to S39 bits 0, 1, and 2.

Default: 3 (for data modem modes)

Defined Values:
0   Disables flow control.
3   Enables RTS/CTS flow control.
4   Enables XON/XOFF flow control.
5   Enables transparent XON/XOFF flow control.
Note: Upon reset, both RTS/CTS and XON/XOFF flow control is enabled for fax modem and voice modes.

Result Codes: OK
Otherwise ERROR

Command: &R	**RTS/CTS Option**
Description:	This selects how the modem controls CTS. CTS operation is modified if hardware flow control is selected (see &K command). The parameter value, if valid, is written to S21 bit 2.
Default:	None
Defined Values:	&R0 In sync mode, CTS tracks the state of RTS; the RTS-to-CTS delay is defined by S26. In async mode, CTS is normally ON and will turn OFF only if required by flow control.
	&R1 In sync mode, CTS is always ON (RTS transitions are ignored). Tracks the state of RTS; In async mode, CTS is normally ON and will turn OFF only if required by flow control.
Result Codes:	OK
	Otherwise ERROR

Command: &S	**DSR Override**
Description:	Selects how the modem will control DSR. The parameter value, if valid, is written to S21 bit 6.
Default:	0
Defined Values:	&S0 DSR will remain ON at all times.
	&S1 DSR will become active after answer tone has been detected and inactive after the carrier has been lost.
Result Codes:	OK
	Otherwise ERROR

Command: +IPR	**Fixed DTE Rate**
Description:	This numeric extended-format parameter specifies the data rate at which the modem will accept commands during online operation. It may be used to select operation at rates at which the modem is not capable of automatically detecting the data rate being used by the DTE. Specifying a value of 0 disables the function and allows operation only at rates automatically detectable by the modem. The specified rate takes effect following the issuance of any result code(s) associated with the current command line.
	The <rate> specified does not apply in Online Data State if Normal Mode (Direct Mode) of operation is selected.
Default:	None
Defined Values:	<rate> Specifies the DTE-modem interface operation rate in bits/s.
	The available rates are 0, 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, or 230400.
	If unspecified or set to 0, automatic detection is selected and the character format is also forced to autodetect, +ICF=0.
	If the rate specified is not supported by the modem, an ERROR result code will be returned.
Report Commands:	+IPR? Reports current rates
	+IPR=? Reports current range Example: +IPR: (0,300,1200,2400,4800,9600,19200,38400,57600,115200, 230400)

Command: +IFC   **DTE-Modem Local Flow Control**

Description: This extended-format compound parameter controls the operation of local flow control between the DTE and the modem during the data state when V.42 error control is used, or when fallback to non-error control mode is specified to include buffering and flow control.
It accepts two numeric subparameters.

Default: 2

Defined Values: **Values defined by <modem_by_DTE>** Specifies the method to be used by the DTE to control the flow of received data from the modem.

+IFC0   None

+IFC1   XON/XOFF on transmitted data (XON/XOFF on transmit data); do not pass XON/XOFF characters to the remote modem.

+IFC2   Circuit 133 (Ready for Receiving).

+IFC3   DC1/DC3 on circuit 103 (Transmitted Data) with DC1/DC3 characters being passed through to the remote DCE in addition to being acted upon for local flow control.

Values defined by <DTE_by_modem> Specifies the method to be used by the modem to control the flow of transmitted data from the DTE.

+IFC0   None.

+IFC1   XON/XOFF on received data.

+IFC2   CTS/RTS.

Report Commands: +IFC?   Reports the current or selected values
Response: +IFC: <modem_by_DTE>,<DTE_by_modem>
Example: +IFC: 2,2 For the defaults.

+IFC=?   Reports the supported range of parameter values
Response: +IFC: (<modem_by_DTE> range),(<DTE_by_modem> range)
Example: +IFC: (0-3),(0-2).

Command: +ILRR   **DTE-Modem Local Rate Reporting**

Description: This extended-format numeric parameter controls whether or not the extended-format +ILRR:<rate> information text is transmitted from the modem to the DTE.

Default: 0

Defined Values: +ILRR0   Disables reporting of local port rate (+ILRR: is not transmitted).

+ILRR1   Enables reporting of local port rate (+ILRR: is transmitted).

Report Commands: +ILRR?   Reports current value

+ILRR=?   Reports supported range of parameter values

Reported Rate: The <rate> reported represents the current (negotiated or renegotiated) DTE-modem rate. If enabled, the intermediate result code is transmitted after any modulation, error control or data compression reports are transmitted, and before any final result code (e.g., CONNECT) is transmitted. The <rate> is applied after the final result code is transmitted.

The DTE-modem port rate will change only if neither buffered mode nor error controlled means are enabled (+ES=x,0) and if the negotiated carrier rate (+MRR) does not match the current DTE-modem port rate (autodetected from the previous command line).

Call Control Commands

Command:	**D**	**Dial**

Description: Directs the modem to go on-line, dial according to the string entered and attempt to establish a connection. If no dial string is supplied, the modem will go on-line and attempt the handshake in originate mode.

Note: If the ATD command is issued before the S1 register has cleared, the modem will respond with the NO CARRIER result code.

If +FCLASS=0 is selected, the modem will behave as a data modem and will attempt to connect to another data modem. The modem will have up to the period of time specified by register S6 or S7 to wait for carrier and complete the handshake. If this time expires before the modem can complete the handshake, the modem will go on-hook with the NO CARRIER response. This command will be aborted in progress upon receipt of any DTE character before completion of the handshake.

If +FCLASS=1, 1.0, or 2 is selected, the modem will behave as a facsimile modem and attempt to connect to a facsimile machine (or modem) by entering the HDLC V.21 channel 2 receive state (as if +FRH=3 had been issued). This command will be aborted upon receipt of any DTE character if the modem has not finished dialing. In this case, the modem will go on-hook and return to command mode after displaying the NO CARRIER message. If the modem has finished dialing, it proceeds as if the +FRH=3 command has been issued. (Refer to the +FRH command to determine how the modem behaves following this stage.)

Dial Modifiers
The valid dial string parameters are described below. Punctuation characters may be used for clarity, with parentheses, hyphen, and spaces being ignored.

Defined Values: Character string <string> corresponding to the selected option(s).

0-9	DTMF digits 0 to 9.
*	The 'star' digit (tone dialing only).
#	The 'gate' digit (tone dialing only).
A-D	DTMF digits **A**, **B**, **C**, and **D**. Some countries may prohibit sending of these digits during dialing.
L	Re-dial last number: the modem will re-dial the last valid telephone number. The **L** must be immediately after the **D** with all the following characters ignored).
P	Select pulse dialing: Pulse Dialing is used in the dialed numbers that follow until a **T** command is encountered. Affects current and subsequent dialing. Some countries prevent changing dialing modes after the first digit is dialed.
T	Select tone dialing: Tone Dialing is used in the dialed numbers that follow until a **P** is encountered. Affects current and subsequent dialing. Some countries prevent changing dialing modes after the first digit is dialed.
R	This command will be accepted, but not acted on.
S=n	Dial the number stored in the directory (n = 0 to 3). (See &Z.)
!	Flash: the modem will go on-hook for a time defined by the value of S29. Country requirements may limit the time imposed.
W	Wait for dial tone: the modem will wait for dial tone before dialing the digits following "W". If dial tone is not detected within the time specified by S7 (US) or S6 (W-class), the modem will abort the rest of the sequence, return on-hook, and generate an error message.
@	Wait for silence: the modem will wait for at least 5 seconds of silence in the call progress frequency band before continuing with the next dial string parameter. If the modem does not detect these 5 seconds

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          of silence before the expiration of the call abort timer (S7), the modem will terminate the call attempt with a NO ANSWER message. If busy detection is enabled, the modem may terminate the call with the BUSY result code. If answer tone arrives during execution of this parameter, the modem handshakes.

&   Wait for credit card dialing tone before continuing with the dial string. If the tone is not detected within the time specified by S7 (US models) or S6 (W-class models), the modem will abort the rest of the sequence, return on-hook, and generate an error message.

,   Dial pause: the modem will pause for a time specified by S8 before dialing the digits following ",".

;   Return to command state. Added to the end of a dial string, this causes the modem to return to the command state after it processes the portion of the dial string preceding the ";". This allows the user to issue additional AT commands while remaining off-hook. The additional AT commands may be placed in the original command line following the ";" and/or may be entered on subsequent command lines. The modem will enter call progress only after an additional dial command is issued without the ";" terminator. Use "H" to abort the dial in progress, and go back on-hook.

^   Toggles calling tone enable/disable: applicable to current dial attempt only.

( )   Ignored: may be used to format the dial string.

-     Ignored: may be used to format the dial string.

<space> Ignored: may be used to format the dial string.

<i>   Invalid character: will be ignored.

>   If enabled by country specific parameter, the modem will generate a grounding pulse on the EARTH relay output.

Command: T   **Set Tone Dial Default**

Description: Forces DTMF dialing until the next P dial modifier or P command is received. The modem will set an S-Parameter bit to indicate that all subsequent dialing should be conducted in tone mode. The DP command will override this command. Clears S14 bit 5.

                          This command may not be permitted in some countries. (See P.)

Result Code: OK

Command: P   **Set Pulse Dial Default**

Description: Forces pulse dialing until the next T dial modifier or T command is received. Sets S14 bit 5.

                          As soon as a dial command is executed which explicitly specifies the dialing mode for that particular call (e.g., ATDT...), this command is overridden so that all future dialing will be tone dialed. (See T command.) This command may not be permitted in some countries.

Result Code: OK

Command: A   Answer

Description: The modem will go off-hook and attempt to answer an incoming call if correct conditions are met. Upon successful completion of answer handshake, the modem will go on-line in answer mode. This command may be affected by the state of Line Current Sense, if enabled. (Most countries do not require Line Current Sense.) Operation is also dependent upon +FCLASS command and country-specific requirements.

If +FCLASS=0 is selected, the modem will enter the Connect state after exchanging carrier with the remote modem. If no carrier is detected within a period specified in register S7, the modem hangs up. Any character entered during the connect sequence will abort the connection attempt.

If +FCLASS=1, 1.0, or 2 is selected, the modem will go off-hook in V.21 answer mode. It will generate the V.21 2100 Hz answer tone for 3 ± 0.5 seconds and, following a delay of 70 ms, will proceed as if the +FTH=3 command were issued. At any stage up to (but excluding) the +FTH=3 command state, any character will abort the communication. (See the description of the +FTH command for details.)

Command: H   Disconnect (Hang-Up)

Description: Initiates a hang up sequence. This command may not be available for some countries due to PTT restrictions.

Default: None

Defined Values: H0   The modem will release the line if the modem is currently on-line, and will terminate any test (AT&T) that is in progress. Country specific, modulation specific, and error correction protocol specific (S38) processing is handled outside of the H0 command.

H1   If on-hook, the modem will go off-hook and enter command mode. For US models, the modem will remain off-hook. For W-class models, the modem will return on-hook after a period of time determined by S7.

Result Codes: OK
                            Otherwise ERROR

Command: O   Return to Online Data Mode

Description: Determines how the modem will enter the online data mode. If in the online command mode, the modem enters the online data mode with or without a retrain. If in the off-line command mode (no connection), the modem reports ERROR.

Default: None

Defined Values: O0   Enters on-line data mode without a retrain.
                            Handling is determined by the Call Establishment task. Generally, if a connection exists, this command connects the DTE back to the remote modem after an escape (+++).

O1   Enters on-line data mode with a retrain before returning to on-line data mode.

O2   Fast retrain without speed change (used for diagnostic purpose only).

O3   Renegotiate rate without speed change (used for diagnostic purpose only.

O4   Renegotiate rate down one speed (used for diagnostic purpose only).

O5   Renegotiate rate up one speed (used for diagnostic purpose only).

Result Codes: OK
                            Otherwise ERROR (or if not connected)

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Command: L   **Speaker Volume**

Description: Sets the speaker volume control. The parameter value, if valid, is written to
                         S22 bits 0 and 1.
Default: 1
Defined Values: L0   Low volume.
                         L1   Low volume. (Default.)
                         L2   Medium volume.
                         L3   High volume.
Result Codes: OK
                         Otherwise ERROR

Command: M   **Speaker Control**

Description: Selects when the speaker will be on or off. The parameter value, if valid, is
                         written to S22 bits 2 and 3.
Default: 1
Defined Values: M0   Speaker is always off.
                         M1   Speaker is on during call establishment, but off when receiving
                               carrier. (Default.)
                         M2   Speaker is always on.
                         M3   Speaker is off when receiving carrier and during dialing, but on
                         during answering.
Result Codes: OK
                         Otherwise ERROR

Command: &G   **Select Guard Tone**

Description: Causes the modem to generate the guard tone selected by this command
                         (DPSK modulation modes only). The parameter value, if valid, is written to
                         S23 bits 6 and 7.
                         This command may not be permitted in some countries.
Default: 0
Defined Values: &G0   Disables guard tone. (Default.)
                         &G1   Disables guard tone.
                         &G2   Selects 1800 Hz guard tone.
Result Codes: <value> = 0 to 2
                         Otherwise ERROR

Command: &P   **Select Pulse Dial Make/Break Ratio**

Description: Determines the make/break ratio used during pulse dialing. The default is
                         country-dependent. The parameter value, if valid, is written to S28 bits 3
                         and 4.
Default: 0
Defined Values: &P0   Selects 39%-61% make/break ratio at 10 pulses per second.
                         &P1   Selects 33%-67% make/break ratio at 10 pulses per second.
                         &P2   Selects 39%-61% make/break ratio at 20 pulses per second.
                         &P3   Selects 33%-67% make/break ratio at 20 pulses per second.
Result Codes: OK
                         Otherwise ERROR

Command: &V   Display Current Configuration and Stored Profiles
Description: Reports the current (active) configuration, the stored (user) profiles, and
                           the first four stored telephone numbers. The stored profiles and telephone
                           numbers are not displayed if the NVRAM is not installed or is not
                           operational as detected by the NVRAM test during reset processing.
Result Code: OK
Example: AT&V
                           ACTIVE PROFILE:
                           B1 E1 L1 M1 N0 QO T V1 W0 X4 Y0 &C1 &D2 &G0 &J0 &K3 &Q5
                           &R1 &S0 &T5 &X0
                           S00:000 S01:000 S02:043 S03:013 S04:010 S05:008 S06:002
                           S07:050 S08:002 S09:006
                           S10:014 S11:095 S12:050 S18:000 S25:005 S26:001 S36:007
                           S38:020 S46:138
                           S48:007 S95:000

                           STORED PROFILE 0:
                           B1 E1 L1 M1 N0 QO T V1 W0 X4 Y0 &C1 &D2 &G0 &J0 &K3 &Q5
                           &R1 &S0 &T5 &X0
                           S00:000 S02:043 S06:002 S07:050 S08:002 S09:006 S10:014
                           S11:095 S12:050 S18:000
                           S36:007 S40:104 S41:195 S46:138 S95:000

                           STORED PROFILE 1:
                           B1 E1 L1 M1 N0 QO T V1 W0 X4 Y0 &C1 &D2 &G0 &J0 &K3 &Q5
                           &R1 &S0 &T5 &X0
                           S00:000 S02:043 S06:002 S07:050 S08:002 S09:006 S10:014
                           S11:095 S12:050 S18:000
                           S36:007 S40:168 S41:195 S46:138 S95:000

                           TELEPHONE NUMBERS:
                           0 = 1 =
                           2 = 3 =
                           OK.

Command: &V1   Display Last Connection Statistics
Description: Displays the last connection statistics in the following format (shown with typical results):

TERMINATION REASON	LOCAL REQUEST
LAST TX rate	26400 BPS
HIGHEST TX rate	26400 BPS
LAST RX rate.	49333 BPS
HIGHEST RX rate	49333 BPS
PROTOCOL	LAPM
COMPRESSION	V42Bis
Line QUALITY	038
Rx LEVEL	015
Highest Rx State	67
Highest TX State	67
EQM Sum	00B4
Min Distance	0000
RBS Pattern	00
Rate Drop	00
Digital Loss	2000
Local Rtrn Count	00
Remote Rtrn Count	00
Flex 9481814347C4	

RBS Pattern: Shows which bits are being robbed in the least significant 6 bytes, e.g., 03 indicates 2 robbed bits in bit positions 0 and 1.

Digital Loss: Shows if a pad was encountered and if so, what was the digital loss. 2000 means 0dB.

Flex: Shows V.8bis information as follows:
First byte: Octet 13 (second byte of manufacturer id, 94 = 56K)
Second byte: Octet 14 (Licensee code: 81 = Conexant)
Third byte: Octet 15 (manufacturer's product capabilities)
Fourth byte: Octet 16 (56K version number)
Fifth byte: Octet 17 (Conexant pump code version number)
Sixth byte: Octet 18 (x-law and controller version number)
Bit 6   Forced/Not forced A-Law/µ-Law
0 = Forced A-Law/µ-Law.
1 = Not forced A-Law/µ-Law.
Bit 5   Select A-Law or µ-Law
0 = Select A-Law.
1 = Select µ-Law.
Bit 4:0 Controller version

Command:	\V	**Single Line Connect Message Enable**
Description:		Enables or disables the single-line connect message format as follows:
Default:		None
Defined Values:		

\V0   Connect messages are controlled by the command settings X, W, and S95.

\V1   Connect messages are displayed in the single line format described below subject to the command settings V (Verbose) and Q (Quiet). In Non-Verbose mode (V0), single line connect messages are disabled and a single numeric result code is generated for CONNECT DTE.

When single line connect messages are enabled, there are no CARRIER, PROTOCOL (+ER:), or COMPRESSION (+DR:) messages apart from the fields described below.

The single line connect message format is:
    CONNECT <DTE
    Speed>/<Modulation>/<Protocol>/<Compression>/<Line Speed>

Where:

DTE Speed =	DTE speed, e.g., 57600.
	Modulation = "V92" for V.92 modulation.
	"V90" for V.90 modulation.
	"K56" for 56K modulation.
	"V34" for V.34 modulation.
	"V32" for V.32 or V.32bis modulation.
	Note: Modulation is omitted for all other modulations.
Protocol =	"NONE" for no protocol.
	"ALT" for Microcom Network Protocol.
	"LAPM" for LAP-M protocol.
Compression =	"V44" for V.44 compression.
	"V42B" for V.42bis compression.
	"ALT" for Microcom MNP5 compression.
	Note: Compression is omitted if protocol is NONE.
Line Speed =	Asymmetric rates are displayed as "/rate:TX/rate:RX", e.g., /1200 TX/75 RX.
	Symmetric rates are displayed as a single DCE rate, e.g., 14400.

Command:	%L	**Report Line Signal Level**
Description:		Returns a value, which indicates the received signal level. The value returned is a direct indication (DAA dependent) of the receive level at the MDP, not at the telephone line connector. For example, 009 = -9 dBm, 043 = -43 dBm, and so on.
Result Codes:		OK

Command:	%Q	**Report Line Signal Quality**
Description:		Reports the line signal quality (DAA dependent). Returns the higher order byte of the EQM value. Based on the EQM value, retrain or fallback/fall forward may be initiated if enabled by %E1 or %E2.
Example:		AT%Q
		015
Result Codes:		OK If connected.
		ERROR If not connected, or connected in 300 bps, V.23, or fax modes.

Command: –STE=   Set Telephony Extension

Description: Enables/disables Line-In-Use, Extension Pickup, and Remote Hangup detection features.

Note: Additional hardware may be required to support these features.

Defined Values: The <value> corresponds to the selected bit-mapped options. The bit fields are defined as follows:

Bit 0   Line-In-Use detection enable/disable.
Bit 1   Extension Pickup detection enable/disable.
Bit 2   Remote Hangup detection enable/disable.

<value> (Dec.)	Remote Hangup	Extension Pickup	Line-in-Use
0 (default)	Disabled	Disabled	Disabled
1	Disabled	Disabled	Enabled
2	Disabled	Enabled	Disabled
3	Disabled	Enabled	Enabled
4	Enabled	Disabled	Disabled
5	Enabled	Disabled	Enabled
6	Enabled	Enabled	Disabled
7	Enabled	Enabled	Enabled

Report Commands: -STE? Reports current values

Example: -STE: 4 Remote Hangup enabled, Extension Pickup disabled, and Line-In-Use disabled.

-STE=?   Reports available options

Behavior in Data Mode (+FCLASS=0):

When on-hook, if the line is in use and an ATDT is issued, the modem will not go off-hook and will return with the message LINE-IN-USE.
When off-hook and either an extension is picked up or a line reversal is detected, the modem will drop the connection. The disconnect reason in register S86=25 (this is also defined for #UD). The user must flash the hook in order to get a dial tone due because the remote server will be retraining.

If the local handset is picked up while the modem is off-hook, the modem will do a link-disconnect, flash the hook for 1.5 seconds, and then connect the local handset to the line. At this point, the user dial tone should be on the local handset. The disconnect reason in S86=25.

Behavior in Voice Mode (+FCLASS=8):

When in voice mode and an extension is picked-up, a <DLE>P is sent to the DTE. When the modem is off-hook, a line reversal may also be detected in which case a <DLE>I is sent to the DTE.

In voice mode, there is no blocking of ATDT when the line is in use. Also, there is no automatic hang-up in voice mode as in data mode. There is only the above stated <DLE> shielding event reporting.

Operation in Data Mode:

Line-In-Use
(Enabled by AT-STE=1, AT-STE=3, AT-STE=5, or AT-STE=7)

Case 1: Telephone Line is in Use
If an ATDT, ATDP or ATDL is issued while Line-In-Use detection is enabled and the telephone line is in use, the modem will immediately return the message LINE-IN-USE to the DTE without going off-hook, and then return to command mode.

Case 2: Telephone Line is in Use but Disconnected
If an ATDT, ATDP or ATDL is issued while Line-In-Use detection is enabled and the telephone line is NOT in use, the modem will go off-hook after a short pause, then respond with CONNECT or NO CARRIER message.

Case 3: Telephone Line is not Connected to Modem
If an ATDT, ATDP, or ATDL is issued while Line-In-Use detection is enabled and the telephone line is not connected, the modem will go off-hook momentarily, go back on-hook, and then respond with NO DIAL TONE message.

Extension Pick-up
(Enabled by AT-STE=2, AT-STE=3, AT-STE=6, or AT-STE=7):

Case 1: Modem off-hook, Local Handset Goes Off-Hook
If the local handset goes off-hook while the modem is in a data connection, the local handset will be muted. The modem will then send a GSTN Cleardown to the remote modem and then go on-hook. The modem will then send a NO CARRIER message to the DTE. A result code of 25 will be left in S86 register. After 2 seconds, the local handset will be connected to the telephone line so the user hears the dial tone.

Remote Hang-up
(Enabled by AT-STE=4, AT-STE=5, AT-STE=6, or AT-STE=7):

Case 1: Modem off-hook, Remote Hang-up
If the modem is connected (off-hook) and the remote modem/server goes hangs up, the central office may issue a line polarity reversal. If a line polarity reversal is detected, the modem will drop the call and respond with NO CARRIER. The reason for hang-up can be determined by #UD or by S86=25. A line reversal can also be simulated by simply pulling out the telephone line during a connection.

Operation in Voice Mode

Line-In-Use
(Enabled by AT-STE=1, AT-STE=3, AT-STE=5, or AT-STE=7):

This feature does not apply in voice mode.

Extension Pickup
(Enabled by AT-STE=2, AT-STE=3, AT-STE=6, or AT-STE=7)

If the modem is off-hook and an extension goes off-hook, the modem issues a <DLE>P to the DTE. The application software should then hang up the line (VLS=0).

Remote Hang-up (Enabled by AT-STE=4, AT-STE=5, AT-STE=6, or AT-STE=7)

If the modem is off-hook and the remote user goes on-hook, the modem issues a <DLE>P to the DTE. The application software should then hang up the line (VLS=0).

Examples:
User is talking on an extension and the modem tries to dial
    AT-STE=7
    ATDT555-1212
    LINE-IN-USE.

The line is not in use and the modem tries to dial
    AT-STE=7
    ATDT555-1212
       Modem goes off-hook
    CONNECT

An extension is off-hook but there is silence on the line and the modem
tries to dial
    AT-STE=3
    ATDT555-1212
       Modem goes off-hook
    NO DIAL TONE

Modem is connected in data mode and remote modem goes on-hook
    AT-STE=4
    ATDT555-1212
    CONNECT
    NO CARRIER   Remote modem drops line
    ATS86=?
    025

Modem is in answer machine mode and an extension goes off-hook
AT-STE=2
AT+FCLASS=8
OK
<DLE>h   Local handset on-hook
<DLE>R   Ring
AT+VLS=1
OK
AT+VSM=1,7200,0,0
AT+VTX   Starts to play greeting message
<DLE>P   User picks up extension
<DLE>!   DTE send abort to end playback
AT+VLS=0   DTE hangs up.

Automated system that needs to periodically use the line while giving the
voice user the highest priority
A common use for these features would be an automated system that
needs to periodically use the line while giving the voice user the highest
priority. The automated system would make a connection when the line is
free. It would do this without disturbing the line if the line is in use. The
automated system would periodically retry the connection until the line is
free. Once the line is free it would dial and make its connection. If a voice
user wishes to use the line while the modem is connected. The modem will
drop the line and give the line to the user. The modem will then try to
regain control of the line by once again periodically retrying to establish a
connection.
AT-STE=7
OK
ATDT5551212
CONNECT
                  Sometime later, the user picks up phone
NO CARRIER
ATS86?
25
OK
                  Delay 30 seconds
ATDT5551212
LINE-IN-USE
                  Try again some time later; user hangs up phone
CONNECT

Modulation Control Commands

Command: +MS   Modulation Selection

Description: This extended-format compound parameter controls the manner of operation of the modulation capabilities in the modem. It accepts six subparameters.

Syntax: +MS=[<carrier>[,<automode>[,<min_tx_rate>[,<max_tx_rate> [,<min_rx_rate> [,<max_rx_rate>]]]]]]

Where possible <carrier>, <min_tx_rate>, <max_tx_rate>, <min_rx_rate>, and <max_rx_rate> values are listed in Table 5-3.

Table 5-3. +MS Command Supported Rates

Modulation	<carrier>	Possible (<min_rx_rate>, <min_rx_rate>, (<min_tx_rate>), and <max_tx_rate>) Rates (bps)
Bell 103	B103	300
Bell 212	B212	1200 Rx/75 Tx or 75 Rx/1200 Tx
V.21	V21	300
V.22	V22	1200
V.22 bis	V22B	2400 or 1200
V.23	V23C	1200
V.32	V32	9600 or 4800
V.32 bis	V32B	14400, 12000, 9600, 7200, or 4800
V.34	V34	33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400
56K	K56	56000, 54000, 52000, 50000, 48000, 46000, 44000, 42000, 40000, 38000, 36000, 34000, 32000
V.90	V90	56000, 54667, 53333, 52000, 50667, 49333, 48000, 46667, 45333, 44000, 42667, 41333, 40000, 38667, 37333, 36000, 34667, 33333, 32000, 30667, 29333, 28000
V.92 downstream	V92	56000, 54667, 53333, 52000, 50667, 49333, 48000, 46667, 45333, 44000, 42667, 41333, 40000, 38667, 37333, 36000, 34667, 33333, 32000, 30667, 29333, 28000
V.92 upstream	V92	48000, 46667, 45333, 44000, 42667, 41333, 40000, 38667, 37333, 36000, 34667, 33333, 32000, 30667, 29333, 28000, 26667, 25333, 24000

Note: Some <carrier> values may not be supported by certain model models. For example, modem models supporting V92 may not support K56.

Defined Values: <carrier>   A string that specifies the preferred modem carrier to use in originating or answering a connection. <carrier> values are strings of up to eight characters, consisting only of numeric digits and upper case letters. <carrier> values for ITU standard modulations take the form: <letter><1-4 digits><other letters as needed>. Defined values are listed in Table 5-3.

<automode>   A numeric value which enables or disables automatic modulation negotiation (ITU-T V.3*2bis* Annex A or V.8). 0 = Automode disabled. 1 = Automode enabled. (Default.)

<min_rx_rate> and <max_rx_rate>
Numeric values which specify the lowest (<min_rx_rate>) and highest (<max_rx_rate>) rate at which the modem may establish a receive connection. May be used to condition distinct limits for the receive direction as distinct from the transmit direction. Values for this subparameter are decimal encoded, in units of bit/s. The possible values for each modulation are listed in Table 5-3. Actual values will be limited to possible values corresponding to the entered <carrier> and fall-back <carrier> as determined during operation. (Default = lowest (<min_rx_rate>) and highest (<max_rx_rate>) rate supported by the selected carrier.)

<min_tx_rate> and <max_tx_rate>

Numeric values which specify the lowest (<min_tx_rate>) and highest (<max_tx_rate>) rate at which the modem may establish a transmit connection. Non-zero values for this subparameter are decimal encoded, in units of bit/s. The possible values for each modulation are listed in Table 5-3.

Actual values will be limited to possible values corresponding to the entered <carrier> and fall-back <carrier> as determined during operation. (Default = lowest (<min_tx_rate>) and highest (<max_tx_rate>) rate supported by the selected carrier.).

Report Commands:	+MS?	Reports current rates

Response: +MS:<carrier>,<automode>,<min_tx_rate>, <max_tx_rate>, <min_rx_rate>,<max_rx_rate>

Note: The current active settings are reported under control of the +MR parameter.

Example: +MS: K56, 1,300,33600,300,56000

For default values. This example allows maximum system flexibility to determine optimal receive and transmit rates during operation.

+MS=?   Reports supported range of parameter values:

Response: +MS: (< carrier> range),(<automode> range),(<min_tx_rate> range), (<max_tx_rate> range), (<min_rx_rate> range), (<max_rx_rate> range)

Example 1:
+MS:(B103,B212,V21,V22,V22B,V23C,V32,V32B,V34, K56,V90),(0,1),(300-33600),(300-33600),(300-56000),(300-56000)

Example 2:
+MS:(B103,B212,V21,V22,V22B,V23C,V32,V32B,V34, V90,V92),(0,1),(300-33600),(300-33600),(300-56000),(300-56000)

Result Code: OK - Valid subparameter string
Otherwise ERROR

Command: +MR   **Modulation Reporting Control**

Description: This extended-format numeric parameter controls whether or not the extended-format +MCR:<carrier> and +MRR:<rate> intermediate result codes are transmitted from the modem to the DTE. If enabled, +MCR:<carrier> and +MRR:<rate> intermediate result codes represent the current (negotiated or renegotiated) modulation <carrier> and <rate> that are transmitted at the point during connect negotiation (handshaking) at which the modem has determined which modulation and rate will be used, i.e., before any Error Control or Data Compression reports are transmitted, and before any final result code (e.g., CONNECT) is transmitted.

     S95 bit 2 is reset to 0 for +MR=0 and is set to a 1 for +MR=1 or +MR=2. The more recent setting of +MR or S95 bit 2, and the W command setting, determines modulation result code reporting (see S95 Parameter and W Command).

Default: 0

Defined Values:
     +MR0   Disables reporting of modulation connection (+MCR: and +MRR: are not transmitted).
     +MR1   Enables reporting of modulation connection (+MCR: and +MRR: are transmitted with TX rate, RX rate).
     +MR2   Enables reporting of modulation connection (+MCR: and +MRR: are transmitted with RX rate only).

Report Commands:
     +MR?   Reports the current value.
     +MR=?   Reports supported range of parameter values:

Command: %E   **Enable/Disable Line Quality Monitor and Auto-Retrain or Fallback/Fall Forward**

Description: Controls whether or not the modem will automatically monitor the line quality and request a retrain (%E1) or fall back when line quality is insufficient or fall forward when line quality is sufficient (%E2). The parameter value, if valid, is written to S41 bits 2 and 6.
If enabled, the modem attempts to retrain for a maximum of 30 seconds.

     Fallback/Fall Forward. When %E2 is active, the modem monitors the line quality (EQM). When line quality is insufficient, the modem will initiate a rate renegotiation to a lower speed within the V.34/V.32 bis/V.32 (RC336) modulation speeds. The modem will keep falling back within the current modulation if necessary until the speed reaches 2400 bps (V.34) or 4800 bps (V.32). Below this rate, the modem will only do retrains if EQM thresholds are exceeded. If the EQM is sufficient for at least one minute, the modem will initiate a rate renegotiation to a higher speed within the current modulation speeds. The rate renegotiations will be done without a retrain if a V.32bis connection is established.

     Speeds attempted during fallback/fall forward are those shown to be available in the rate sequences exchanged during the initial connection. Fallback/fall forward is available in error correction and normal modes, but not in direct mode or synchronous mode with external clocks.

Default: 2

Defined Values:
     %E0   Disable line quality monitor and auto-retrain.
     %E1   Enable line quality monitor and auto-retrain.
     %E2   Enable line quality monitor and fallback/fall forward. (Default.)

Result Codes:
     OK
     Otherwise ERROR

Command: %U   **Select µ-Law or A-Law Codec Type**

Description: Selects µ-Law or A-Law codec type for V.90 and 56K modulation.
                            This command also stores the selected setting directly to NVRAM.
Default: Default value is country specific
Defined Values: 0   Selects µ-Law.
                            1   Selects A-Law.
Result Codes: OK
                            Otherwise ERROR

Command: B   **CCITT or Bell**

Description: When the modem is configured to allow either option, the modem will
                            select Bell or CCITT modulation for a line speed connection of 300 or 1200
                            bps. Any other line speed will use a CCITT modulation standard. The
                            parameter value, if valid, is written to S27 bit 6.
Default: 0
Defined Values: B0   Selects CCITT operation at 300 or 1200 bps during Call
                                   Establishment and a subsequent connection. (Default.)
                            B1   Selects BELL operation at 300 or 1200 bps during Call
                                   Establishment and a subsequent connection.
Result Codes: OK
                            Otherwise ERROR

Error Control Commands

Command: +ES   **Error Control and Synchronous Mode Selection**

Description: This extended-format command specifies the initial requested mode of operation when the modem is operating as the originator. Optionally specifies the acceptable fallback mode of operation when the modem is operating as the originator, and optionally specifies the acceptable fallback mode of operation when the modem is operating as the answerer. Accepts three numeric subparameters.

Default: Varies by request

Defined Values: **<orig_rqst>**

Decimal number specifies the initial requested mode of operation when the modem is operating as the originator. The options are:

+ES0   Initiate call with Direct Mode.

+ES1   Initiate call with Normal Mode (also referred to as Buffered Mode) only.

+ES2   Initiate V.42 without Detection Phase. If V.8 is in use, disable V.42 Detection Phase.

+ES3   Initiate V.42 with Detection Phase. **(Default.)**

+ES4   Initiate MNP.

+ES6   Initiate V.80 Synchronous Access Mode when connection is completed, and Data State is entered. (See +ESA and +ITF commands.)

+ES7   Initiate Frame Tunneling Mode when connection is complete, and Data Mode is entered.

<orig_fbk>

Decimal number specifies the acceptable fallback mode of operation when the modem is operating as the originator.

+ES0   LAPM, MNP, or Normal Mode error control optional. **(Default.)**

+ES1   LAPM, MNP, or Direct Mode error control optional.

+ES2   LAPM or MNP error control required; disconnect if error control is not established.

+ES3   LAPM error control required; disconnect if error control is not established.

+ES4   MNP error control required; disconnect if error control is not established.

<ans_fbk>

Decimal number specifies the acceptable fallback mode of operation when the modem is operating as the answerer or specifies V.80 Synchronous Access Mode.

+ES0   Direct Mode.

+ES1   Error control disabled, use Normal Mode.

+ES2   LAPM, MNP, or Normal Mode error control optional. (Default.)

+ES3   LAPM, MNP, or Direct Mode error control optional.

+ES4   LAPM or MNP error control required; disconnect if error control is not established.

+ES5   LAPM error control required; disconnect if error control is not established.

+ES6   MNP error control required; disconnect if error control is not established.

+ES8   Initiate V.80 Synchronous Access Mode when connection is completed and Data State is entered (see +ESA and +ITF).

+ES9   Initiate Frame Tunneling Mode when connection is complete, and Data Mode is entered.

Examples: +ES=6   Enable V.80 Synchronous Access Mode originator.

+ES=6   Enable V.80 Synchronous Access Mode originator.

+ES=,,8   Enable V.80 Synchronous Access Mode answerer.

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	+ES=6,,8	Enable V.80 Synchronous Access Mode.
	+ES=3	Enable V.42 with Detection Phase originator. Disable V.80 Synchronous Access Mode originator.
	+ES=,,2	Allow LAPM, MNP, or Normal Mode connection answerer. Disable V.80 Synchronous Access Mode answerer.
	+ES=3,,2	Enable V.42 with Detection Phase originator, allow LAPM, MNP, or Normal Mode connection answer. Disable Synchronous Access Mode originator and answerer.
Report Commands:	+ES?	Reports the current values
		Response: +ES: <orig_rqst>,<orig_fbk>,<ans_fbk>
		Example: +ES: 3,0,2 For the default setting.
	+ES=?	Reports supported range of parameter values
		Response: +ES: (<orig_rqst> range),(<orig_fbk> range), (<ans_fbk> range)
		Example: +ES: (0-4,6,7),(0-4),(0-6,8,9)

Command: +EB   Break Handling in Error Control Operation

Description:	This extended-format compound parameter controls the break handling in V.42 operation. It accepts three numeric subparameters:
Default:	None
Defined Values:	<break_selection> Decimal number 0 specifying that break is to be ignored, i.e., not signaled to remote DCE.
	<timed> Decimal number 0 specifying that any transmitted V.42 L-SIGNAL will not indicate break signal length <default_length> Decimal number 0 specifying that break is not delivered to the DTE.
Report Commands:	+EB? Reports current or selected values
	Response: +EB:
	<break_selection>,<timed>,<default_length><CR>
	Example: +EB: 0,0,0 For default settings.
	+EB=? Reports supported range of parameter values
	Response: +EB: (<break_selection> range),(<timed> range), (default_length> range)
	Example: +EB: (0),(0),(0)

Command: +ESR   Selective Repeat

Description:	This extended-format numeric parameter controls the use of the selective repeat (SREJ) option in V.42.
	Decimal number 0 specifying that SREJ is not used.
Report Commands:	+ESR? Reports Current or Selected Values:
	Response: +ESR: <value>
	Example: +ESR: 0 For default setting
	+ESR=? Reports Supported Range of Parameter Values
	Response: +ESR: (<value>)
	Example: +ESR: (0)

Command: +EFCS   32-bit Frame Check Sequence

Description:	This extended-format numeric parameter controls the use of the 16-bit or 32-bit frame check sequence (FCS) option in V.42.
Defined Values:	<value> Decimal number 0 specifying the use of the 16-bit FCS specified in V.42.
Report Commands:	+EFCS? Current or Selected Values:
	Response: +EFCS: <value>
	Example: +EFCS: 0 For default setting.
	+EFCS=? Reporting Supported Range of Parameter Values
	Response: +EFCS: (<value> range)
	Example: +EFCS: (0)

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Command:	+ER	Error Control Reporting
Description:		This extended-format numeric parameter controls whether or not the intermediate result code is transmitted from the modem to the DTE. S95 bit 3 is reset to 0 for +ER=0 and is set to a 1 for +ER=1. The more recent setting of +ER or S95 bit 3, and the W command setting, determines the actual error control result code reporting (see S95 Parameter and W).
Default:		0
Defined Values:	+ER0	Error control reporting disabled (no +ER intermediate result code transmitted).
	+ER1	Error control reporting enabled (+ER intermediate result code transmitted).
Report Commands:	+ER?	Reports Current or Selected Values Response: +ER: <current value> Example: +ER: 0 for the default setting
	+ER=?	Reporting Supported Range of Parameter Values. Response: +ER: (<value> range) Example: +ER: (0,1)

Command:	+ER: <type>	Report the Current Error Control
Description:		The +ER: <type> reported represents the current (negotiated or renegotiated) modem-modem error control type. If enabled, the intermediate result code is transmitted during error control negotiation (handshaking) at which time the modem has determined the error control protocol will be used (if any), before the final result code (e.g., CONNECT) is transmitted. The +ER intermediate result code, if enabled, is issued after the Modulation report (+MCR and +MRR) and before the Data Compression Report (+DR).
Defined Values:	NONE	Error control is not in use.
	LAPM	V.42 LAPM protocol is in use.
	ALT	MNP is in use.
		Example: +ER: LAPM

Command:	+ETBM	Call Termination Buffer Management
Description:		This extended-format compound parameter controls the handling of data remaining in modem buffers upon call termination. It accepts three numeric subparameters:
Default:		None
Defined Values:	<pending_TD>	Decimal number 0 specifies disconnect will occur immediately and all buffered transmit data will be discarded when the local DTE requests call disconnection.
	<pending_RD>	Decimal number 0 specifying that disconnect will occur immediately and all buffered receive data will be discarded when the local DTE requests call disconnection.
	<timer>	Decimal number 0 specifying that the modem will not attempt to deliver the buffered data before abandoning the attempt and discarding remaining data.
Report Commands:	+ETBM?	Reports Current or Selected Values. Response: +ETBM: <pending_TD>,<pending_RD>,<timer> Example: +ETBM: 0,0,0
	+ETBM=?	Reports Supported Range of Parameter Values. Response: +ETBM: (<pending_TD> range),(<pending_RD> range), (<timer> range) Example: +ETBM: (0),(0),(0)

Command: \B	**Transmit Break to Remote**
Description:	In non-error correction mode, the modem will transmit a break signal to the remote modem with a length in multiples of 100 ms according to parameter specified. If a number in excess of 9 is entered, 9 is used. The command works in conjunction with the \K command.
	In error correction mode, the modem will signal a break through the active error correction protocol, giving no indication of the length.
Defined Values:	1-9 Break length in 100 ms units. (Default = 3.)
	(Non-error corrected mode only.)
Result Codes:	OK if connected in data modem mode.
	NO CARRIER if not connected or connected in fax modem mode.
	Note: When the modem receives a break from the remote modem, break is passed to the DTE as follows: In non-error correction mode direct, the break length is passed; in non-error correction mode normal and in error correction mode, a 300 ms break is passed.

Command: \K	**Break Control**
Description:	Controls the response of the modem to a break received from the DTE or the remote modem or the \B command. The parameter value, if valid, is written to S40 bits 3, 4, and 5.
Defined Values:	The response is different in three separate states.
	The first state is where the modem receives a break from the DTE when the modem is operating in data transfer mode:
	0 Enter on-line command mode, no break sent to the remote modem.
	1 Clear data buffers and send break to remote modem.
	2 Same as 0.
	3 Send break to remote modem immediately.
	4 Same as 0.
	5 Send break to remote modem in sequence with transmitted data. (Default.)
	The second case is where the modem is in the online Command State (waiting for AT commands) during a data connection, and the \B is received in order to send a break to the remote modem:
	0 Clear data buffers and send break to remote modem.
	1 Clear data buffers and send break to remote modem. (Same as 0.)
	2 Send break to remote modem immediately.
	3 Send break to remote modem immediately. (Same as 2.)
	4 Send break to remote modem in sequence with data.
	5 Send break to remote modem in sequence with data. (Same as 4.) (Default.)
	The third case is where a break is received from a remote modem during a non-error-corrected connection:
	0 Clears data buffers and sends break to the DTE.
	1 Clears data buffers and sends break to the DTE. (Same as 0.)
	2 Send a break immediately to DTE.
	3 Send a break immediately to DTE. (Same as 2.)
	4 Send a break in sequence with received data to DTE.
	5 Send a break in sequence with received data to DTE. (Same as 4.) (Default.)
Result Codes:	OK
	Otherwise ERROR

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Command: -K   **MNP Extended Services**

Description:	Enables or disables conversion of a V.42 LAPM connection to an MNP 10 connection. The parameter value, if valid, is written to S40 bits 0 and 1.
Defined Values:	-K0 Disables V.42 LAPM to MNP 10 conversion. (Default.)
	-K1 Enables V.42 LAPM to MNP 10 conversion.
	-K2 Enables V.42 LAPM to MNP 10 conversion; inhibits MNP Extended Services initiation during V.42 LAPM answer mode detection phase.
Result Codes:	OK
	ERROR

Data Compression Commands

This section contains parameters to condition modem use of standard ITU-T V.4*2bis* Data Compression Procedures.

Command: +DS	**Data Compression**
Description:	This extended-format compound parameter controls the V.42bis data compression function if provided in the modem. It accepts four numeric subparameters:
Defined Values:	**<direction>** Specifies the desired direction(s) of operation of the data compression function; from the DTE point of view.

        +DS0   Negotiated; no compression (V.42bis P0=0).
        +DS3   both directions, accept any direction (V.42bis P0=11). (Default.)

        <compr_neg>   Specifies whether or not the modem should continue to operate if the desired result is not obtained.
        +DS0   Do not disconnect if V.42bis is not negotiated by the remote modem as specified in <direction>.

        <max_dict>   Specifies the maximum number of dictionary entries (2048 entries) which should be negotiated (may be used by the DTE to limit the code word size transmitted, based on its knowledge of the nature of the data to be transmitted).

        <max_string>   Specifies the maximum string length (32 bytes) to be negotiated (V.42bis P2).

Report Commands:	+DS?	Reports Current or Selected Values.
		Response: +DS:
		<direction>,<compr_neg>,<max_dict>,<max_string>
		Example: +DS:
		3,0,2048,32 for the defaults and 2048 entry max dictionary.
	+DS=?	Reports Supported Range of Parameter Values.
		Response: +DS:
		(<direction> range),(< compr_neg > range),
		(<max_dict> range),(<max_string> range)
		Example: +DS: (0,3),(0),(2048),(32)

Command: +DS44	**V.44 Compression Select**
Description:	This extended-format compound parameter controls the V.44 data compression function.
Defined Values:	**<direction>** Decimal number that specifies the desired direction(s) of operation of the data compression function; from the DTE point of view.

        +DS440   Negotiated, no compression.
        +DS441   Transmit only.
        +DS442   Receive only.
        +DS443   Both directions, accept any direction. (Default.)

        <compress_negotiation> Decimal number that specifies whether or not the modem should continue to operate if the desired result is not obtained.
        +DS440   Do not disconnect if V.44 is not negotiated by the remote DCE as specified in <direction>. (Default.)
        +DS441   Disconnect if V.44 is not negotiated by the remote DCE as specified in <direction>.

        <capability> Decimal number that specifies the use of stream method, packet method, multi-packet method.
        +DS440   Stream method. (Default.)
        +DS441   Packet method.
        +DS442   Multi-packet method.

<max_codewords_tx> Decimal number 256 to 2048 that specifies the maximum number of codewords which should be negotiated in the transmit direction. (Default = 2048.)

<max_codewords_rx> Decimal number 256 to 2048 that specifies the maximum number of codewords which should be negotiated in the receive direction. (Default = 2048.)

<max_string_tx> Decimal number 32 to 255 that specifies the maximum string length to be negotiated in the transmit direction. (Default = 32.)

<max_string_rx> Decimal number 32 to 255 that specifies the maximum string length to be negotiated in the receive direction. (Default = 32.)

<max_history_tx> Decimal number 2048 to 4096 that specifies the maximum size of the history buffer to be negotiated in the transmit direction. (Default = 4096.)

<max_history_rx> Decimal number 2048 to 4096 that specifies the maximum size of the history buffer to be negotiated in the receive direction. (Default = 4096.)

Report Commands:	+DS44?	Reports Current or Selected Values.
		Response:
		+DS44:<direction>,<compression_negotiation>,<capability>, <max_codewords_tx>,<max_codewords_rx>,<max_string_tx>, <max_string_rx>,<max_history_tx>,<max_history_rx>
		Example: +DS44:3,0,0,2048,2048,32,32,4096,4096 For the default setting.
	+DS44=?	Reports Supported Range of Parameter Values.
		Response: +DS44:(list of supported <direction> values),(list of supported <compression_negotiation> values),(list of supported <capability> values),(list of supported <max_codewords_tx> values),(list of supported <max_codewords_rx> values),(list of supported <max_string_tx> values),(list of supported <max_string_rx> values),(list of supported <max_history_tx> values),(list of supported <max_history_rx> values)

Command: +DR   Data Compression Reporting

Description:	This extended-format numeric parameter controls whether or not the extended-format +DR: intermediate result code is transmitted from the modem to the DTE. S95 bit 5 is reset to 0 for +DR=0 and is set to a 1 for +DR=1. The more recent setting of +DR or S95 bit 5, and the W command setting, determines the actual data compression result code reporting (see S95 Parameter and W Command).
Defined Values:	+DR0 Data compression reporting disabled (no +DR result code transmitted).
	+DR1 Data compression reporting enabled (+DR result code transmitted). (Default.)
Report Commands:	+DR? Reports Current or Selected Values.
	Response: +DR: <current value>
	Example: +DR: 1 For the default setting.
	+DR=? Reports Supported Range of Parameter Values.
	Response: +DR: (<value> range)
	Example: +DR: (0,1)
Intermediate Result Code:	+DR: <type>
	The +DR: <type> reported represents the current (negotiated or renegotiated) modem-modem data compression type. If enabled, the intermediate result code is transmitted at the point after error control negotiation (handshaking) at which the modem has determined which data compression technique will be used (if any) and the direction of operation. The +DR intermediate result code, if enabled, is issued after the Error Control Report (+ER) and before the final result code (e.g., CONNECT).

The format of this result code is:

Defined Values: `<type>`   An alphanumeric code corresponding to the selected option:
NONE Data compression is not in use.

V42B   V.42bis is in use in both directions.

V42B   RD V.42 bis is in use in receive direction only V42B TD V.42 bis is in use in transmit direction only V44 V.44 is in use in both directions V44 RD V.44 is in use in receive direction only V44 TD V.44 is in use in transmit direction only ALT MNP 5 compression.

Example: +DR: V42B

Command: **%C**   **Enable/Disable Data Compression**

Description: Enables or disables data compression negotiation. The modem can only perform data compression on an error-corrected link. The parameter value, if valid, is written to S41 bits 0 and 1.

Defined Values: %C0   Disables data compression. Resets S46 bit 1.

%C1   Enables MNP 5 data compression negotiation. Resets S46 bit 1.

%C2   Enables V.42 bis data compression. Sets S46 bit 1.

%C3   Enables both V.42 bis and MNP 5 data compression. Sets S46 bit 1. (Default.)

Result Codes: OK
ERROR

V.8/V.8bis Commands

Command: +A8E	**V.8 and V.8bis Operation Controls**
Description:	This command is defined for two conditions: as a parameter while the modem is on-hook, and as an action command while the modem is off-hook. If enabled, V.8 negotiation does not preclude simultaneous implementation of other negotiation means (e.g., V.8bis, V.18, V.32bis Annex A).
	This command is a compound parameter if issued while the modem is on-hook, used to precondition V.8 and V.8bis originating and answering operation. It is issued by the DTE before the Dial (D) or Answer (A) command, regardless of the state of the +FCLASS parameter.
	This command is an action command if issued while the modem is off-hook, to (re)start V.8 or V.8bis negotiation. For example, if initial V.8 negotiation failed, but subsequent T.30 negotiation indicated V.8 capability, this command may be used to initiate V.8 negotiation.

Defined Values:

<v8o> Decimal number which enables/disables issuance of +A8*x* indications during modem-controlled V.8 origination negotiation.

  1   Enable DCE-controlled V.8 origination negotiation without +A8x indications. (Default.)

  6   Enable DCE-controlled V.8 origination negotiation with +A8x indications.

<v8a>= Decimal number which enables/disables issuance of +A*8x* indications during modem-controlled V.8 answer negotiation.

  1   Enable DCE-controlled V.8 answer negotiation without +A8x indications. (Default.)

  5   Enable DCE-controlled V.8 answer negotiation with +A8x indications.

<v8cf>= Set the V.8 CI signal call function to the hexadecimal octet XY.

  00 (Default.)
  21
  C1

<v8b>= Decimal number which enables/disables V.8bis negotiation.

  0   Disable V.8bis negotiation.
  1   Enable V.8bis negotiation. (Default.)

<cfrange>= "<string of values>". Applicable only for <v8a>=5.
  Not supported.

< protrange >= "<string of values>". Applicable only for <v8a>=5.
  Not supported.

Default values:

1,1,00,1,0,0
The ATD and ATA commands behave as specified in V.250, and +A8n indications are not generated by the modem.
For subparameter values <v8o>=6 and <v8a>=5, the +A8I indications are issued during the course of the V.8 session to notify the DTE when the relevant V.8 signals are received.

Report Commands:

+A8E?   Reports Current or Selected Values.
  Response: +A8E:
    <v8o>,<v8a>,<v8cf>[,<v8b>][,<cfrange>][,<protrange>]
  Example: +A8E: 1,1,00,1,0,0 For the defaults

+A8E=? Reports Supported Range of Parameter Values.
  Response: +A8E: (<v8o> range),(<v8a> range),(v8cf in octets),
    (<v8b> range),(<cfrange>),(<protrange>)
  Example: +A8E: (1,6),(1,5),(0,21,C1),(0,1),(0),(0)

Command: +A8I: CI Signal Indication

Description: This indication is issued by an answering modem, if +A8E,<v8a> .0, to indicate detection of a V.8 CI signal, and report the recovered Call Function octet(s).

Defined Values: <v8cf>   A hexadecimal code octet representation of the Call Function octet(s). +A8I:0 indicates that the modem timed out waiting for CI.

Example: +A8I:0   The modem timed out waiting for CI.
                            +A8I:X   YYY

Diagnostic Commands

Command: #UD   Last Call Status Report

Description: #UD is an action command requesting logged operation events reporting. It does not take parameters and must be the last command in the command line.

The modem logs aspects of their operation for each call, and saves these results until cleared by one of the following events:

    Power off.
    Hard reset (e.g., negate DTR with &D3 set; reset button).
    Soft reset = ATZ or AT&F.
    ATD command issued.
    ATA command issued.
    Automatic answer (e.g., set register S0>0 and ring detected).

These results are NOT cleared by changing DTR, V.24 circuit 108.2, if &D0, &D1 or &D2.

Data Call State Model:

For purposes of this command, there are four data call states, and associated status issues:

1. Call Setup
    -Calling DCE: get dial tone, generate dial digits, and detect call progress signals.
    -Answering DCE: detect ringing, detect Caller ID, etc.
2. Negotiation
    -V.25 calling tone/answer tone exchanges
    -V.8 or V.8bis call function negotiations
    -V-series modem carrier detection and training
    -Modem-to-modem protocols (e.g., V.42, V.42bis).
3. Data Transfer
    -Bit-error rates, for each direction
    -Rate renegotiation
    -Retraining
4. Call Termination
    -protocol disconnect signals
    -carrier disconnect signals
    -loss of carrier
    -excessive error rates

Command Syntax:

In response to this command, the modem will report one or more lines of information text as defined below. Information text format conforms to V.250; each line is preceded by a <CR><LF> pair, and terminated by <CR><LF>. (CR and LF characters may be changed by writing new values to the contents of registers S3 and S4, respectively.)

The modem may generate a single line or multiple lines, followed by **OK** result code. For example, if call setup failed, only that result is useful. Each information text line is formatted as follows, including one or more key=value pairs:

Response: DIAG <token key=value [[key=value] [key=value]] …>
Defined Values: DIAG 5 hexadecimal characters (44h, 49h, 41h, 47h, 20h)
<   Left angle bracket (less than sign) (3Ch) token Unique 32-bit hexadecimal string 2A4D3263(32h, 4h1, 34h, 44h, 33h, 32h, 36h, 33h)
space   space character (20h)
Key   One- or two-digit hexadecimal number (see Key in Table 5-4)
=   Equal sign (3Dh)
Value   Any string as defined below (Table 5-4 - Table 5-9 as appropriate)
>   Right angle bracket (greater than sign) (3Eh)

Unless otherwise noted, all values are hexadecimal numbers. Any numeric values from tables in ITU V.58 are converted to hexadecimal. Multi-digit values are reported MSD first. Leading 0's may be deleted. See examples in Table 5-13.

Monitoring an Active Connection

This command is intended for use after call termination. However, codes are defined so that a modem can respond before the first call is placed, and during a call for live monitoring purposes. For example, key 60, call termination, has value 1 defined, indicating that the call is still in progress.

There are at least two ways to do this. First, the DTE could switch the modem to Online command state, issue the command, capture the responses and then issue an ATO command. For smoother online monitoring, in-band means defined in ITU V.80 are recommended if available in the modem. If V.80 methods are used, each response line shall be a separate extended in-band message.

Notes for Tables

1. The modem may insert a delay (e.g., 10 ms) between information text lines.
2. The code tables include values for data and fax calls. Some of the codes are applicable only to data calls (e.g., data compression), some are applicable only to call origination (e.g., busy, answering signal detection) and some are applicable only to the answering modem (e.g., calling signal detection).

callCleared codes from 3.6.4/V.58-1994

callCleared: indicates that the DCE has gone on-hook and that the previously existing network connection has been cleared. These values are hex values, converted from decimal in V.58. callCleared codes are described in Table 5-12.

Table 5-4. AT#UD Last Call Status Report Format

Key	Value(s)	Definition
0	2 digits	Diagnostic Command Specification revision number, digit.digit
1	Table 5-5	Call Setup Result code
2	Table 5-6	Multi-media mode
3	Table 5-7	DTE-DCE interface mode
4	String	V.8 CM octet string, same format as V.250, in quotes
5	String	V.8 JM octet string, same format as V.250, in quotes
10	0-2F	Received signal power level, in –dBm (0-43)
11	0-1F	Transmit signal power level, in –dBm (e.g., 0-17)
12	0-64	Estimated noise level, in –dBm (e.g., 10-90)
17	0-FFF	Round Trip delay, in units of ms
18	Table 5-8	V.34 INFO bit map
20	Table 5-9	Transmit Carrier Negotiation Result
21	Table 5-9	Receive Carrier Negotiation Result
22	0-1F40	Transmit Carrier symbol rate (0-8000) in symbol/s
23	0-1F40	Receive Carrier symbol rate (0-8000) in symbol/s
24	0-FA0	Transmit Carrier frequency (0-4000) in Hz
25	0-FA0	Receive Carrier frequency (0-4000) in Hz
26	0-FA00	Initial transmit carrier data rate (0-64000) in bit/s
27	0-FA00	Initial receive carrier data rate (0-64000) in bit/s
30	0-FF	Temporary carrier loss event count
31	0-FF	Carrier Rate re-negotiation event count
32	0-FF	Carrier Retrains requested
33	0-FF	Carrier Retrain requests granted
34	0-FA00	Final transmit carrier data rate in bit/s
35	0-FA00	Final receive carrier data rate in bit/s
40	Table 5-10	Protocol Negotiation Result
41	0-400	Error Control frame size in bytes
42	0-FF	Error control link timeouts in transmission
43	0-FF Error	control link NAKs received
44	Table 5-11	Compression Negotiation Result
50	0-2	Transmit flow control: 0=off; 1=DC1/DC3; 2=V.24 circuit 106/133
51	0-2	Receive flow control: 0=off; 1=DC1/DC3; 2=V.24 circuit 106/133
52	0-FFFFFFFF	Transmit characters sent from DTE
53	0-FFFFFFFF	Received characters sent to DTE
54	0-FFFF	Transmit characters lost (data overrun errors from DTE)

55	0-FFFF	Received characters lost (data overrun errors to DTE)
56	0-FFFFFFFF	Transmit I- Frame count, if error control protocol running
57	0-FFFFFFFF	Received I-Frame count, if error control protocol running
58	0-FFFF	Transmit I-Frame error count, if error control protocol running
59	0-FFFF	Received I- Frame error count, if error control protocol running
60	Table 5-12	Termination Cause
61	0-FF Call	Waiting event count

Table 5-5. Call Setup Result Codes

Code	Definition
0	No previous call (modem log has been cleared since any previous calls)
1	No dial tone detected
2	Reorder signal detected, network busy
3	Busy signal detected
4	No recognized signal detected (e.g., no signal, or nothing recognizable)
5	Voice detected * if this is a voice modem (e.g., V.253) operating in voice mode (e.g., +FCLASS=8.0)
7	Data Answering signal detected (e.g., V.25 ANS, V.8 ANSam)
8	Data Calling signal detected (e.g., V.25 CT, V.8 CI)
9	Fax Answering signal detected (e.g., T.30 CED, DIS)
A	Fax Calling signal detected (e.g., T.30 CNG)
B	V.8bis signal detected

Table 5-6. Multimedia Modes

Code	Definition
0	Data Only
1	Fax Only
2	Voice
9	Video-telephony, H.324
A	Other V.80 call

Table 5-7. DTE-DCE modes

Code	Definition
0	Async data
1	V.80 transparent synchronous mode
2	V.80 framed synchronous mode

Table 5-8. V.34 INFO bit report

Bits Source bits	Definition
31-30	INFO0 bit 20; 0
20-29	INFOc bits 79-88
16-19	INFOc bits 26-29 or 35-38 or 44- 47 or 53-56- or 62-65 or 71-74
Pre-emphasis field, selected by the symbol rate chosen	
12-15	INFOa bits 26-29
10-11	MP bit 50; 0
0-9	INFOa bits 40-49

Table 5-9. gstnModulationSchemeActive from 3.7.2/V.58

Value	Description
0	V.17 (G3 Fax call)
1	V.21
2	V.22
3	V.22bis
4	V.23 Constant Carrier (1200/75)
8	V.27ter (G3 Fax call)
9	V.29 HD (G3 Fax call)
A	V.32
B	V.32bis
C	V.34
E	V.90 and V.92
81	56K
84	Bell 212A
85	Bell 103

Table 5-10. errorControl Active from 3.5.2/V.58

Value	Description
0	Disable/none
1	V.42 LAPM
2	V.42 Alternative protocol (MNP™)
80	MNP10™

Table 5-11. compressionActive from 3.2.2/V.58

Value	Description
0	None
1	V.42bis and V.44
80	MNP5™

Table 5-12. callCleared codes from 3.6.4/V.58-1994

Value	Description	Notes
0	CauseUnidentified	Call setup issues
1	No Previous call	Not in V.58
2	Call is still in progress	Not in V.58
3	Call Waiting signal detected	Not in V.58, only if modem can detect it
4	Delayed	Same as value 2A, CallAttemptsLimitExceeded
19	InactivityTimerExpired	
1F	cct108isOffInhibitsDial	DTR low
20	cct108turnedOff	DTR drop
29	BlacklistedNumber	
2A	CallAttemptsLimitExceeded	Same as "Delayed", see ETS 300 001
2B	ExtensionPhoneOff-hook	If extension detection supported
2C	CallSetupFailTimerExpired	e.g., S7 timeout
2D	IncomingCallDetected	If incoming call while sending dial command.
2E	LoopCurrentInterrupted	
2F	NoDial tone	
31	ReorderTone	Fast busy
33	EngagedTone	Busy
34	LongSpaceDisconnect	And if modem program to abort on long space
3C	CarrierLost	Signal Converter
3D	TrainingFailed	
3E	NoModulationinCommon	
3F	RetrainFailed	
40	RetrainAttemptCountExceeded	
41	GstnCleardownReceived	
42	FaxDetected	If this was not a fax call attempt
46	InTestMode	Test
50	AnyKeyAbort	Call Control
51	DteHangupCommand	If ATH was used to terminate the previous call.
52	DteResetCommand	If ATZ was used to terminate the previous call.
5A	FrameReject	Error Control
5B	NoErrorControlEstablished	Error control was required
5C	ProtocolViolation	
5D	n400exceeded LAPM retransmission Count Timer	
5E	NegotiationFailed	
5F	DisconnectFrameReceived	
60	SabmeFrameReceived	
64	LossOfSynchronization	Data Compression

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Example Modem Response and Usage

Example #UD commend response are shown in Table 5-13.

Table 5-13. Completed Data Call, with some errors and rate retrain during the call

Modem Response Line	Description
DIAG <2A4D3263 0=09>	This is version 0.9
DIAG <2A4D3263 1=06 2=0 3=0>	Data Answer signal detected; Data only; Character async
DIAG <2A4D3263 5="C14513902A" 6="A145">	V.8 Call Menu indicates: V.8 Joint Menu selects:
DIAG <2A4D3263 10=1F 11=0C 12=52>	Receive level = -31 dBm; transmit level = -12 dBm; noise level = -82 dBm
DIAG <2A4D3263 14=03 15=05 16=10>	Far end echo delay in milliseconds; Far end echo loss in dB; Near end echo loss = 16 dB
DIAG <2A4D3263 20=C 22=780 24=0C80 26=79E0>	Transmitter: V.34 training completed; V.34 carrier frequency = 1920; V.34 symbol rate = 3200; initial transmit rate is 31200 bit/s
DIAG <2A4D3263 21=D 25=1F40 27=DAC0>	Receiver: V.90 training completed; V.90 symbol rate = 8000; initial receive rate is 56000 bit/s
DIAG <2A4D3263 30=00 31=03 32=01 33=01>	No carrier loss events, 3 carrier rate renegotiations attempted; 1 carrier retrain requested; 1 carrier retrain granted
DIAG <2A4D3263 34=7080 35=CB20>	Final transmit rate is 28800 bit/s; final receive rate is 52000 bit/s
DIAG <2A4D3263 40=1 41=100>	LAPM negotiation completed; frame size = 256
DIAG <2A4D3263 42=0 43=0>	No error control timeout or link NAKs
DIAG <2A4D3263 44=1 45=400>	V.42bis data compression used; dictionary size = 1024
DIAG <2A4D3263 50=2 51=2>	Hardware transmit and receive flow control
DIAG <2A4D3263 52=343CC 54=0>	213964 DTE characters transmitted, w/o underrun
DIAG <2A4D3263 53=7230E6 55=47>	7483622 DTE characters received, 71 characters lost due to receive data overrun
DIAG <2A4D3263 56=29D 58=0001>	597 (decimal) frames transmitted, with 1 frame error
DIAG <2A4D3263 58=2A4B 59=0004>	10827 (decimal) frames received, with 4 frame errors
DIAG <2A4D3263 60=51>	Local PC initiated hangup

Compatibility Commands

Command: &L   **Leased Line Operation**
Description: Requests leased line or dial-up operation. This command is provided for
                            compatibility only; no mode change is performed, dial-up operation
                            continues. The OK response is returned for a valid parameter, but no other
                            action is performed. The parameter value, if valid, is written to S27 bit 2.
Defined Values: &L0   Requests dial-up operation. Dial-up operation continues.
Result Codes: OK
                            ERROR

Command:)M   **Enable Cellular Power Level Adjustment**
Description: This command is included for compatibility only and has no effect other
                            than returning a result code.
Defined Values:)M0
)M1
)M2
Result Codes: OK
                            ERROR

Command: @M   **Initial Cellular Power Level Setting**
Description: This command is included for compatibility only and has no effect other than
                            returning a result code.
Defined Values: @M0
                            @M30
Result Codes: OK.
                            ERROR

Command: :E   **Compromise Equalizer Enable Command**
Description: This command is included for compatibility only and has no effect other than
                            returning a result code.
Defined Values: :E0
                            :E1
Result Codes: OK
                            ERROR

FastConnect Commands

Command:	**$F**	**FastConnect Control**

Description: Allows configuring of the client modem to connect to a central site modem that supports non-standard V.22 and V.22 bis FastConnect protocols. Specifies the initial requested mode of operation when the modem is operating as the originator. The options are:

Defined Values:
$F0   Normal connection (Default)
$F1   FastConnect without answer tone
$F2   Reserved
$F3   FastConnect with answer tone

V.92 +P and –Q Commands

This section describes the +P (PCM DCE) and –Q commands and parameters used to control the V.92 Mode operation.

Command:	**+PCW**	**Call Waiting Enable**

Description: Controls the operation of the modem in the presence of call waiting.

Defined Values:
+PCW0   Request modem-on-hold if enabled by +PMH and collect caller ID information if enabled by +VRID. Toggle V.24 circuit 125. (Default.)
+PCW1   Hang-up.
+PCW2   Ignore call waiting.

Result Codes:
OK
ERROR

Report Commands:
+PCW?   Reports Selected Value(s).
             Response: +PCW: <value>
             Example: +PCW: 0 For the default setting.
+PCW=?   Reports Supported Range of Parameter Values
             Response: +PCW: (<value> range)
             Example: +PCW: (0,1,2)

Command:	**+PMH**	**Modem-on-Hold Enable**

Description: Controls the selection of modem-on-hold in the modem. The action of the modem in response to modem-on-hold events is determined by the state of this command as well as the state of a negotiated handshake with a V.92-compliant server in V.92 Mode.

Defined Values:
+PMH0   Modem-on-hold enabled in V.92 Mode. (Default.)
+PMH1   Disabled modem-on-hold.

Result Codes:
OK 0 or 1 in V.92 Mode (see the +MS command)
ERROR

Report Commands:
+PMH?   Reports Current or Selected Value.
             Response: +PMH: <current value>
             Example: +PMH: 0 For the default setting.
+PMH=?   Reports Supported Range of Parameter Values.
             Response: +PMH: (<value> range)
             Example: +PMH: (0,1)

Command: +PMHR   Initiate Modem-on-Hold

Description:	Requests the modem to initiate or to confirm a modem-on-hold procedure. The modem will return ERROR if modem-on-hold is not enabled or if the modem is in an idle condition. The modem will return the string response +PMHR: <value> where <value> is a decimal value corresponding to the status of the modem's hold exchange procedure as defined below. This response may be delayed depending upon the context under which the +PMHR command is made, i.e., if the +PMHR is in response to an incoming modem-on-hold or if it is initiating a request.

Note: If modem-on-hold is enabled but the remote server does not support V.92 then the modem will always report 0 to show that the hold request is denied.

Response:	+PMHR:<value>

The value corresponds to the maximum hold time the server or hold-granting modem will allow.

+PMHR0   V.92 MOH request denied or not available.
+PMHR1   MOH with 10-second timeout Granted.
+PMHR2   MOH with 20-second timeout Granted.
+PMHR3   MOH with 30-second timeout Granted.
+PMHR4   MOH with 40-second timeout Granted.
+PMHR5   MOH with 1-minute timeout Granted.
+PMHR6   MOH with 2-minute timeout Granted.
+PMHR7   MOH with 3-minute timeout Granted.
+PMHR8   MOH with 4-minute timeout Granted
+PMHR9   MOH with 6-minute timeout Granted.
+PMHR10 MOH with 8-minute timeout Granted.
+PMHR11 MOH with 12-minute timeout Granted.
+PMHR12 MOH with 16-minute timeout Granted.
+PMHR13 MOH with indefinite timeout Granted.

Result Codes:	OK 0-13 in V.92 Mode (+MS=V92) ERROR

Command: +PMHT   Modem-on-Hold Timer

Description:	Controls whether or not the modem will grant or deny a modem-on-hold (MOH) request as well as setting the MOH Timeout value.
Defined Values:	+PMHT0 Deny V.92 modem-on-hold Request (Default.)

+PMHT1   Grant MOH with 10-second timeout
+PMHT2   Grant MOH with 20-second timeout
+PMHT3   Grant MOH with 30-second timeout
+PMHT4   Grant MOH with 40-second timeout
+PMHT5   Grant MOH with 1 minute timeout
+PMHT6   Grant MOH with 2 minute timeout
+PMHT7   Grant MOH with 3 minute timeout
+PMHT8   Grant MOH with 4 minute timeout
+PMHT9   Grant MOH with 6 minute timeout
+PMHT10 Grant MOH with 8 minute timeout
+PMHT11 Grant MOH with 12 minute timeout
+PMHT12 Grant MOH with 16 minute timeout
+PMHT13 Grant MOH with indefinite timeout

Result Codes:	OK 0-13 in V.92 Mode (+MS=V92) ERROR
Report Commands:	+PMHT? Reports Current or Selected Values. Response: +PMHT: <value> Example: +PMHT: 0 For the default setting.
	+PMHT=? Reports Supported Range of Parameter Values. Response: +PMHT: (<value> range) Example: +PMHT: (0,1,2,3,4,5,6,7,8,9,10,11,12,13)

Command: +PIG   PCM Upstream Ignore

Description: Controls the selection of PCM upstream in the modem. The actual state of
                               PCM upstream is determined by the state of this command as well as the
                               state of a negotiated handshake with a V.92-compliant server in V.92
                               Mode.

Defined Values: +PIG0   Enable PCM upstream negotiation.
                               +PIG1   Disable PCM upstream negotiation. (Default.)

Result Codes: OK 0 or 1 in V.92 Mode (+MS=V.92)
                               ERROR

Report Commands: +PIG?   Reports Selected Value(s).
                                            Response: +PIG: <value>
                                            Example: +PIG: 1 For the default setting.
                               +PIG=?   Reports Supported Range of Parameter Values.
                                            Response: +PIG: (<value> range)
                                            Example: +PCW: (0,1)

Command: +PMHF   V.92 Modem-on-Hold Hook Flash

Description: Causes the modem to initiate the flash hook sequence when in the
                               modem-on- hold procedure. This enables switching to the second call
                               (incoming or outgoing).
                               This command applies only to V.92 modem-on-hold. There are no
                               parameters associated with this command.

Result Code: OK   When the modem completes the flash hook sequence.
                               ERROR   If this command is initiated and the modem is not on hold.

Command: +PQC   V.92 Phase 1 and Phase 2 Control

Description: Controls the global enabling or disabling of the V.92 shortened Phase 1
                               and Phase 2 startup procedures. This command is used in conjunction with
                               the +PSS command.

Defined Values: +PQC0   Enable Short Phase 1 and Short Phase 2. (Default.)
                               +PQC1   Enable Short Phase 1 only.
                               +PQC2   Not supported.
                               +PQC3   Disable Short Phase 1 and Short Phase 2.

Result Codes: OK 0, 1, or 3 in V.92 Mode (+MS=V.92)
                               ERROR

Report Commands: +PQC?   Reports Selected Values.
                                            Response: +PQC: <value>
                                            Example: +PQC: 0
                               +PQC=?   Reports Supported Range of Parameter Values.
                                            Response: +PQC: (<value> range)
                                            Example: +PQC: (0,1,3)

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Command: +PSS   **Use Short Sequence**

Description: Causes a calling modem to force either a V.92 short or full startup sequence as defined by the +PQC command on the next and subsequent connections.

Defined Values: +PSS0   The modems decide whether or not to use the short startup procedures. The short startup procedures can only be used if enabled by the +PQC command. (Default.)

                         +PSS1   Reserved.

                         +PSS2   Forces the use of the full startup procedures on the next and subsequent connections independent of the setting of the +PQC command.

Result Codes: OK 0 - 2 in V.92 Mode (+MS=V.92)
                         ERROR

Report Commands: +PSS?   Reports Selected Values.
                                  Response: +PSS: <value>
                                  Example: +PSS: 0 For the default <value>.

                         +PSS=?   Reporting Supported Range of Parameter Values:
                                  Response: +PSS: (<value> range)
                                  Example: +PSS: (0,1,2)

Command: -QCPC   **Force Full Startup Procedure on Next Connection**

Description: Causes the modem to use full startup procedures on the next connection attempt regardless of the setting of the +PQC command. After this attempt, the modem will select the startup procedure as defined by the +PQC command. If a shortened startup procedure is enabled by the +PQC command, then the quick connect profile will also be updated on the next connection attempt.

Result Code: OK In V.92 Mode (+MS=V.92)
                         ERROR

Command: -QCPS   **Enable Quick Connect Profile Save**

Description: This command controls whether or not the modem will save the generated quick connect profile.

Defined Values: -QCPS0   Do not allow the quick connect profile to be saved.
                         -QCPS1   Allow the quick connect profile to be saved. (Default.)

Result Codes: OK in V.92 Mode (+MS=V.92) and quick connect is enabled (+PSS = 0)
                         ERROR

Report Commands: -QCPS?   Reports Selected Value(s).
                                  Response: -QCPS: <value>
                                  Example: -QCPS: 1 For the default setting.

                         -QCPS=? Reports Supported Range of Parameter Values.
                                  Response: -QCPS: (<value> range)
                                  Example: -QCPS: (0,1)

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 value may be stored on one of two user profiles with the command **&W**.

Register	Unit	Range	Default	Description
S0	1 *ring*	0–255	0	**Number of Rings to Auto-Answer:** Sets the number of rings until the modem answers. ATS0=0 disables autoanswer completely. *
S1	1 ring	0–255	0	**Ring Counter:** Counts the rings that have occurred. S1 is cleared if no rings occur over eight-second intervals.
S2	decimal	0–255	43 (+)	**Escape Character:** Holds the decimal value of the ASCII character used as the escape character. The default value corresponds to an ASCII '+'. A value over 127 disables the escape process; e.g., no escape character will be recognized.*
S3	decimal	0–127	13 (^M)	**Carriage Return Character:** Sets the command line and result code terminator character. Pertains to asynchronous operation only.
S4	decimal	0–127	10 (^J)	**Line Feed Character:** Sets the character recognized as a line feed. Pertains to asynchronous operation only. The Line Feed control character is output after the Carriage Return Control character if verbose result codes are used.
S5	decimal	0–255	8 (^H)	**Backspace Character :** Sets the character recognized as a backspace. Pertains to asynchronous operation only. The modem will not recognize the Backspace character if it is set to a value that is greater than 32 ASCII. This character can be used to edit a command line. When the echo command is enabled, the modem echoes back to the local DTE the Backspace character, an ASCII space character and a second Backspace character; this means a total of three characters are transmitted each time the modem processes the Backspace character.
S6	seconds	2–255	2	**Wait Time Before Blind Dialing or for Dial Tone:** 1. Sets the length of time, in seconds, that the modem will wait before starting to dial after going off-hook when blind dialing. This operation, however, may be affected by some ATX options according to country restrictions. The "Wait for Dial Tone" call progress feature (W dial modifier in the dial string) will override the value in register S6. (When configured for US). 2. Sets the length of time, in seconds, that the modem will wait for dial tone when encountering a "W" dial modifier before returning NO DIAL TONE result code. (W class). Default is country-dependent. The modem always pauses for a minimum of 2 seconds, even if the value of S6 is less than 2 seconds. *
S7	seconds	1–255*	50	**Wait Time for Carrier, Silence, or Dial Tone:** 1. Sets the length of time, in seconds, that the modem will wait for carrier before hanging up. The timer is started when the modem finishes dialing (originate), or 2 seconds after going off-hook (answer). In originate mode, the timer is reset upon detection of answer tone if allowed by country restrictions. 2. Sets the length of time, in seconds, that modem will wait for silence when encountering the @ dial modifier before continuing with the next dial string parameter. 3. Sets the length of time, in seconds, that the modem will wait for dial tone when encountering a "W" dial modifier before continuing with the next dial string parameter. (US model.) The default is country dependent. *
S8	seconds	2–255	2	**Pause Time for Dial Delay**: Sets the time, in seconds, that the modem must pause when the "," dial modifier is encountered in the dial string. *

Register	*Unit*	*Range*	*Default*	*Description*
S9	0.1 s	1–255	6	**Carrier Detect Response Time:** Supported for backward compatibility only. No value can be written. Responds with default value. *
S10	0.1 s	1–255	14	**Lost Carrier to Hang Up Delay:** Sets the length of time, in tenths of a second that the modem waits before hanging up after a loss of carrier. This allows for a temporary carrier loss without causing the local modem to disconnect. When register S10 is set to 255, the modem functions as if a carrier is always present. *
				The actual interval the modem waits before disconnecting is the value in register S10 minus the value in register S9. Therefore, the S10 value must be greater than the S9 value or else the modem disconnects before it recognizes the carrier.
				Note: For Call Waiting detection, if the modem is set to US country code and S10 >=16, then the modem will detect the Call Waiting tone and hang-up the line. If S10 <16, the modem will not detect Call Waiting tone.
S11	0.001 s	50–255	95	**DTMF Tone Duration:** 1. For US models, S11 sets the duration of tones in DTMF dialing (has no effect on pulse dialing). 2. For W-class models, S11 is a country parameter. The default is country dependent. *
S12	0.02 s	0–255	50	**Escape Prompt Delay (EPD):** Defines the maximum period, in fiftieths of a second, allowed between receipt of the last character of the three escape character sequence from the DTE and sending of the OK result code to the DTE. If any characters are detected during this time, the OK will not be sent. Sending of the OK result code does not affect entry into command mode. (See 3.1.3). *
S14			138 (8Ah)	**General Bit-Mapped Options Status:** Indicates the status of command options.

S14 description continued:

Bit 0   This bit is ignored.
Bit 1   Command echo (En)
    0 =   Disabled (E0)
    1 =   Enabled (E1) (Default.)
Bit 2   Quiet mode (Qn)
    0 =   Send result codes (Q0) (Default.)
    1 =   Do not send result codes (Q1)
Bit 3   Result codes (Vn)
    0 =   Numeric (V0)
    1 =   Verbose (V1) (Default.)
Bit 4   Reserved
Bit 5   Tone (T)/Pulse (P)
    0 =   Tone (T) (Default.)
    1 =   Pulse (P)
Bit 6   Reserved
Bit 7   Originate/Answer
    0 =   Answer
    1 =   Originate (Default.)
S19 is supported for backward compatibility only. No value can be written. Responds with default value.

| *S16* | | | 0 | **Test Mode Bit-Mapped Options Status:** Indicates the test in progress status. |

S16 description continued:

Bit 0   Local analog loopback
    0 =   Disabled (Default.)
    1 =   Enabled (&T1)
Bits 1-7   Not used

| *S19* and *S20* | | | | **Reserved** |

Register	_Unit_	_Range_	_Default_	_Description_
S21			52 (34h)	**V.24/General Bit-Mapped Options Status:** Indicates the status of command options.

		Bits 0 - 1	Reserved (0)	
		Bit 2	CTS behavior (&Rn)	
		0 =	CTS tracks RTS (&R0)	
		1 =	CTS always on (&R1) (Default.)	
		Bits 3-4	DTR behavior (&Dn)	
		0 =	&D0 selected	
		1 =	&D1 selected	
		2 =	&D2 selected (Default.)	
		3 =	&D3 selected	
		Bit 5	RLSD (DCD) behavior (&Cn)	
		0 =	&C0 selected	
		1 =	&C1 selected (Default.)	
		Bit 6	DSR behavior (&Sn)	
		0 =	&S0 selected (Default.)	
		1 =	&S1 selected	
		Bit 7	Long space disconnect (Yn)	
		0 =	Y0 (Default.)	
		1 =	Y1	

Register	_Unit_	_Range_	_Default_	_Description_
S22			117 (75h)	**Speaker/Results Bit-Mapped Options Status:** Indicates the status of command options.

		Default:	117 (75h) (01110101b)	
		Bits 0-1	Speaker volume (Ln)	
		0 =	Off (L0)	
		1 =	Low (L1) (Default.)	
		2 =	Medium (L2)	
		3 =	High (L3)	
		Bits 2-3	Speaker control (Mn)	
		0 =	Disabled (M0)	
		1 =	Off on carrier (M1) (Default.)	
		2 =	Always on (M2)	
		3 =	On during handshake (M3)	
		Bits 4-6	Limit result codes (Xn)	
		0 =	X0	
		4 =	X1	
		5 =	X2	
		6 =	X3	
		7 =	X4 (Default.)	
		Bit 7	Reserved	

Register	_Unit_	_Range_	_Default_	_Description_
S23			0	**General Bit-Mapped Options Status:** Indicates the status of command options.

		Bits 0-6	Not used	
		Bits 6-7	Guard tone (&Gn)	
		0 =	None (&G0) (Default.)	
		1 =	None (&G1)	
		2 =	1800 Hz (&G2)	

Register	_Unit_	_Range_	_Default_	_Description_
S24	seconds	0–255	0	**Sleep Inactivity Timer:** Sets the length of time, in seconds, that the modem will operate in normal mode with no detected telephone line or DTE line activity before entering low-power sleep mode. The timer is reset upon any DTE line or telephone line activity. If the S24 value is zero, neither DTE line nor telephone inactivity will cause the modem to enter the sleep mode.
S25	0.01 s	0–255	5	**Delay to DTR OFF:** Sets the length of time that the modem will ignore DTR for taking the action specified by &Dn. Its units are seconds for synchronous modes and one hundredths of a second for other modes.
S26	0.01 s	0–255	1	**RTS-to-CTS Delay:** Sets the time delay, in hundredths of a second, before the modem turns CTS ON after detecting an OFF-to-ON transition on RTS when &R0 is commanded. Pertains to synchronous operation only.

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Register	*Unit*	*Range*	*Default*	*Description*
S27			73 (49Ah)	**General Bit-Mapped Options Status:** Indicates the status of command options.

S27 description:

Default: 73 (49h) (01001001b)

<u>Bits 0, 1, 3</u>   <u>Synchronous/asynchronous selection (&Mn/&Qn)</u>

    3 1 0

    0 0 0   &M0 or &Q0

    0 0 1   &M1 or &Q1

    0 1 0   &M2 or &Q2

    0 1 1   &M3 or &Q3

    1 0 0   Reserved

    1 0 1   &Q5 (Default.)

    1 1 0   &Q6

Bit 2   Leased line control (&Ln)

    0 =   Dial up line (&L0) (Default.)

Bits 4 - 5   Internal clock select (&Xn)

    0 =   Internal clock (&X0) (Default.)

    1 =   External clock (&X1)

    2 =   Slave clock (&X2)

Bit 6   CCITT/Bell mode select (Bn)

    0 =   CCITT mode (B0)

    1 =   Bell mode (B1) (Default.)

Bit 7 - Reserved

Register	*Unit*	*Range*	*Default*	*Description*
S28			0	**General Bit-Mapped Options Status:** Indicates bit mapped options status.

S28 description:

Default: 0

Bits 0 - 1   Reserved

Bit 2   Reserved (always 0).

Bits 3 - 4   Pulse dialing (&Pn)

    0 = 39%-61% make/break ratio at 10 pulses per second (&P0)

    1 = 33%-67% make/break ratio at 10 pulses per second (&P1)

    2 = 39%-61% make/break ratio at 20 pulses per second (&P2)

    3 = 33%-67% make/break ratio at 20 pulses per second (&P3)

Bit 5-7   Reserved

Register	*Unit*	*Range*	*Default*	*Description*
S29	10 ms	0–255	70	**Flash Dial Modifier Timer:** Sets the length of time, in units of 10 ms, that the modem will go on-hook when it encounters the flash (!) dial modifier in the dial string. S29 is a country dependent parameter. The S29 value cannot be changed using S29=XX. Default: 70 (700 ms) for U.S.
S30	10 s	0–255	0	**Disconnect Inactivity Timer:** Sets the length of time, in tens of seconds, that the modem will stay online before disconnecting when no data is sent or received. In error-correction mode, any data transmitted or received will reset the timer. In other modes, any data transmitted will reset the timer. The timer is inoperative in synchronous mode.
S31			192 (C0h)	**General Bit-Mapped Options Status:** Indicates bit mapped options status.

S31 description:

Default: 192 (C0h) (11000000b)

Bit 0   Single line connect message enable/disable (\Vn)

    0 =   Messages controlled by S95, Wn and Vn (\V0) (Default.)

    1 =   Single line connect message (\V1)

Bit 1   Reserved (0)

Bits 2-3   Error correction progress messages (Wn)

    0 =   DTE speed only (W0) (Default.)

    1 =   Full reporting (W1)

    2 =   DCE (line) speed only (W2)

Bits 4-5   Caller ID (+VCID)

    0 =   Caller ID disabled (+VCID=0) (Default.)

    1 =   Short (formatted) Caller ID enabled (+VCID=1)

    2 =   Long (unformatted) Caller ID enabled (+VCID=2)

Bits 6-7   Reserved (Default = 11b)

Register	Unit	Range	Default	Description
S36			7	**LAPM Failure Control:** This value indicates what should happen upon a LAPM failure. These fallback options are initiated immediately upon connection if S48=128. If an invalid number is entered, the number is accepted into the register, but S36 will act as if the default value has been entered. *

Default: 7 (00000111b)
Bits 0-2
0 = Modem disconnects.
1 = Modem stays on-line and a Direct mode connection is established.
2 = Reserved.
3 = Modem stays on-line and a Normal mode connection is established.
4 = An MNP connection is attempted and if it fails, the modem disconnects.
5 = An MNP connection is attempted and if it fails, a Direct mode connection is established.
6 = Reserved.
7 = An MNP connection is attempted and if it fails, a Normal mode connection is established. (Default.)
Bits 3-7   Reserved

Register	Unit	Range	Default	Description
S38	seconds	0–255	20	**Delay Before Forced Hang Up:** Specifies the delay between the modem's receipt of the H command to disconnect (or ON-to-OFF transition of DTR if the modem is programmed to follow the signal), and the disconnect operation. Applicable to error-correction connection only. This parameter can be used to ensure that data in the modem buffer is sent before the modem disconnects.

If S38 is set to a value between 0 and 254, the modem will wait that number of seconds for the remote modem to acknowledge all data in the modem buffer before disconnecting. If time expires before all data is sent, the NO CARRIER result code will be issued to indicate that data has been lost. If all data is transmitted prior to time-out, the response to the H0 command will be OK.
If S38 is set to 255, the modem does not time-out and continues to attempt to deliver data in the buffer until the connection is lost or the data is delivered.

Register	Unit	Range	Default	Description
S39			3	**Flow Control Bit-Mapped Options Status.**

Default: 3 (00000011b)
Bits 0-2   Status of command options
       0 =   No flow control
       3 =   RTS/CTS (&K3) (Default.)
       4 =   XON/XOFF (&K4)
       5 =   Transparent XON (&K5)
       6 =   Both methods (&K6)
Bits 3-7   Reserved

Register	Unit	Range	Default	Description
S40			104 (68h)	**General Bit-Mapped Options Status.** Indicates the status of command options.

Default: 104 (68h) (01101000b)
Bits 0-1   MNP Extended Services (-Kn)
       0 =   Disable extended services (-K0) (Default.)
       1 =   Enable extended services (-K1)
       2 =   Enable extended services (-K2)
Bit 2   Reserved
Bits 3-5   Break Handling (\Kn)
       0 =   \K0
       1 =   \K1
       2 =   \K2
       3 =   \K3
       4 =   \K4
       5 =   \K5 (Default.)
Bits 6-7   Reserved*

Register	*Unit*	*Range*	*Default*	*Description*

S41 195 (C3h) **General Bit-Mapped Options Status.** Indicates the status of
command options. *

Default:	13 (C3h) (00001101b)
Bits 0 -1	Compression selection (%Cn)
0 =	Disabled (%C0)
1 =	MNP 5 (%C1)
2 =	V.42 bis (%C2)
3 =	MNP 5 and V.42 bis (%C3) (Default.)
Bits 2, 6	Auto retrain and fallback/fall forward (%En)

Bit 6	Bit 2	Meaning
0	0	Retrain and fallback/fall forward disabled (%E0)
0	1	Retrain enabled (%E1)
1	0	Fallback/fall forward enabled (%E2) (Default.)

Bit 3   Reserved
Bits 4-5 Reserved
Bit 7   Reserved

S46 138 **Data Compression Control.** Controls selection of compression. *
The following actions are executed for the given values:
S46=136 Execute error correction protocol with no compression.
S46=138 Execute error correction protocol with compression. (Default.)

S48 7 **V.42 Negotiation Control.** Negotiation process determines the
capabilities of the remote modem. However, when the capabilities of
the remote modem are known and negotiation is unnecessary, this
process can be bypassed if so desired.
Range: 0, 7, or 128 If an invalid number is entered, it is accepted into
the S-Parameter, but S48 will act as if 128 has been entered.
S48=0 Disable negotiation; bypass the detection and negotiation
   phases; and proceed with LAPM.
S48=7 Enable negotiation. (Default.)
S48=128 Disable negotiation; bypass the detection and negotiation
   phases; and proceed at once with the fallback action specified
   in S36. Can be used to force MNP.

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Register	*Unit*	*Range*	*Default*	*Description*
S86		0–26	21	**Call Failure Indication.** When the modem issues a NO CARRIER result code, a value is written to S86 Register to help determine the reason for the failed connection. S86 records the first event that contributes to a NO CARRIER message. The code definitions are:

S86=0   Normal hangup, no error occurred.
S86=1   Reserved.
S86=2   Reserved.
S86=3   Call Waiting caused disconnect.
S86=4   Physical carrier loss.
S86=5   No error correction at the other end.
S86=6   No response to feature negotiation.
S86=7   This modem is async only; the other modem is sync only.
S86=8   No framing technique in common.
S86=9   No protocol in common.
S86=10   Bad response to feature negotiation.
S86=11   No sync information from the remote modem.
S86=12   Normal hangup initiated by the remote modem.
S86=13   Retransmission limit reached.
S86=14   Protocol violation occurred.
S86=15   Lost DTR.
S86=16   Received GSTN cleardown.
S86=17   Inactivity timeout.
S86=18   Speed not supported.
S86=19   Long space disconnect.
S86=20   Key abort disconnect.
S86=21   Clears previous disconnect reason.
S86=22   No connection established.
S86=23   Disconnect after three retrains.
S86=24   Call Waiting tone detected.
S86=25   Extension pickup detected.
S86=26   Remote hangup detected.

Register	*Unit*	*Range*	*Default*	*Description*
S91	dBm	0–15	10	**PSTN Transmit Attenuation Level.** In non-PCM modes (V.90 or K56flex are PCM modes), S91 sets the transmit attenuation level from 0 to 15 dBm for the PSTN mode, resulting in a transmit level from 0 to -15 dBm. In some countries, the transmit level may not be changed and there are checks to prevent transmit attenuation level change. The default is country dependent.
S95			0	**Extended Result Codes Control.** A bit set to a 1 in this parameter, in conjunction with the W command, will enable the corresponding extended result code. *

The +MR, +ER, and +DR settings also control S95 bits 2, 3, and 5, respectively. The more recent settings of +MR, +ER, and +DR, or host writing of S95 bits 2, 3, and 5, along with the W command setting, determine the corresponding actual result code reporting (see +MR, +ER, DR, and W commands).

Bit 0   CONNECT result code indicates DCE speed instead of DTE speed.
Bit 1   Append/ARQ to CONNECT XXXX result code in error-correction mode (XXXX = rate).
Bit 2   Enable +MCR: XXXX result code (XXXX = modulation) and +MRR: XXXX result code (XXXX = rate). (Also, see +MR.)
Bit 3   Enable +ER: XXXX result code (XXXX = protocol identifier).
Bit 4   Reserved.
Bit 5   Enable +DR: XXXX result code (XXXX = compression type).
Bits 6-7 Reserved.

Register	*Unit*	*Range*	*Default*	*Description*
S210		0–255	13 (0Dh)	**V.34 Symbol Rate.** The bits in this parameter control V.34 symbols rates and enable/disable V.34 asymmetric rates. This parameter is used for diagnostic purposes only.

Default: 13 (0Dh) (00001101b)
Bits 0 -2 Selects the range of allowed V.34 symbol rates.

2	1	0	Symbol Rates (baud)
0	0	0	2400 only
0	0	1	2400 only (no 2734)
0	1	0	2400, 2800
0	1	1	2400, 2800, 3000
1	0	0	2400, 2800, 3000, 3200
1	0	1	2400, 2800, 3000, 3200, 3429 (Default.)

Bit 3   Enable/disable V.34 asymmetric rates.
    0 =   Disable asymmetric rates
    1 =   Enable asymmetric rates (Default.)
Bits 4-7 Reserved.

Examples
S210=13   Enable asymmetric rates with all symbol rates available (Default.).
S210=5   Disable asymmetric rates with all symbol rates available.
S210=8   Enable asymmetric rates with only 2400 baud available.
S210=11   Enable asymmetric rates with 2400 to 3000 baud available.

* Register value may be stored on one of two user profiles with the **&W** command.

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.

Result Codes

Short Form	Long Form
+F4	+FCERROR
0	OK
1	CONNECT
2	RING
3	NO CARRIER
4	ERROR
5	CONNECT1200
6	NO DIAL TONE
7	BUSY
8	NO ANSWER
9	CONNECT600
10	CONNECT 2400
11	CONNECT 4800
12	CONNECT 9600
13	CONNECT 7200
14	CONNECT 12000
15	CONNECT 14400
16	CONNECT 19200
17	CONNECT 38400
18	CONNECT 57600
19	CONNECT 115200
20	CONNECT 230400
22	CONNECT 75TX/1200RX
23	CONNECT 1200TX/75RX
24	DELAYED
32	BLACKLISTED
33	FAX
35	DATA
40	+MRR: 300
44	+MRR: 1200/75
45	+MRR: 75/1200
46	+MRR: 1200
47	+MRR: 2400
48	+MRR: 4800
49	+MRR: 7200
50	+MRR: 9600
51	+MRR: 12000
52	+MRR: 14400
53	+MRR: 16800
54	+MRR: 19200
55	+MRR: 21600
56	+MRR: 24000
57	+MRR: 26400
58	+MRR: 28800
59	CONNECT 16800
60	CONNECT 21600
62	CONNECT 24000
63	CONNECT 26400
64	CONNECT 28800
66	+DR: A LT
67	+DR: V 42B
69	+DR: N ONE
70	+ER: N ONE

Short Form	Long Form
77	+ER: L APM
78	+MRR: 31200
79	+MRR: 33600
80	+ER: A LT
81	+ER: A LT-CELLULAR
83	LINE-IN-USE
84	CONNECT 33600
91	CONNECT 31200
134	+MCR: B 103
135	+MCR: B 212
136	+MCR: V 21
137	+MCR: V 22
138	+MCR: V 22B
139	+MCR: V 23
140	+MCR: V 32
141	+MCR: V 32B
142	+MCR: V 34
144	+MCR: K 56
145	+MCR: V 90
150	+MRR: 32000
151	+MRR: 34000
152	+MRR: 36000
153	MRR: 38000
154	+MRR: 40000
155	+MRR: 42000
156	+MRR: 44000
157	+MRR: 46000
158	+MRR: 48000
159	+MRR: 50000
160	+MRR: 52000
161	+MRR: 54000
162	+MRR: 56000
165	CONNECT 32000
166	CONNECT 34000
167	CONNECT 36000
168	CONNECT 38000
169	CONNECT 40000
170	CONNECT 42000
171	CONNECT 44000
172	CONNECT 46000
173	CONNECT 48000
174	CONNECT 50000
175	CONNECT 52000
176	CONNECT 54000
177	CONNECT 56000
178	CONNECT 230400
180	CONNECT 28000
181	CONNECT 29333
182	CONNECT 30667
183	CONNECT 33333
184	CONNECT 34667
185	CONNECT 37333
186	CONNECT 38667
187	CONNECT 41333
188	CONNECT 42667
189	CONNECT 45333
190	CONNECT 46667
191	CONNECT 49333
192	CONNECT 50667
193	CONNECT 53333
194	CONNECT 54667
195	+MRR: 28000

Short Form	Long Form
196	+MRR: 29333
197	+MRR: 30667
198	+MRR: 33333
199	+MRR: 34667
200	+MRR: 37333
201	+MRR: 38667
202	+MRR: 41333
203	+MRR: 42667
204	+MRR: 45333
205	+MRR: 46667
206	+MRR: 49333
207	+MRR: 50667
208	+MRR: 53333
209	+MRR: 54667

Chapter 6 – Fax Class 1 and Class 1.0 Commands

Fax I/O Processing

The fax I/O interface supports asynchronous serial and parallel interfaces. The character format is 8 bit data, no parity, and 1 stop bit. Start and stop elements are removed from the transmit data and added to the receive data. Both transmit and receive data are buffered. Flow control using XON/XOFF or RTS/CTS is provided.

Unique control character strings are identified, filtered, or reinserted into the I/O data stream. These control characters and their resultant action are described below.

DTE-to-Modem Transmit Data Stream

Characters Detected	Action Taken
<DLE><data>	Delete <DLE><data> characters.
<DLE><ETX>	Recognize as a string terminator and take appropriate action.
<DLE><DLE>	Replace with single <DLE> character.

Modem-to-DTE Receive Data Stream

Characters Detected	Action Taken
<DLE>	Insert extra <DLE> ahead of <DLE>.

The modem also identifies the end of a frame by inserting <DLE><ETX> into the data stream after the FCS bytes.

Fax Mode Selection

Fax Class 1 and Fax Class 1.0 commands are identified in Table 6-1. Fax Class 1.0 includes all Fax Class 1 commands

Table 6-1. Fax Class 1 and Fax Class 1.0 Commands

Command/Parameter	Function	Applicable in Fax Class 1	Applicable in Fax Class 1.0
+FCLASS=<class>	Select, read or test service class	X	X
+FAA=<value>	Auto answer enable	-	X
+FAE=<value>	Auto answer enable	X	X
+FTS=<time>	Stop transmission and pause	X	X
+FRS=<time>	Wait for silence	X	X
+FTM=<mod>	Transmit data with <mod> carrier	X	X
+FRM=<mod>	Receive data with <mod> carrier	X	X
+FTH=<mod>	Transmit HDLC data with <mod> carrier	X	X
+FRH=<mod>	Receive HDLC data with <mod> carrier	X	X
+FAR=<off/on>	Adaptive reception control	-	X
+FCL=<time>	Carrier loss timeout	-	X
+FDD=<value>	Double escape character replacement control	-	X
+FIT=<time>, <action>	DTE inactivity timeout	-	X
+FPR=<rate>	Fixed DTE Rate	-	X
+FMI?	Report manufacturer ID	-	X
+FMM?	Report model ID	-	X
+FMR?	Report revision ID	-	X
+FLO	Flow Control	-	X
&K	Local DTE-modem flow control (see Call Control Section)	X	X
A	Answer	X	X
D<string>	Dial	X	X
H	Hangup (see Call Control Section)	X	X
X stands for Applicable. - stands for Not Applicable.			

Fax Origination

Origination of fax calls is made using the ATD command. Upon completion of the dial function, a calling tone at 1100 Hz is transmitted, with a cadence of 0.5 seconds on and 3 seconds off. The modem automatically enters mode +FRH=3 and sends the CONNECT message to the DTE when FSK flags are detected from the remote.

Fax Answering

Answering of fax calls is identical to answering of data calls with the exception that the modem enters the fax handshaking mode instead of the data handshaking mode after going off-hook. If +FAE=0, the modem, after sending answer tone, automatically enters fax mode (+FTH=3), sends the CONNECT message to the DTE, and starts sending FSK flags. If +FAE=1, the modem determines whether the caller is a data modem or fax modem and sends the DATA or FAX result code, respectively, to the DTE.

Fax Control Transmission

Fax control transmission is initiated by the +FTH=<mod> command. After this command is issued, the modem generates the CONNECT message and transmits carrier in the modulation scheme specified by the parameter n. The modem then transmits HDLC flags for a minimum of 1 second. The modem continues to transmit the HDLC flags until it receives a character from the DTE.
When characters are received from the DTE, the modem adds start and end flags, performs zero-bit insertion, generates FCS, and deletes <DLE><chr> character pairs before transmitting the characters to the remote fax machine. Each <DLE><DLE> sequence is transmitted as a single <DLE>. <DLE><ETX> is considered as the end of frame marker and is not transmitted. All data received from the DTE after

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<DLE><ETX> is ignored by the modem until the modem generates either the CONNECT, OK, or ERROR result code.

If no more data is in the transmit buffer and the final bit was a 1 (bit 4 of the second byte received from the DTE), the modem generates the OK result code and returns to the command mode. If the final bit was a 0, the modem generates the CONNECT message and waits for further data from the DTE while transmitting HDLC flags. If no more data is received before 5 seconds elapse, the modem drops carrier, goes on-hook, and generates the ERROR result code.

Fax Control Reception

Fax control reception is initiated using the AT+FRH=<mod> command. After this command is issued, the modem looks for carrier in the modulation scheme specified by the parameter n. If no carrier is detected before the period of time specified by register S7 expires, the modem generates the NO CARRIER message and returns to command mode.

If a carrier is detected that is not the one specified by the parameter n, the modem generates the +FCERROR message and returns to the command mode. If the specified carrier is detected, the modem generates the CONNECT message and enters the HDLC receive mode.

In HDLC receive mode, the modem receives HDLC frames from the remote fax machine, strips the flags, performs zero-bit deletion, performs error checking, and handles <DLE><chr> character pairs before passing the data to the DTE. The modem prefixes each <DLE> character with another <DLE> character before sending it to the DTE. After the last byte in the frame, the modem sends <DLE><ETX> to the DTE marking the end of the frame. The modem then generates either the OK message if no errors were detected or the ERROR message if errors were detected (FCS is incorrect), and returns to command mode.

While in command mode, the modem continues to receive data in the selected modulation scheme, and sends the data after sending the CONNECT message to the DTE when the DTE reissues the +FRH command with the same parameter. If the DTE issues the +FRH command with a different parameter, the modem clears all buffers and proceeds as described previously.

If carrier is lost while in command mode and the DTE reissues the +FRH command with the same parameter, and there is no data in the buffer, the modem sends the ERROR result code to the DTE and returns to the command mode. If there is data in the buffer, the modem sends the next frame of buffered data to the DTE, followed by <DLE><ETX>, and either the ERROR result code if errors were detected or the OK result code if no errors were detected. The modem then returns to command mode.

The modem concludes an error is detected if carrier is lost for any period of time during or before the reception of a frame. If carrier is lost for a time period longer than the time specified by the register S10, the modem finishes delivering the data in the receive buffer (if any) to the DTE, sends <DLE><ETX>, generates the ERROR message, and returns to command mode. All subsequent data received from the remote is discarded.

If the modem detects a frame abort sequence (seven consecutive ones with no zero insertion) while it is waiting for a frame beginning flag (it was receiving HDLC flags), it will wait for the HDLC flags again until either carrier is lost or the DTE aborts the process by sending an abort character or by dropping DTR with &D2 in effect. If the frame abort sequence is detected while the modem is receiving a frame it finishes delivering the data in the receive buffer (if any) to the DTE, sends <DLE><ETX>, generates the ERROR message, and returns to command mode. The modem keeps looking for HDLC flags followed by more data from the remote, with the selected modulation scheme.

If the modem detects a receive buffer overflow condition, it concludes that there was an FCS error in that frame. The modem will receive more frames only if a starting flag is detected and there is room in the receive buffer. If a starting flag is detected and there is no room in the buffer, the modem discards all data in that frame.

If the modem receives any character from the DTE after the +FRH command (except flow control characters if software flow control is in effect), or if the modem detects a high-to-low transition of the DTR signal while &D1 is in effect, it sends <DLE><ETX> to the DTE, generates OK result code, and returns to command mode. The receive buffer is cleared and all data received from the remote is discarded. If the modem detects a DTR drop while &D2 is in effect, it goes on-hook, sends <DLE><ETX> to the DTE,

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generates OK result code, and returns to command mode. If the modem detects a DTR drop while &D3 is in effect, the modem performs a warm reset.

Fax Data Transmission

Fax data transmission is initiated by the AT+FTM=<mod> command. After this command is issued, the modem generates the CONNECT message and transmits carrier in the modulation scheme specified by the parameter n. The modem then transmits constant 1 bits for a minimum of one second and continues to transmit constant 1 bits until it receives a character from the DTE.

When data is received from the DTE, the modem deletes start and stop bits and deletes all <DLE><chr> character pairs before transmitting the data to the remote. Each <DLE><DLE> sequence is transmitted as a single <DLE>. <DLE><ETX> is considered as the end of stream marker, and is not transmitted. All data received from the DTE after the <DLE><ETX> is ignored by the modem until the modem generates either the CONNECT, OK, or ERROR result code.

If no more data is in the transmit buffer, and the last transmitted character was not an ASCII NULL, the modem generates the OK result code and returns to the command mode. If the last character transmitted was an ASCII NULL, the modem generates the CONNECT message to the DTE and waits for further data from the DTE while transmitting NULLs to the remote. If more data is received before five seconds elapse, the modem continues to transmit the data as described in the previous paragraph. If five seconds elapse and no data is received from the DTE, the modem drops carrier, goes on-hook, and generates the ERROR result code.

Fax Data Reception

Fax data reception is initiated using the AT+FRM=<mod> command. After this command is issued, the modem looks for carrier in the modulation scheme specified by the parameter n. If no carrier is detected before the period of time specified by register S7 expires, the modem generates the NO CARRIER message and returns to command mode. If a V.21 carrier is detected when a high-speed carrier is expected, the modem generates the +FCERROR message and returns to the command mode. If the specified carrier is detected, the modem generates the CONNECT message and enters the data receive mode.

While in data receive mode, the modem receives data from the remote, adds start and stop bits, and handles <DLE><chr> character pairs before passing the data to the DTE. The modem prefixes each <DLE> character with another <DLE> character before sending it to the DTE.

If the modem detects a receive buffer overflow condition, it stops receiving from the remote until there is room in the receive buffer. The modem informs the DTE of the buffer overflow after it sends to the DTE the last character that was stored in the buffer before the overflow occurred.

If the modem receives any character from the DTE after the +FRM command (except flow control characters if software flow control is in effect), or if the modem detects a high-to-low transition of the DTR signal while &D1 is in effect, it sends <DLE><ETX> to the DTE, generates the OK result code, and returns to command mode. The receive buffer is cleared and all data received from the remote is discarded. If loss of DTR is detected while &D2 is in effect, the modem goes on-hook, sends <DLE><ETX> followed by OK result code to the DTE, and returns to command mode. If the modem detects a DTR drop while &D3 is in effect, the modem performs a warm reset.

Commands and Parameters

Mode Entry Commands

+FCLASS=1   Select Facsimile Class 1 Mode
+FCLASS=1 selects the Fax Class 1 Mode. The Fax Class 1 Mode commands and responses described in this section are applicable when command +FCLASS=1 as shown in Table 6-1.

+FCLASS=1.0 - Select Facsimile Class 1.0 Mode
+FCLASS=1.0 selects the Fax Class 1.0. The Fax Class 1.0 Mode commands and responses described in this section are applicable when command +FCLASS=1.0 as shown in Table 6-1.

Mode Commands

Command:	**+FAA**	**Auto Answer Enable - Class 1.0**

Description: This command enables or disables fax adaptive answer. This command operates identically to the +FAE command.

Defined Values: <value> Decimal number corresponding to the selected option.
0 Disable data /fax auto answer mode. (Default.)
1 Enable data /fax auto answer mode. The modem determines the calling type and issues DATA result code (13) if the caller is a data modem or issues FAX result code (15) if the caller is a fax modem.

Command:	**+FAE**	**Auto Answer Enable - Class 1 and 1.0**

Description: This command enables or disables fax adaptive answer. This command operates identically to the +FAA command.

Defined Values: <value> Decimal number corresponding to the selected option.
0 Disable data /fax auto answer mode. (Default.)
1 Enable data /fax auto answer mode. The modem determines the calling type and issues DATA result code (13) if the caller is a data modem or issues FAX result code (15) if the caller is a fax modem.

After a data (not fax) connection is achieved (indicated by the DATA result code), the DTE must issue an ATO command to cause the modem to go on-line.

Command:	**+FTS**	**Transmit Silence**

Description: This command causes the modem to terminate a transmission and wait for <time> 10-ms intervals before responding with the OK result code.

Defined Values: <time> Decimal number from 0 (default) to 255 that specifies the length of time in 10-ms intervals to delay before responding with the OK result code after terminating the session.

Result Codes: OK Reported when transmission has been terminated for the specified amount of time.
ERROR <value> is invalid or this command is issued while the modem is on-hook.

Reporting Supported Range of Parameter Values:
Command: +FTS=?
Response: +FTS: <time> range
Example: +FTS: 0-255.

Command: +FRS   Receive Silence

Description: This command causes the modem to listen and report an OK result code
                         when silence has been detected on the line for the specified period of time.
                         This command will terminate when the required period of silence is detected
                         or when the DTE sends the modem another character other than XON or
                         XOFF, which is discarded. In either event, the OK result code is returned.
                         This command is aborted if any character is received from the DTE after
                         receipt of the command but before the time delay elapses. In this case, the
                         modem discards the aborting character and issues an OK result code.

Defined Values: <time> Decimal number from 0 (default) to 255 which specifies the length of
                         time in 10-ms intervals to delay before responding with the OK result code
                         after detecting silence on the line.

Result Codes: OK Reported when silence has been present on the line for the specified
                         amount of time or when the DTE sends the modem a character other than
                         XON or XOFF.
                         ERROR <value> is invalid or this command is issued while the modem is on-
                         hook.

Reporting Supported Range of Parameter Values:
                         Command: +FRS=?
                         Response: +FRS: <time> range
                         Example: +FRS: 0-255

Command: +FTM   Transmit Facsimile

Description: This command causes the modem to transmit data using the modulation
                         defined below. When a valid <mod> value is entered, the modem transmits
                         the proper training sequence in the selected mode, followed by constant 1 bits
                         until data is received from the DTE. The modem also returns the CONNECT
                         result code at the beginning of the training sequence.

Defined Values: <mod> Decimal number corresponding to the selected modulation mode and
                         data rates shown in Table 6-2.

Table 6-2. Fax Class 1 and Fax Class 1.0 Modulation Modes and Rates

<mod>	Modulation	Training	Modulation Mode and Rate
3	V.21		300 bps
24	V.27 ter		2400 bps
48	V.27 ter		4800 bps
72	V.29		7200 bps
73	V.17	Long	7200 bps long
74	V.17	Short	7200 bps short
96	V.29		9600 bps
97	V.17	Long	9600 bps long
98	V.17	Short	9600 bps short
121	V.17	Long	12000 bps long
122	V.17	Short	12000 bps short
145	V.17	Long	14400 bps long
146	V.17	Short	14400 bps short

Result Codes: CONNECT Reported when the modems begins the training sequence after
                         receipt of a valid <mod> value.
                         ERROR If the modem's transmit buffer becomes empty and the last
                         transmitted character is NUL (00), the modem continues to transmit NULs
                         until the DTE sends more data or five seconds elapses. After five seconds
                         elapse with an empty transmit buffer, the modem will turn off the transmit
                         carrier, return to the command state, and report the ERROR result code.
                         OK If the modem's transmit buffer becomes empty and the last transmitted
                         character is not NUL, the modem will turn off the transmit carrier, return to the
                         command state, and report the OK result code.

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Reporting Current or Selected Values:
> Command: +FTM?
> Response: +FTM: <mod>
> Example: +FTM: 98 For V.17 9600 bps.

Reporting Supported Range of Parameter Values:
> Command: +FTM=?
> Response: +FTM: (<mod> range)
> Example: +FTM: 3,24,48,72,73,74,96,97,98,121,122,145,146

Command: +FRM   Receive Facsimile

Description:	This command causes the modem to enter the receiver mode using the modulation defined below.
Defined Values:	<mod> Decimal number corresponding to the selected modulation mode and data rates shown in Table 6-2.

Reporting Current or Selected Values:
> Command: +FRM?
> Response: +FRM: <mod>
> Example: +FRM: 98 For V.17 9600 bps.

Reporting Supported Range of Parameter Values:
> Command: +FRM=?
> Response: +FRM: (<mod> range)
> Example: +FRM: 3,24,48,72,73,74,96,97,98,121,122,145,146

Result Codes: CONNECT Reported when the selected carrier is detected.
+FCERROR Reported if another carrier is detected and FAR=0; the modem then returns to the command state.
NO CARRIER Reported if loss-of-carrier is detected.
OK Reported if the DTE sends any character to the modem other than XON or XOFF while operating in configured flow control from the DTE; the modem then returns to the command state.

Command: FTH   Transmit Data with HDLC Framing

Description:	This command causes the modem to transmit data using HDLC protocol and the modulation defined below.
Defined Values:	<mod> Decimal number corresponding to the selected modulation mode and data rates shown in Table 6-2.
Result Codes:	CONNECT Reported for either of two conditions:

1. At the beginning of transmission of the training pattern for the selected modulation.
2. If the Final Frame bit is 0.
OK Reported for either of two conditions:
1. If the Final Frame Bit is 1.
2. if the DTE sends only <DLE><ETX> (a null frame) while transmitting flags.
ERROR Reported if five seconds elapse from the time when the modem reported the CONNECT result code without any additional data transmitted from the DTE; the modem then turns off carrier and returns to the command mode.

Reporting Current or Selected Values:
> Command: +FTH?
> Response: +FTH: <mod>
> Example: +FTH: 98 For V.17 9600 bps.

Reporting Supported Range of Parameter Values:
> Command: +FTH?
> Response: +FTH?
> Example: +FTH: 98 For V.17 9600 bps.

Command: +FRH   Receive Data with HDLC Framing

Description:	This command causes the modem to receive frames using HDLC protocol and the modulation defined below. An ERROR response code results if this command is issued while the modem is on-hook.
Defined Values:	<mod> Decimal number corresponding to the selected modulation mode and data rates shown in Table 6-2.

Reporting Current or Selected Values:

Command: +FRH?
Response: +FRH: <mod>
Example: +FRH: 98 For V.17 9600 bps.

Reporting Supported Range of Parameter Values:

Command: +FRH?
Response: +FRH?
Example: +FRH: 98 For V.17 9600 bps.

Result Codes:	CONNECT Reported for either of two conditions: **1.** When the selected carrier is detected with an HDLC flag. **2.** If the DTE sends another +FTH=<MOD> command after sending the result code indicating frame reception is complete. +FCERROR Reported if a different carrier is detected and FAR=0. NO CARRIER Reported if loss of carrier is detected. OK Reported for either of two conditions: **1.** If a frame was received correctly. **2.** If the DTE sends any character other than XON or XOFF while the modem is in the configured flow control. ERROR Reported if a frame was received in error.

Service Class 1 Commands

Command: +FAR   Adaptive Reception Control

Description: If Adaptive Reception is enabled, the modem adaptively detects the selected message carrier or V.21 control messages. If the expected carrier is detected, the modem operates as specified in the respective +FRM=<mod or +FRH=<mod commands. If V.21 flag preamble is detected instead, the modem issues a +FRH:3 intermediate result code, and then executes an implied +FRH=3 command.

Defined Values: <value> Decimal number corresponding to the selected option.
0 Disable Adaptive Reception. (Default.)
1 Enable Adaptive Reception.

Reporting Current or Selected Values:
Command: +FAR?
Response: +FAR: <value
Example: +FAR: 0 For the default setting.

Reporting Supported Range of Parameter Values:
Command: +FAR=?
Response: +FAR: (<value> range)
Example: +FAR: (0,1)

Command: +FCL   Carrier Loss Timeout

Description: This parameter allows the DTE to select the modem's loss-of-carrier delay between initial loss-of-carrier and qualified loss-of-carrier, when the modem will give up and exit a receive mode. Intermediate (less than FCL timeout) loss-of-carrier should be indicated by insertion of the SQ-BAD signal quality indicator in the received data stream.
In unframed receive modes, if the modem detects RTC as described in Recommendation T.30 prior to initial loss of the high speed carrier, or if the modem detects V.21 carrier after initial loss of high speed carrier, then the modem immediately accepts the loss-of-carrier as qualified, without waiting for the FCL timer to expire.
In HDLC receive modes, if the modem detects HDLC abort prior to initial loss of the high speed carrier, or if the modem detects V.21 carrier after initial loss of high speed carrier, then the modem l immediately accepts the loss-of-carrier as qualified, without waiting for the FCL timer to expire.

Defined Values: <value> Decimal number representing the loss-of-carrier delay time in units of 100 ms. The range is 0 - 255.

Reporting Current or Selected Values:
Command: +FCL?
Response: +FCL: <time
Example: +FCS: 0 For the default setting.

Reporting Supported Range of Parameter Values:
Command: +FCL=?
Response: +FCL: (time range)
Example: +FCL: (0-255)

Command: +FDD   Double Escape Character Replacement

Description: This parameter conditions the use of the ˜DLE˜˜˜SUB˜ pair to encode consecutive <1/0 €<1/0 in data. This may be used to prevent unbound expansion of data that contains many <1/0 patterns.

Defined Values: <value> Decimal number corresponding to the selected option. For modem decode of <DLE><SUB>, the defined range are:
0 <DLE> <DLE> or discard (default and only)
1 <DLE> <DLE> (not supported)
For modem encoding of <1/0> <1/0>the defined values are:
0 <DLE> <DLE> <DLE> <DLE> (default and only)
1 <DLE> <SUB> (not supported)

Reporting Current or Selected Values:
Command: +FDD?
Response: +FDD: <value>
Example: +FDD: 0 For the default setting.

Reporting Supported Range of Parameter Values:
Command: +FDD=?
Response: +FDD: (<value> range)
Example: +FDD: (0)

Command: +FIT   DTE Inactivity Timeout

Description: This command specifies a DTE inactivity timeout value that allows the modem to break away from an unsuccessful connection attempt at any stage of a facsimile transfer. The DTE inactivity timer operates only while the modem is off-hook.

Defined Values: <time The <time parameter indicates the DTE inactivity timeout in seconds. The value of 0 indicates that timeout is disabled (default). The required timeout range is 1 to 255 seconds. The inactivity timer starts when the modem has taken some action that requires DTE response. If the DTE does respond, the modem resets the inactivity timer. Inactivity timer related events are listed in Table 6-3.
<action The <action parameter has two meanings.
0 Upon timeout, the modem will go on-hook, executing an implied ATH command; then reset to +FCLASS 0.
1 Upon timeout, the DCE will only go on-hook.

Reporting Current or Selected Values:
Command: +FIT?
Response: +FIT: <time ,action
Example: +FIT: 0,0 For the default settings.

Reporting Supported Range of Parameter Values:
Command: +FIT?
Response: +FIT: (<time> range), (<action> range)
Example: +FIT: (0-255),(0-1)

Table 6-3. Inactivity Timer Start and Stop Events

On-line state	Start timer event	Stop timer event
Waiting for a command	modem sends final result code	DTE sends AT or "at"
Waiting for transmit data	modem sends CONNECT after +FTM or +FTH command	DTE sends data
Waiting for transmit data	modem sends <XON or sets CTS ON	DTE sends data
Waiting to deliver received data	modem sends <XOFF after +FRM or +FRH command	DTE sends <XON
Waiting to deliver received data	DTE sets V.24 Ckt 133 OFF after +FRM or +FRH command	DTE sets V.24 Ckt 133 ON

Command: +FPR   Fixed DTE Rate

Description: This numeric extended-format parameter specifies the data rate at which the
                             modem will accept commands during on-line operation. It may be used to
                             select operation at rates at which the modem is not capable of automatically
                             detecting the data rate being used by the DTE. Specifying a value of 0
                             disables the function and allows operation only at rates automatically
                             detectable by the modem. The specified rate takes effect following the
                             issuance of any result code(s) associated with the current command line.
                             The <rate> specified does not apply in Online Data State if Normal Mode
                             (Direct Mode) of operation is selected.

Syntax: +FPR=<rate code>

Defined Values: <rate code> Specifies the DTE-modem interface operation rate in bits/s with a
                             rate code. The available rate codes are:
                             0 Automatic detection (default)
                             1 2400 bits/s (executes +IPR=2400)
                             2 4800 bits/s (executes +IPR=4800)
                             4 9600 bits/s (executes +IPR=9600)
                             8 19200 bits/s (executes +IPR=19200)
                             10 38400 bits/s (executes +IPR=38400)
                             18 57400 bits/s (executes +IPR=57400)
                             If unspecified or set to 0, automatic detection is selected and the character
                             format is also forced to autodetect, +ICF=0.
                             If the rate specified is not supported by the modem, an ERROR result code
                             will be returned.

Reporting Current or Selected Values:
                             Command: +FPR?
                             Response: <rate code>
                             Example 1: 0 For automatic rate detection.
                             Example 2: 18 For 57600 bits/s.

Reporting Supported Range of Parameter Values:
                             Command: +FPR=?
                             Response: (<rate code> range)
                             Example: (0,1,2,4,8,10,18)

Command: +FMI?   Request Manufacturer Identification

Description   This command causes the modem to report the modem product manufacturer.
Syntax: +FMI?
Typical Response: Multi-Tech
                             OK

Command: +FMM?   Request Model Identification

Description: This command causes the modem to report the modem product model.
Syntax: +FMM?
Typical Response: V90
                             OK

Command: +FMR?   Request Revision Identification

Description: This command causes the modem to transmit one or more lines of information
                             text identifying the modem version, revision level, or date.
Syntax: +FMR?
Typical Response: V3.001-V90_2M_DLS
                             OK

Command: +FLO   Flow Control

Description:	This parameter allows the DTE to identify and select the type of flow control used.
Syntax:	+FLO=<method>
Defined Values:	<method> Decimal number corresponding to the selected option.
	0 XON/XOFF and RTS/CTS flow control turned off.
	1 Use XON/XOFF flow control in either direction.
	2 Use RTS for flow control of the modem by the DTE; use CTS for flow control of the DTE by the modem.

Reporting Current or Selected Values:

Command: +FLO?

Response: +FLO: <method>

Example: +FLO: 0 For the default setting.

Reporting Supported Range of Parameter Values:

Command: +FLO=?

Response: +FLO: (<method>range)

Example: +FLO: (0-2)

Result Codes: OK <method> = 0-2.

ERROR Otherwise.

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Examples

Examples of calling (transmitting) and answering (receiving) one page using Fax Class 1 commands are shown in Table 6-4 and Table 6-5, respectively. The examples show the interchange between the DTE and the modem for various cases. Comments are included to explain how to handle various situations. Commands and responses are in upper case and comments are in lower case. All streams of data denoted by <..frame> are terminated by the <DLE><ETX> characters.

Table 6-4. Fax Class 1 Calling Sequence (Transmitting a Single Page)

DTE Commands	Modem Responses	Local Modem Action	Remote Station Action	Notes
AT+FCLASS=1	OK	Set Class 1		
ATDT<string>	CONNECT <NSF frame> <DLE><ETX> OK	Dial and send CNG Look for V.21 Detect flags	Answer send CED, V.21 Send HDLC flags Send NSF frame	AT+FRH=3 implied by dialing with +FCLASS=1.0
AT+FRH=3	CONNECT <CFI frame data> <DLE><ETX> OK	Detect flags get CSI get FCS accept FCS	send CSI frame check FCS	Frame status OK
AT+FRH=3	CONNECT <DIS frame data> <DLE><ETX> OK	Detect flags get DIS get FCS accept FCS	send DIS frame check FCS	DTE must detect final frame bit to anticipate loss of carrier
AT+FRH=3	NO CARRIER	detect loss-of-carrier	drop carrier	
AT+FRH=3 <TSI frame data> <DLE><ETX> <DCS frame data> <DLE><ETX>	CONNECT CONNECT OK	send V.21 carrier send flags send TSI frame send FCS send flags send DCS frame send FCS, flags drop carrier	detect carrier detect flags get TSI frame get DCS frame	Final frame bit clear tells the modem to expect another frame. Final frame bit set tells the modem not to expect another frame
AT+FTS=8; +FTM=96 <TCF data pattern> <DLE><ETX>	CONNECT OK	wait 80 ms send V.29 carrier send TCF data drop carrier	detect carrier get TCF data	
AT+FRH=3	CONNECT <CFR frame data> <DLE><ETX> OK	detect carrier detect flags get CFR frame check FCS accept FCS	send V.21 carrier send flags get CRF frame send FCS	Final frame bit set. frame OK
AT+FRH=3	NO CARRIER	detect loss-of-carrier	drop carrier	
AT+FTM=96 <page image data> <DLE><ETX>	CONNECT OK	send V.29 carrier send page data drop carrier	detect carrier receive page	
AT+FTS=8; +FRH=3 <EOP frame data> <DLE><ETX>	CONNECT OK	wait 80 ms send V.21 carrier send flags send EOP frame send FCS drop carrier	detect carrier detect flags receives EOP	final frame
AT+FRH=3	CONNECT <MCF frame data> <DLE><ETX> OK	detect carrier detect flags get MCF frame check FCS accept FCS	send V.21 carrier send flags get MCF frame send FCS	Final frame bit set. frame OK
AT+FRH=3	NO CARRIER	detect loss-of-carrier	drop carrier	
AT+FRH=3 <DNC frame> <DLE><ETX>	CONNECT OK	send V.21 carrier send flags send DNC frame send FCS drop carrier	detect carrier detect flags receive DC|NC	final frame
ATH0	OK	hang up	hang up	

Table 6-5. Fax Class 1 Answering Sequence (Receiving a Single Page)

DTE Commands	Modem Responses	Local Modem Action	Remote Station Action	Notes
AT+FCLASS=1	OK	Set Class 1		
	RING<-	detect ringing	dials [,send CNG]	
ATA <CSI frame data> <DLE><ETX> <DIS frame data> <DLE><ETX>	CONNECT CONNECT OK	off-hook, send CED, send V.21 carrier send flags send CSI frame send FCS send flags send DIS data send FCS and flags drop carrier	get CED, detect carrier detect flags receive CSI get FCS get flags get DIS get flags	AT+FRH=3 implied by answering with +FCLASS=1.0. not final frame final frame
AT+FRH=3	CONNECT <TSI frame data> <DLE><ETX> OK	detect carrier detect flags receive TSI receive FCS accept FCS	send V.21 carrier send flags send TSI frame send FCS	 frame OK
AT+FRH=3	CONNECT <DCS frame data> <DLE><ETX> OK	receive DCS receive FCS accept FCS	send DCS frame send FCS	final frame bit set frame OK
AT+FRH=3	NO CARRIER	detect loss-of-carrier	drop carrier	DTE did not check final frame bit and issued +FRH=3
AT+FTM=96	CONNECT <TCF data> <DLE><ETX> OK	detect carrier receive TCF detect loss-of-carrier	wait 75 ms send V.29 carrier send TCF data drop carrier	
AT+FRH=3 <CFR frame data> <DLE><ETX>	CONNECT OK	send V.21 carrier send flags get CRF frame send FCS drop carrier	detect carrier detect flags receive CFR	 final frame
AT+FTM=96	CONNECT <page image data> <DLE><ETX> NO CARRIER	detect carrier receive page detect loss-of-carrier	send V.29 carrier send page data drop carrier	
	CONNECT <EOP frame data> <DLE><ETX> NO CARRIER	detect carrier detect flags receive EOP receive FCS accept FCS	wait 75 ms send V.21 carrier send flags send EOP frame send FCS	 frame OK
AT+FRH=3	NO CARRIER	detect loss-of-carrier	drop carrier	
AT+FRH=3 <MCFame data> <DLE><ETX> 	CONNECT OK	send V.21 carrier send flags get MCF frame send FCS accept FCS	detect carrier detect flags receive MCF frame	 final frame
AT+FRH=3	CONNECT <DCN frame data> <DLE><ETX> OK	detect carrier detect flags receive DCN receive FCS accept FCS	send V.21 carrier send flags send DCN frame send FCS	 frame OK
AT+FRH=3	NO CARRIER	detect loss-of-carrier	drop carrier	end of session
ATH0	OK	hang up		

Chapter 7 – Voice Commands

Voice Commands Overview

Voice commands are identified in Table 7-1.

Table 7-1. Voice Commands

Command	Function
Configuration	
+FCLASS	Set Mode
+VCID	Caller ID (CID)
+VNH	Automatic Hang-up control
+FMI?	Manufacturer Identification
+FMM?	Product Identification
+FMR?	Version, Revision, etc.
+FLO	Flow Control
Voice	
+VIP	Voice Initialize All Parameters
+VRX	Start modem Receive (Record)
+VTS	Voice Tone Send (Send single frequency or DTMF)
+VTX	Start modem Transmit (Playback)
+VGR	Voice Gain Receive (Record Gain)
+VGT	Voice Gain Transmit (Playback Volume)
+VIT	Voice Inactivity Timer (DTE/Modem)
+VLS	Analog Source/Destination Selection
+VRA	Ringback Goes Away Timer
+VRN	Ringback Never Appeared Timer
+VSD	Silence Detection (QUIET & SILENCE)
+VSM	Compression Method Selection
+VTD	Beep Tone Duration Timer
+VDR	Distinctive Ring
+VDT	Control Tone Cadence Reporting
+VPR	Select DTE/modem Interface Rate (Turn off autobaud)

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<DLE> Shielded Event Codes Sent to the DTE

Table7-2 lists the supported <DLE> shielded codes sent to the DTE in the expression <DLE><code>. The number in parenthesis in the second column corresponds to the T.50 equivalent.

Table 7-2. Supported <DLE> Shielded Codes Sent to the DTE

Code	T.50 Equivalent	Event Report Description
<DLE>	(1/0)	Two contiguous <DLE><DLE> codes indicate a single <DLE> in the data stream
<SUB>	(1/10)	<DLE><DLE> in the data stream
<ETX>	(0/3)	End Data State
X	(5/8)	Packet Header for the "Complex Event Detection Report"
.	(2/14)	Packet Terminator for the "Complex Event Detection Report"
/	(2/15)	Start of DTMF tone shielding
~	(7/15)	DTMF transitions to off
R	(5/2)	Ring
1	(3/1)	DTMF 1
2	(3/2)	DTMF 2
3	(3/3)	DTMF 3
4	(3/4)	DTMF 4
5	(3/5)	DTMF 5
6	(3/6)	DTMF 6
7	(3/7)	DTMF 7
8	(3/8)	DTMF 8
9	(3/9)	DTMF 9
0	(3/0)	DTMF 0
A	(4/1)	Extended Keypad DTMF A
B	(4/2)	Extended Keypad DTMF B
C	(4/3)	Extended Keypad DTMF C
D	(4/4)	Extended Keypad DTMF D
*	(2/10)	Extended Keypad DTMF E
#	(2/3)	Extended Keypad DTMF F
o	(6/15)	Receive Buffer Overrun
c	(6/3)	Facsimile Calling
e	(6/5)	Data Calling
h	(6/8)	Line Current Break (local phone goes on-hook)
H	(4/8)	Line Current Detected (local phone goes off-hook)
s	(7/3)	"Presumed Hangup"(SILENCE) Time-out
q	(7/1)	"Presumed End of Message" (QUIET) Time-out
J	(4/10)	SIT Signal
l	(6/12)	Loop Current Interruption
r	(7/2)	Ringing Tone
b	(6/2)	BUSY
d	(6/4)	DIAL TONE
u	(7/5)	Transmit Buffer Underrun
p	(7/0)	Line voltage increase
P	(5/0)	Line voltage decrease (extension pickup)
a	(6/1)	Facsimile or Data Answer
f	(6/6)	Data Answer

<DLE> Shielded Codes Sent to the Modem (DCE)

Table 7-3 lists the supported <DLE> shielded codes sent to the modem in the expression <DLE><code>. The number in parenthesis in the second column corresponds to the T.50 equivalent.

Table 7-3. Supported <DLE> Shielded Codes Sent to the Modem (DCE)

Code	Code	Simple Action Command Description
<DLE>	(1/0)	Two contiguous <DLE><DLE> codes indicate a single <DLE> in the data stream ("Immediate Command" or "Stream Command")
u	(7/5)	[Action Numbers 0 and 3] Increase the volume or gain by one unit ("Immediate Command")
d	(6/4)	[Action Numbers 1 and 4] Decrease the volume or gain by one unit ("Immediate Command")
p	(7/0)	[Action Number 9] Pause
r	(7/2)	[Action Number 10] Resume
<ETX>	(0/3)	[Action Number 11] End voice Transmit State ("Stream Command")
<CAN>	(1/8)	[Action Number 12] Clear transmit buffer of voice data ("Immediate Command")
!	(2/1)	[Action Number 15] Receive abort ("Immediate Command")

Voice Configuration Commands

Command: +FCLASS=8 **Select Voice Mode**

+FCLASS=8 selects the Voice Mode. The Voice Mode commands and responses described in this section are applicable when command +FCLASS=8. (See the Generic Modem Control section for the definition of the FCLASS command.)

Command: +VNH **Automatic Hang-up Control**

This command enables or disables automatic hangups.

Syntax: +VNH=<hook>

Defined Values: <hook> Decimal number corresponds to the selected option (Table 6-4).

0   The modem enables automatic hangups as is normal in other modes.
1   The modem disables automatic hangups usually found in the other non-Voice Modes.
2   The modem disables automatic hangups in the other non-Voice Modes. The modem performs only a "logical" hangup (returns to OK result code).

Table 7-4. +VNH Command Behavior

Command	Command Response			
	No Carrier Present	ATH	ATZ	DTR & D2
+VNH=0	Y	Y	Y	Y
+VNH=1	N	Y	Y	Y
+VNH=2	N	N	N	Y

Notes:
Y= will hang-up; N= will not hang-up.
How +VNH is reset:
    DTE uses +VNH command to change setting.
    DTE issues another +FCLASS mode change without issuing another +VNH.
    A hang-up event occurs (see this table).
            DTE issues +VIP command.

Reporting Current or Selected Values:
    Command: +VNH?
    Response: <hook>
    Example: 0 For the default setting.
Reporting Supported Range of Parameter Values:
    Command: +VNH=?
    Response: (<hook> range)
    Example: (0-2)
Result Codes: OK <hook> = 0-2.
    ERROR Otherwise.

Basic Voice Commands

Command: +VIP   **Voice Initialize All Parameters**

Description: his command causes the modem to initialize all voice parameters to their default values.
Syntax: +VIP
Result Code: OK
    ERROR If not in Voice Mode.

Command: +VRX   **Start Modem Receive (Record):**

Description: This command causes the modem to start the voice reception process.
Syntax: +VRX
Result Codes: OK
    ERROR If not in Voice Mode.

Command: +VTS   **Send Voice Tone(s)**

Description: This command causes the modem to send DTMF digit or hookflash tones with the duration specified by +VTD, to send DTMF digit or hookflash tones with duration specified by this command, or to send single or dual tone frequencies with duration specified with this command.
Syntax: +VTS=<string>
Defined Values: <string>   The tone generation consists of elements in a list where each element is separated by a comma. Each element can be:
1. A single character which the modem interprets as a DTMF digit (0 - 9, #, *, or A-D) or hookflash (!), with a duration given by the +VTD command.
2. A 3-element string enclosed in square brackets, "[freq1,freq2,dur]", which the modem interprets as a general dual tone and duration selection, or
3. A 2-element string enclosed in curly braces, "{X,dur}", which the modem interprets as a DTMF digit (0 - 9, #, *, or A-D), or hookflash (!) with a duration (dur) different than that given by the +VTD command.

Missing subparameters assume the default value. Unspecified values always default to zero 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 3-element list (freq1,freq2,dur), which can be used to send single or dual tones. The first element is the first frequency (freq1) with range 0 or 200-3000 Hz. The second element is the second frequency (freq2), with range 0 or 200-3000 Hz. The third element is the duration (dur) in 0.01 second intervals with range 0-255 (ASCII units of 10 ms). A list may contain null elements. For example [3000] means that the DCE generates a single tone at 3000 Hz for the default duration, [3000,3300] means that the DCE generates a dual tone at 3000 and 3300 Hz for the default duration, and [,3300] means that the DCE generates a single tone at 3300 Hz for the default duration.

The quantity in the curly braces consists of a 2-element list (X,dur), which can be used to send DTMF tones or hookflash. The first element is the DTMF tone or hookflash (!) character (X), and the second element is the duration (dur) in 0.01 seconds. The characters are of the same set given above. A list may contain null elements. For example, {2} means DTMF tone "2" for the default duration, and {} 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.

Reporting Supported Range of Parameter Values:

     Command: +VTS=?

     Response: (<freq1> range), (<freq2> range), (<dur> range)

     Example: (200-3000),(200-3000),(0-255)

     OK

Result Codes: OK Valid command.

     ERROR The <string> command is invalid, or a selected frequency is out of range.

Example 1.   This example illustrates tone generation without using any null elements.

     The command example is followed by a description of command execution.

      AT+VTS= {!,30},1,2,[1000,1300,50],!,{*,6},[800,1300,50],9

     1. Hookflash with a duration of 300 ms.

     2. Play DTMF 1 with duration given by the +VTD command.

     3. Play DTMF 2 with duration given by the +VTD command.

     4. Play tone pair at 1 000 Hz and 1 300 Hz with a duration of 500 ms.

     5. Hookflash with duration given by the +VTD command.

     6. Play DTMF * with duration of 60 ms.

     7. Play tone pair at 800 Hz and 1300 Hz with duration of 500 ms.

     8. Play DTMF 9 with duration given by the +VTD command.

Example 2.   This example illustrates tone generation using null elements. The command

     example is followed by a description of command execution.

      AT+VTS=1,2,[1000,1300,50],[800],9

     1. Play DTMF 1 with duration given by the +VTD command.

     2. Play DTMF 2 with duration given by the +VTD command.

     3. Play tone pair at 1000 Hz and 1300 Hz with a duration of 500 ms.

     4. Play tone pair at 800 Hz with duration given by the +VTD command.

     5. Play DTMF 9 with duration given by the +VTD command.

Example 3.   This example illustrates tone generation using null elements and periods of

     silence. The command example is followed by a description of command execution.

      AT+VTS=1,[,,50],2,[],9

     1. Play DTMF 1 with duration given by the +VTD command.

     2. Play silence with duration of 500 ms.

     3. Play DTMF 2 with duration given by the +VTD command.

     4. Play silence with duration given by the +VTD command.

     5. Play DTMF 9 with duration given by the +VTD command.

Command: +VTX Start Modem Transmit (Playback)

Description: This command causes the modem to start the voice transmission process.

Syntax: +VTX

Result Codes: CONNECT The modem accepts the command.

     ERROR The modem is not connected to at least one off-hook telephone line

     or one non-telephone line.

Command: +VGR Voice Gain Receive (Record Gain)

Description: This command causes the modem to set the gain for received voice samples.

Syntax: +VGR=<gain> 0 (only valid number) selects automatic gain control

Reporting Current or Selected Values:

     Command: +VGR?

     Response: <gain>

     Example: 0 For the default setting.

Reporting Supported Range of Parameter Values:

     Command: +VGR=?

     Response: <gain> range

     Example: 0

Result Codes: OK <gain> = 0.

     ERROR Otherwise, or if not in Voice Mode.

Command: +VGT   Voice Gain Transmit (Playback Volume)

Description: This command causes the modem to set the volume level.
Syntax: +VGT=<level>
Defined Values: <level> Decimal number corresponding to the volume level.
Reporting Current or Selected Values:
    Command: +VGT?
    Response: <level>
    Example: 128 For the default setting.
Reporting Supported Range of Parameter Values:
    Command: +VGT=?
    Response: <level> range
    Example: 0-255
Result Codes: OK <level> = 0-255.
    ERROR Otherwise, or if not in Voice Mode.

Command: +VIT   Voice Inactivity Timer (DTE/Modem)

Description: This command sets the modem's initial value for the DTE/modem inactivity timer.
Syntax: +VIT=<timer>
Defined Values: <timer> Decimal number corresponding to the time in units of 1.0 second.
    A value of 0 disables the timer.
Reporting Current or Selected Values:
    Command: +VIT?
    Response: <timer>
    Example: 0 For the default setting.
Reporting Supported Range of Parameter Values:
    Command: +VIT=?
    Response: <timer> range
    Example: 0-255
Result Codes: OK <timer> = 0-255.
    ERROR Otherwise, or if not in Voice Mode.

Command: +VLS   Analog Source/Destination Selection

Description: This command causes the modem to select one or more source/destinations of the analog data.

Syntax: +VLS=<label>

Defined Values: <label> Decimal number corresponding to the selected analog source/destination hardware configuration (see Table 6-5).
Response: <label>
Example: 0   For the default setting.

Reporting Supported Range of Parameter Values:

Command: +VLS=?

Response: <label>,<devices>,<transmit event>,<receive event>,<idle event>
Where each event subparameter is a hex number the represents an event bit field of the reporting capabilities of each state. (See Table 6-6):
<label> Identifies the modem analog source/destination hardware configuration.
<devices> A <string constant> made up of Primitives,
<xxxx event> <transmit event>, <receive event>, and <idle event>subparameters are the DCE event reporting capabilities for the Voice Transmit State, Voice Receive State, and the Voice Command State, respectively. Each of the event reporting subparameters is a hex number that represents an event bit field. The hex number format is defined in Table 6-6); a one in the bit field indicates that the DCE can report the associated event. Each of the possible hardware configurations has its own <label>, ..., <idle event> description line (the above form description shows just one). A <CR><LF> terminates each description line.

Example: AT+VLS=?
0,"",B0804100,B0804100,B0804100
1,"T",0B8433C1,0FE431C1,0B8431C1
2,"L",08800300,0CE00100,08800100
3,"LT",0B8433C1,0FE431C1,0B8431C1
4,"S",00800300,04E00100,20800100
5,"ST",0B8433C1,0FE431C1,0B8431C1
8,"S1",00800300, 04E00100,20800100
9,"S1T",0B8433C1,0FE431C1,0B8431C1
11,"M1",00800300,04E00100,20800100
14,"H",00800300,04E00100,20800100
18,"M1S",00800300,04E00100,20800100
19,"M1S1",00800300,04E00100,20800100

Result Codes: OK <label> = 0-5,8-9,11,14,18-19.
ERROR The <label> value is out of range, or if the modem cannot service the request in the <label> subparameter.

Table 7-5. +VLS Command Options

Label	Primitives	Description	+VTX	+VRX	+VSP=1
0	None	DCE on-hook. Local phone connected to the line.			
1	T	DCE off-hook. DCE connected to the line. Local phone provided with power to detect hook condition.	X	X	
2	L	DCE on-hook. Local phone connected to the DCE.	X	X	
3	LT	DCE off-hook. Local phone connected to the line. DCE connected to the line.	X	X	
4	S	Internal Speaker connected to the DCE. DCE on-hook. Local phone connected to the line.	X		
5	ST	Internal Speaker connected to the line. DCE off-hook. DCE connected to the line. Local phone provided with power to detect hook condition.	X	X	
6	M	Internal Microphone connected to the DCE. DCE on-hook. Local phone connected to the line.		X	
7	MST	Internal Microphone and Internal Speaker connected to the line. DCE off-hook. DCE connected to the line. Local phone provided with power to detect hook condition.			X
8	S1	External Speaker connected to the DCE. DCE on-hook.	X		

Label	Primitives	Description	+VTX	+VRX	+VSP=1
		Local phone connected to the line.			
9	S1T	External Speaker connected to the line. DCE off-hook. DCE connected to the line. Local phone provided with power to detect hook condition.	X	X	
10	MS1T	Internal microphone and External Speaker connected to the line. DCE off-hook. DCE connected to the line. Local phone provided with power to detect hook condition.			X
11	M1	External Microphone connected to the DCE. DCE on-hook. Local phone connected to the line.		X	
12	M1ST	External Microphone and Internal Speaker connected to the line. DCE off-hook. DCE connected to the line. Local phone provided with power to detect hook condition.			X
13	M1S1T	External Microphone and External Speaker connected to the line. DCE off-hook. DCE connected to the line. Local phone provided with power to detect hook condition.			X
14	H	External Microphone and Speaker combination (handset or headset) connected to the DCE. DCE on-hook. Local phone connected to the line.	X	X	
15	HT	External Microphone and Speaker combination (handset or headset) connected to the line. DCE off-hook. DCE connected to the line. Local phone provided with power to detect hook condition.	X	X	
16	MS	MS Internal Microphone and Internal Speaker connected to DCE.			
17	M1S	MS1 Internal Microphone and External Speaker connected to DCE.			
18	MS1	External Microphone and Internal Speaker connected to DCE.			
19	M1S1	External Microphone and External Speaker connected to DCE.			

Primitives (Column 2):
   L Local Phone.
   T Telephone Line.
   M Internal Microphone.
   M1 External Microphone.
   S Internal Speaker.
   S1 External Speaker.
   H External Microphone and Speaker combination (handset or headset).
      Note: All label options in this table may not be supported by the product; see +VLS command

Table 7-6. Events Detectable in the Voice Mode per V.253

Event Number	Event Description	Event Reporting
0	Caller Id Report	Message
1	DID Report	Message
2	Distinctive Ringing	Pattern
3	RING	Simple
4	DTMF Received	Simple
5	Receive Buffer Overrun	Simple
6	Facsimile Calling (e.g., 1100 Hz)	Simple
7	Data Calling (e.g., 1300 Hz)	Simple
8	Local Phone On/Off-hook	Simple
9	Presumed Hangup (SILENCE) Time-out	Simple
10	Presumed End of Message (QUIET) Time-out	Simple
11	SIT Signal	Simple, Message
12	Bong Tone	Simple
13	Loop Current Interruption	Simple
14	Loop Current Polarity Reversal	Simple
15	Call Waiting Beep/Interrupt	Simple
16	Distinctive Call Waiting	Simple
18	Ringing Tone	Simple
19	BUSY	Simple
20	DIAL TONE	Simple
21	Reorder/Fast Busy	Simple
22	V.21 Channel 2 7E flags	Simple
23	Transmit Buffer Underrun	Simple
24	Extension Phone On/Off-hook	Simple
25	Facsimile or Data Answer (e.g., 2100 Hz)	Simple
26	Data Answer (e.g., 2225 Hz)	Simple
27	Voice Detect	Simple
29	Stuttered Dial tone	Simple (note 1)
30	Invalid Voice Data Format	Simple
31	Lost Data Detected Event	Simple
32	Facsimile Answer	Simple

Legend:

This table lists events without any regard as to whether the DCE reporting of the event is optional or mandatory, and without assigning a DCE reporting mechanism.

The first column lists the event number assignment for each event. The event number also serves another purpose; each number is a bit position in a bit field. Event number 0 is the most significant bit of the left most hex number in a hex representation (V.253 defines a total of eight hex digits). The final bit in the bit field occupies the least significant bit position of the right-most hex number. The bit representations of the event numbers are used in the +VLS= command.

The third column lists whether a single character is enough to report the event, or if the DCE must supply a more complicated report. The description Simple indicates a single character response (<DLE> shielded), Message indicates a full text message (<DLE><X> packet), and Pattern indicates a repeating Message.

Notes:

1. The use of complex event reporting for Stuttered Dial tone is for further study.

Command: +VRA   Ringback Goes Away Timer

Description: This command sets the length of time the modem will wait between ringbacks
during call origination before the modem can assume that the remote station
has gone off-hook.

Syntax: +VRA=<interval>

Defined Values: <interval> Decimal number (0-255) specifying the silence interval time in units
of 0.10 second between the end of one ring interval and the start of the next
ring interval. A value of 0 forces the modem to report the OK result code
immediately after the first Ringback. The range is 0.1 to 25.5 seconds for
<interval> = 1 to 255.

Reporting Current or Selected Values:
Command: +VRA?
Response: <interval>
Example: 50 (5 seconds) For the default setting.

Reporting Supported Range of Parameter Values:
Command: +VRA=?
Response: (<interval> range)
Example: (0-255) 255 = 25.5 sec

Result Codes: OK <interval> = 0-255
ERROR Otherwise, or if not in Voice Mode.

Command: +VRN   Ringback Never Appeared Timer

Description: This command sets the length of time the modem will wait between ringbacks
during call origination before the modem can assume that the remote station
has gone off-hook.

Syntax: +VRN=<interval>

Defined Values: <interval> Decimal number specifying the time period, in units of 1.0 second,
that the modem will wait for Ringback during call origination. A value of 0
forces the modem to report the OK result code immediately after dialing. The
range is 1 to 25 seconds for <interval> = 1 to 25.

Reporting Current or Selected Values:
Command: +VRN?
Response: <interval>
Example: 10 (10 seconds) For the default setting.

Reporting Supported Range of Parameter Values:
Command: +VRN=?
Response: (<interval> range)
Example: (0-25)

Result Codes: OK <interval> = 0-25
ERROR Otherwise, or if not in Voice Mode.

Command: +VSD   Silence Detection (Quiet and Silence)

Description: This command causes the modem to set 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" (QUIT)
or "Presumed Hangup (SILENCE) event reports.

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

Defined Values: <sds> Decimal number corresponding to the selected parameter.
0 Use +VSM silence compression setting and algorithm for long-term silence
detection (if +VSM is in use) or proprietary silence compression setting and
algorithm for long-term silence detection (if +VSM is not in use).
127 Sets less aggressive long-term silence detection independent of
presence or use of silence compression.
128 Sets nominal long-term silence detection independent of presence or use
of silence compression.

129 Sets more aggressive long-term silence detection independent of presence or use of silence compression.

<sdi> Decimal number specifying the required period of silence, in units of 0.1 second, before the modem can report silence detected at the end of a voice receive either with the "Presumed End of Message" (QUIT) or "Presumed Hangup (SILENCE) event reports. A value of 0 disables the modem silence detection. The range is 0.1 to 25.5 seconds for <sdi> = 1 to 255.

Reporting Current or Selected Values:

Command: +VSD?
Response: <sds>,<sdi
Example: 0,50 For the default setting.

Reporting Supported Range of Parameter Values:

Command: +VSD=?
Response: (<sds> range),(<sdi> range)
Example: (0,127-129),(0-255)

Result Codes:

OK <hook> = 0 or 1.
ERROR Otherwise, or if not in Voice Mode.

Command: +VSM   Compression Method Selection

Description: This command causes the modem to set the voice compression method, the silence compression sensitivity, and the voice-sampling rate.

Syntax: +VSM=<cml>,<vsr>,<sds>,<sel>

Defined Values: <cml> Decimal number identifying the compression method.

<vsr> <range of values> containing the supported range of voice samples per second of the analog signal.

<scs> <range of values> containing the supported range of sensitivity settings for voice receives.

<sel> <range of values> containing the supported range of expansion values for voice transmits.

Reporting Current or Selected Values:

Command: +VSM?
Response: <cml>,<vsr>,<sds>,<sel>
Example: 1,8000,0,0 For the default setting.

Reporting Supported Range of Parameter Values:

Command: +VSM=?
Response: <cml>,<cmid>,<bps>,<tm>,<vsr>,<sds>,<sel>

<cml> Decimal number identifying the compression method (1, 129, 130, 140, or 141).

<cmid> Alphanumeric string describing the compression method (UNSIGNED PCM, IMA ADPCM, UNSIGNED PCM, 2 Bit ADPCM, or 4 Bit ADPCM).

<bps> Decimal number defining the average number of bits in the compressed sample not including silence compression (2, 4 or 8).

<tm> Decimal number (0) reporting the time interval, in units of 0.1 second, between timing marks. A 0 value reports that timing marks are not supported.

<vsr> <range of values> containing the supported range of voice samples per second of the analog signal (8000).

<scs> <range of values> containing the supported range of sensitivity settings for voice receives (0). A 0 indicates not supported.

<sel> <range of values> containing the supported range of expansion values for voice transmits (0). A 0 indicates not supported.

Example: 1,"UNSIGNED PCM",8,0,8000,0,0
129,"IMA ADPCM",4,0,8000,0,0
130,"UNSIGNED PCM",8,0,8000,0,00
140,"2 Bit ADPCM",2,0,8000,0,0
141,"4 Bit ADPCM",4,0,8000,0,0
OK

Result Codes: OK Valid range.
ERROR Otherwise, or if not in Voice Mode.

Command: +VTD   Beep Tone Duration Timer

Description:	This command causes the modem to set the default DTMF/tone generation duration.
Syntax:	+VTD=<dur>
Defined Values:	<dur> Decimal number specifying the default DTMF/tone generation duration in units of 0.01 second. A value of 0 specifies the value entered by the S11 parameter (50-255 ms). The range is 0.01 to 2.55 seconds for <dur> = 1 to 255.

Reporting Current or Selected Values:
>Command: +VTD?
>Response: <dur>
>Example: 100 For the default setting.

Reporting Supported Range of Parameter Values:
>Command: +VTD=?
>Response: (<dur> range)
>Example: (0-255)

Result Codes:	OK <dur>= 0-255. ERROR Otherwise, or if not in Voice Mode.

Command: +VDR   Distinctive Ring

Description:	This 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.
Syntax:	+VDR=<enable>, <report>
Defined Values:	<enable> Decimal number corresponding to the selected option. 0 The modem will not report ring cadence information. 1 The modem will report ring cadence information as specified for the <report> subparameter. <report> Decimal number specifying ring cadence information report when enabled by the <enable> subparameter. 0 The modem will produce only DROF and DRON messages. The modem will not produce any RING event codes. The modem will report other call progress event codes as normal. Other The modem will produce only DROF and DRON messages. The modem will produce a RING event code after <report>/10 seconds after the falling edge of the ring pulse (i.e., after the DRON report).

Reporting Current or Selected Values:
>Command: +VDR?
>Response: <enable>,<report>
>Example: 0,0 For the default setting.
>Reporting Supported Range of Parameter Values:
>Command: +VDR=?
>Response: (<enable> range),(<report>range)
>Example: (0,1),(0-6)

Result Codes:	OK <enable>,<report> = (0,1),(0-6) ERROR Otherwise, or if not in Voice Mode.

Command: +VDT   Control Tone Cadence Reporting

Description:	his command is included for compatibility only and has no effect other than returning a result code.
	This command allows the modem to enable or disable reporting of the control tone cadence information in the frequency band used by the Ringback/Remote Ring, BUSY, and reorder/Fast Busy tones (usually in the 300 to 600 Hz range).
Syntax:	+VDT=<enable>,<report>
Defined Values:	<enable> Decimal number corresponding to the selected option.
	0 The modem will not produce any control tone cadence report.
	<report> Decimal number specifying the produced any control tone cadence report when enabled by the <enable> subparameter.
	0 The modem will produce only CPOF and CPON messages.
	Other Reserved.

Reporting Current or Selected Values:
Command: +VDT?

Response: <enable>,<report>
Example: 0,0 For the default setting.

Reporting Supported Range of Parameter Values:
Command: +VDT=?
Response: (<enable> range),(<report> range)
Example: (0),(0)

Result Codes: OK <enable>,<report> = (0),(0)
ERROR Otherwise, or if not in Voice Mode.

Command: +VPR   Select DTE/Modem Interface Rate (Turn Off Autobaud)

Description:	This command selects the DTE/modem interface rate.
Syntax:	+VPR=<rate>
Defined Values:	<rate>> Decimal number corresponding to the DTE/modem interface rate where 0 = autobaud rate determined by processing the AT command, and 1,2,3,4,8,16,24,48,96 correspond to multipliers of 2400 bps to determine the actual rate:

      0 = Autobaud
      1 = 2400 bps
      2 = 4800 bps
      3 = 7200 bps
      4 = 9600 bps
      8 = 19200 bps
      16 = 38400 bps
      24 = 57600 bps
      48 = 115200 bps
      96 = 230400 bps

Reporting Current or Selected Values:
Command: +VPR?
Response: <rate>
Example: 0 For the default setting (Autobaud).

Reporting Supported Range of Parameter Values:
Command: +VPR=?
Response: (<rate> range)
Example: (0,1,2,3,4,8,16,24,48,96)

Result Codes: OK <rate> = 0,1,2,3,4,8,16,24,48,96.
ERROR Otherwise, or if not in Voice Mode.

Chapter 8 – Setting Country Codes

The Default Country Code is B5.

If You Want to Change the Country Code

1. View the List of Available Country Codes by executing the command **AT+GCI=?<CR>**
2. Set and save the country code by executing the command **AT+GCI=*nn*<CR>**
   Note: *nn* is the country code.
3. **OK** is displayed.
4. The country code is then displayed (see the example below).

To Verify the Country Code

1. Type **AT+GCI?<CR>**, or you can
   type **ATI5<CR>**

Example

1. Type the command **AT+GCI=B5<CR>**
2. Verify **B5** was set by typing **AT+GCI?<CR>** or **ATI5<CR>**
3. **B5** indicates the configuration is set for any **B5** country such as **Canada** or the **United States**, etc.

Country Codes Supported

The list below describes the country code settings for the countries that Multi-Tech currently supports.

Country	Country Code	Country	Country Code
Argentina	07	Philippines	B5
Australia	09	Portugal	FD
Austria	FD	Slovak Republic	FD
Belgium	FD	Spain	FD
Canada	B5	Sweden	FD
China	B5	Switzerland	FD
Cyprus	FD	Taiwan	FE
Czech Republic	FD	United Kingdom	FD
Denmark	FD	United States	B5
Finland	FD		
France	FD		
Germany	FD		
Greece	FD		
Hong Kong	99		
Hungary	FD		
Iceland	FD		
Indonesia	99		
Ireland	FD		
Italy	FD		
Japan	00		
Korea	B5		
Liechtenstein	FD		
Luxembourg	FD		
Mexico	B5		
Netherlands	FD		
New Zealand	7E		
Norway	FD		

Appendix A – Mechanical Details

Test/Demo Board Components
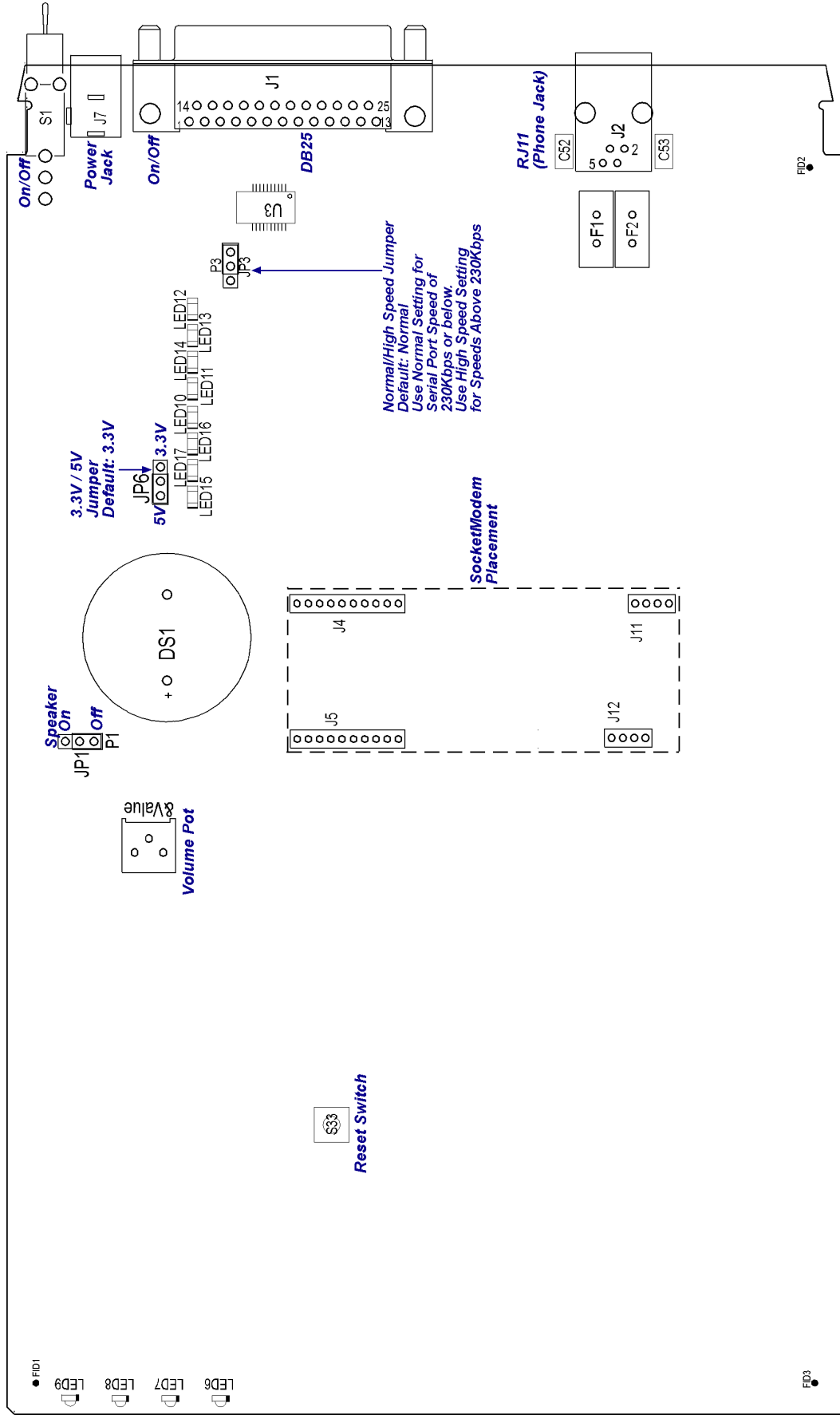
5V / 3.3V Jumper – JP6

The operating voltage factory default setting is 3.3V operation. The JP1 jumper must be set to 3.3-volt operation.

Warning – Be sure to that 5V/3.3V jumper is set 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 Systems, Inc. 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 the SocketModem. The transformer connector is keyed to prevent improper connection to the Test/Demo board.

Serial Test/Demo Board Block Diagram
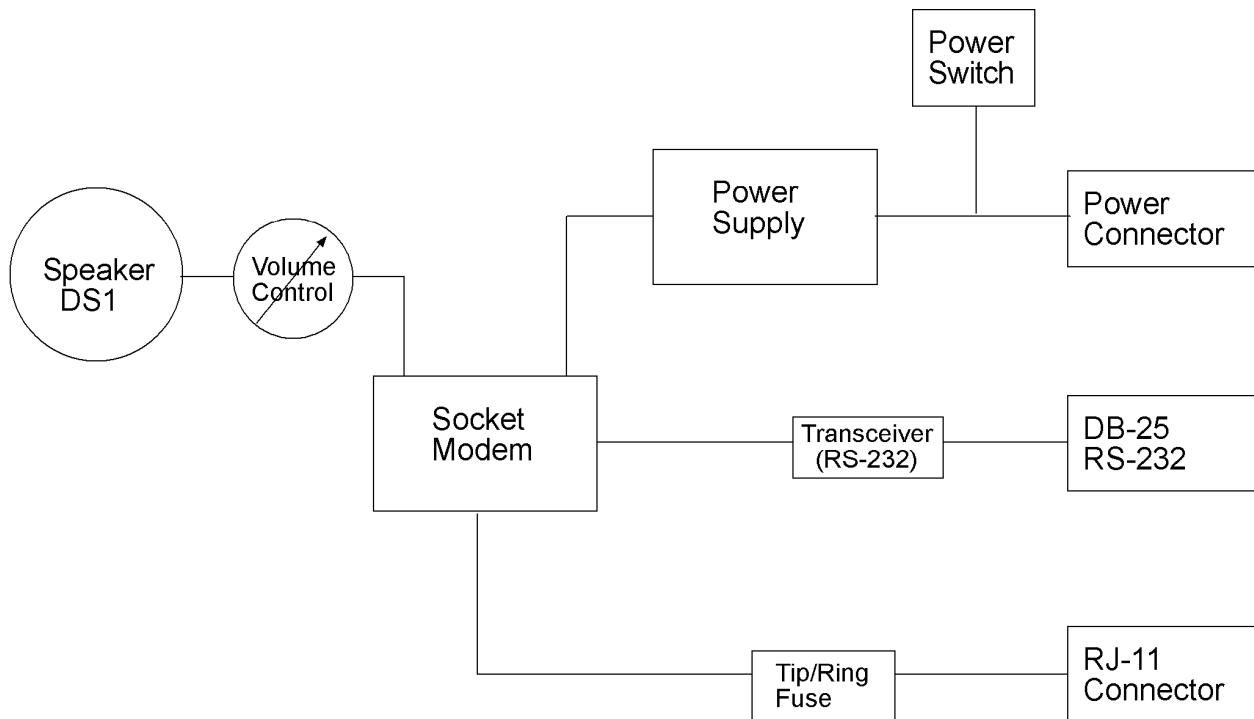
Serial Test/Demo Board Block Diagram

Parallel Test/Demo Board Block Diagram
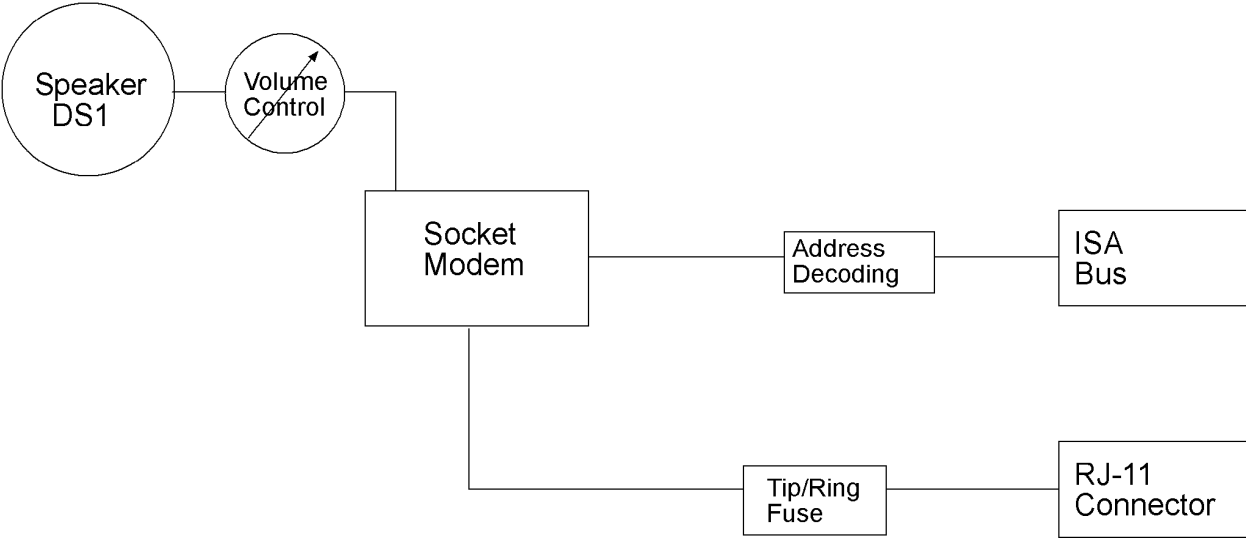
Parallel Test/Demo Board Block Diagram

Appendix B - Safety/EMC Approvals, Design Considerations, and Regulatory Compliance

Approvals – Product Safety and EMC

Safety Certifications
UL 60950
EN 60950
CSA 950
AS 3260
CCC
EMC Approvals
FCC Part 15 (Class B)
Canada (Class B)
EN 55022 (Class B)
EN 55024

Telecom Certifications

We are continually working to extend this list. Please contact your Multi-Tech sales representative to get an updated list. Telecom Certifications as of August 3, 2003.

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

Regulatory Design Considerations

This section discusses hardware considerations, safety, 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.
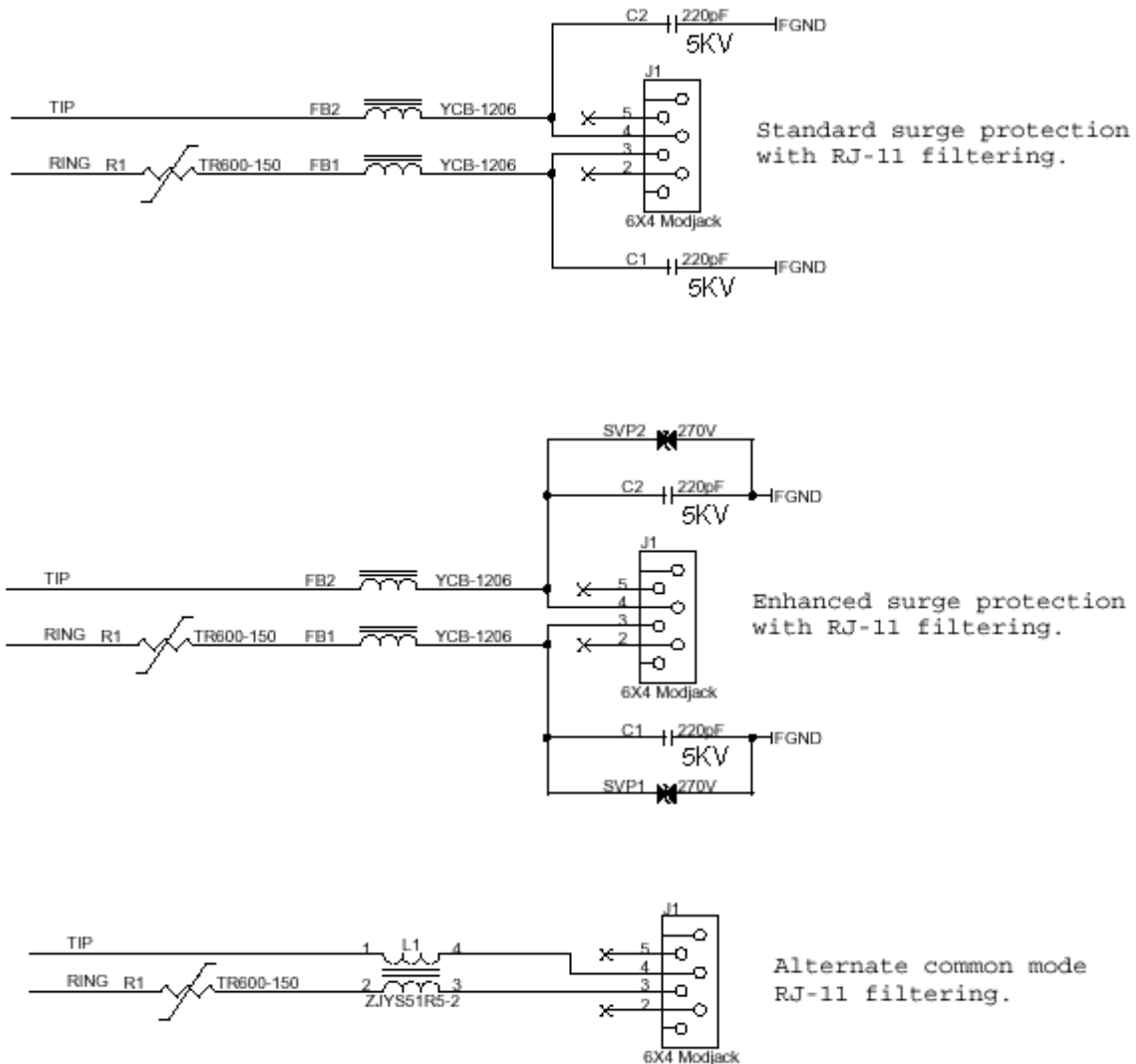
Figure B–1. Recommended Main Board Filtering

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 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 – NOVACAP – Part # - ESZZ11NKES50ZNXT
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.

Recommended Connector
Manufacturer – Stewart – Part # - SS-6446-NF-A431

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

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.

Common Mode Choke
Manufacturer – TDK – Part # - ZJYS51R5-2PT

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

Recommended Transceiver
Manufacturer – Analog Devices – Part # - ADM207EAR

Other Design Considerations

Good engineering practices must be adhered to when designing a printed circuit board (PCB) containing the SocketModem module. Suppression of noise is essential to the proper operation and performance of the modem itself and for surrounding equipment.

Two aspects of noise in an OEM board design containing the SocketModem must be considered: on-board/off-board generated noise that can affect digital signal processing. Both on-board and off-board generated noise that is coupled on-board can affect interface signal levels and quality. Of particular concern is noise in frequency ranges affecting modem performance.

On-board generated electromagnetic interference (EMI) noise that can be radiated or conducted off-board is a separate, but equally important, concern. This type of noise can affect the operation of surrounding equipment. Most local government agencies have stringent certification requirements that must be met for use in specific environments.

Proper PC board layout (component placement, signal routing, trace thickness and geometry, etc.) component selection (composition, value, and tolerance), interface connections, and shielding are required for the board design to achieve desired modem performance and to attain EMI certification.

The aspects of proper engineering practices are beyond the scope of this designer guide. The designer should consult noise suppression techniques described in technical publications and journals, electronics and electrical engineering text books, and component supplier application notes.

PC Board Layout Guidelines

In a 2-layer design, provide an adequate ground grid in all unused space around and under components on both sides of the board and connect in such a manner as to avoid small islands. A grid is preferred over a solid plane to improve solderability. Typically, the grid is composed of 0.012-inch traces and 0.012- inch spaces on a 0.025-inch grid. Connect each grid to other grids on the same side at several points and grids on the opposite side through the board at several points.

In a 4-layer design, provide adequate ground plane covering the entire board. In 4-layer designs, power and ground are typically on the inner layers. All power and ground traces should be 0.05 inches wide.

Tip and Ring signal traces are to be no closer than 0.062 inches to any other traces for U.S. applications. Tip and Ring signal traces are to be no closer than 0.078 inches (2.0 mm) from any other traces or ground circuits for European applications. 2.0 mm spacing must be used if the host board is to support both U.S. and European SocketModem applications.

If the SocketModem is mounted flush with the host PCB, the host PCB should be clear of all traces directly underneath the SocketModem oscillator section (under the chip). It is strongly recommended that the SocketModem be mounted at least 0.130 inch above the host PCB.

The recommended hole size for the SocketModem pins is 0.036 in. +/-0.003 in. in diameter. Spacers can be used to hold the SocketModem vertically in place during the wave solder process. A spacer should be placed on pin 32 and pin 64 of the SocketModem. A suggested part number for the spacer is BIVAR 938-0.130 for P1(0.310in) option SocketModems. The spacers can be left on permanently and will not effect operation.

Electromagnetic Interference (EMI) Considerations

The following guidelines are offered to specifically help minimize EMI generation. Some of these guidelines are the same as, or similar to, the general guidelines but are mentioned again to reinforce their importance. In order to minimize the contribution of the SocketModem-based design to EMI, the designer must understand the major sources of EMI and how to reduce them to acceptable levels.

1. Keep traces carrying high frequency signals as short as possible.

2. Provide a good ground plane or grid. In some cases, a multilayer board may be required with full layers for ground and power distribution.

3. Decouple power from ground with decoupling capacitors as close to the SocketModem module power pins as possible.

4. Eliminate ground loops, which are unexpected current return paths to the power source and ground.

5. Decouple the telephone line cables at the telephone line jacks. Typically, use a combination of series inductors, common mode chokes, and shunt capacitors. Methods to decouple telephone lines are similar to decoupling power lines, however, telephone line decoupling may be more difficult and deserves additional attention. A commonly used design aid is to place footprints for these components and populate as necessary during performance/EMI testing and certification.

6. Decouple the power cord at the power cord interface with decoupling capacitors. Methods to decouple power lines are similar to decoupling telephone lines.

7. Locate high frequency circuits in a separate area to minimize capacitive coupling to other circuits.

8. Locate cables and connectors so as to avoid coupling from high frequency circuits.

9. Lay out the highest frequency signal traces next to the ground grid.

10. If a multilayer board design is used, make no cuts in the ground or power planes and be sure the ground plane covers all traces.

11. Minimize the number of through-hole connections on traces carrying high frequency signals.

12. Avoid right angle turns on high frequency traces. Forty-five degree corners are good; however, radius turns are better.

13. On 2-layer boards with no ground grid, provide a shadow ground trace on the opposite side of the board to traces carrying high frequency signals. This will be effective as a high frequency ground return if it is three times the width of the signal traces.

14. Distribute high frequency signals continuously on a single trace rather than several traces radiating from one point.

Safety

All creepages and clearances for the MT5600SMI have been designed to meet requirements of safety standards EN60950. 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.

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.
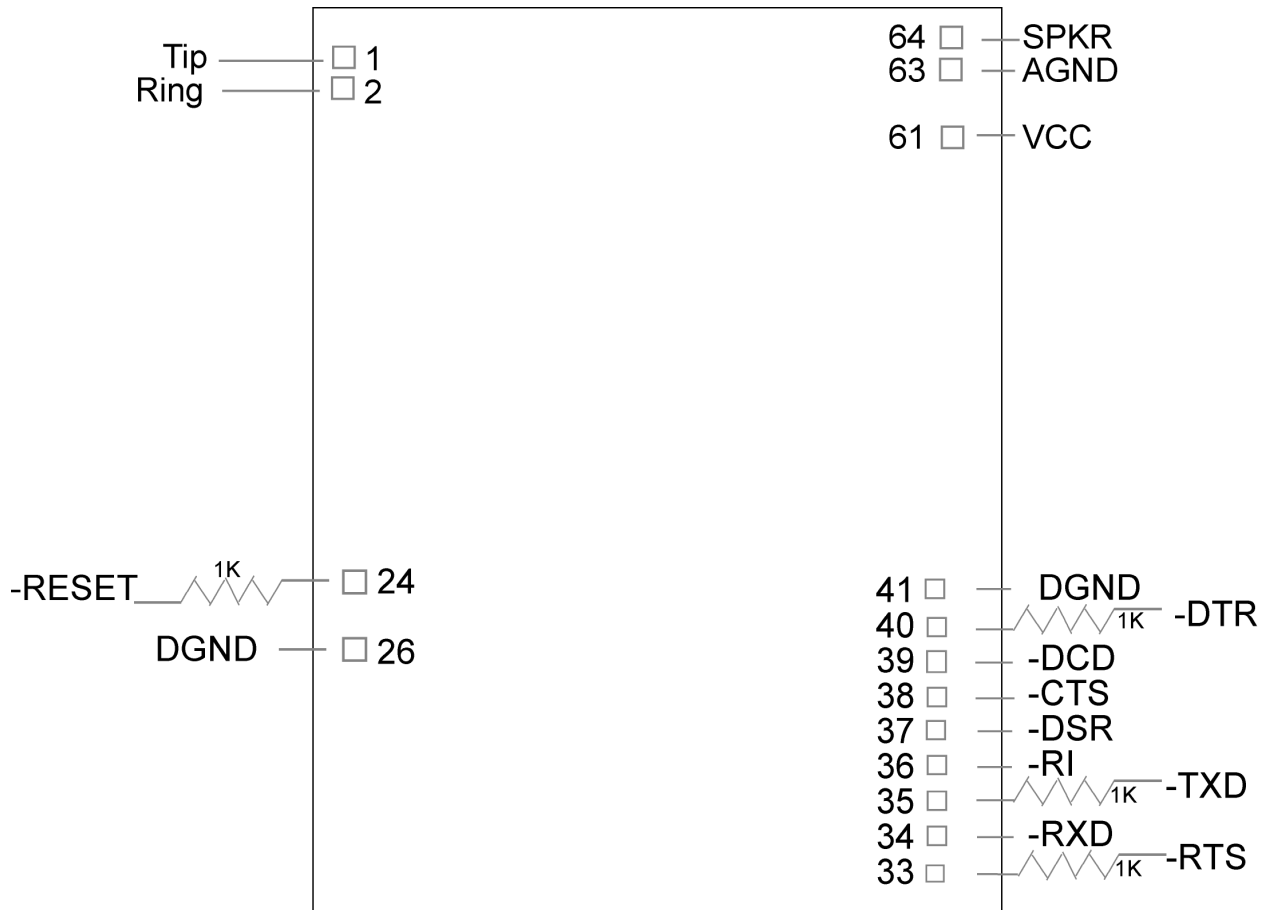
Regulatory Compliance

Regulatory Requirements for the United States

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.

47 CFR Part 68 Telecom

1. This equipment complies with Part 68 of the 47 CFR rules and the requirements adopted by the ACTA. Located on this equipment is a label that contains, among other information, the registration number and ringer equivalence number (REN) for this equipment or a product identifier in the format:

   > For current products is **US:AAAEQ##Txxxx**.
   > For legacy products is **AU7USA-xxxxx-xx-x**.

   If requested, this number must be provided to the telephone company.
2. A plug and jack used to connect this equipment to the premises wiring and telephone network must comply with the applicable 47 CFR Part 68 rules and requirements adopted by the ACTA. It's designed to be connected to a compatible modular jack that is also compliant.
3. The ringer equivalence number (REN) is used to determine the number of devices that may be connected to a telephone line. Excessive RENs on a telephone line may result in the devices not ringing in response to an incoming call. In most but not all areas, the sum of RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to a line, as determined by the total RENs, contact the local telephone company. For products approved after July 23, 2001, the REN for this product is part of the product identifier that has the format US:AAAEQ##Txxxx. The digits represented by ## are the REN without a decimal point (*e.g.*, 03 is a REN of 0.3). For earlier products, the REN is separately shown on the label.
4. 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 isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.
5. 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 to maintain uninterrupted service.
6. If trouble is experienced with this equipment, please contact Multi-Tech Systems, Inc. at the address shown below for details of how to have the repairs made. If the equipment is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.
7. Connection to party line service is subject to state tariffs. Contact the state public utility commission, public service commission or corporation commission for information.
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. If your home has specially wired alarm equipment connected to the telephone line, ensure the installation of this equipment does not disable your alarm equipment.
   If you have questions about what will disable alarm equipment, consult your telephone company or a qualified installer.
10. Connection to party line service is subject to state tariffs. Contact the state public utility commission, public service commission or corporation commission for information.
11. This equipment is hearing aid compatible.
12. Manufacturing Information:

Manufacturer:	Multi-Tech Systems, Inc.
Trade Name	SocketModem
Model Number:	MT5600SMI
Registration No:	AU7USA-46014-MD-E
Ringer Equivalence:	0.1B
Modular Jack (USOC):	RJ11
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

Current Label Content and Format as of August 2003

Approved terminal equipment and approved protective circuitry shall prominently display the following information using the format shown below:

- Responsible party
- Product Identification
- Equipment Code
- Ringer Equivalence
- Ringer Type
- Indication that the product meets the requirements of 47 CFR Part 68

The information required by the first five items shall correspond to the records in the ACTA database of approved equipment. The required information shall be encoded in the following format: **US:AAAEQ##Txxxx**

Where:

- *US* is a fixed field that indicates the equipment meets all requirements of 47 CFR Part 68 (including the requirements published by ACTA).
- **AAA** is the responsible party's Grantee Code obtained previously from the FCC's Common Carrier Bureau or currently from ACTA.
- **EQ** is an Equipment Code indicating to the Service Provider any special signal handling or billing requirements. The Equipment codes are listed in Annex A (normative).
- **##** is the Ringer Equivalence Number without a decimal point (e.g. REN of 1.0 = 10, REN of 0.3 = 03). In the case of a "Z" ringer, ZZ shall appear. In the case of approved equipment without a network interface and equipment not connecting to circuits with analog ringing supplied then "NA" shall appear.
- **T** is the ringer type letter associated with the Ringer Equivalence Number, in accordance with the technical requirements. In the case of approved equipment without a network interface and equipment not connecting to circuits with analog ringing supplied, the letter "N" shall appear.
- **xxxx** is a product identifier, unique when combined with the responsible party's Grantee Code, of at least one and up to nine alphanumeric characters (including one or more dashes (-) if desired. A dash shall not appear as the first or last character nor shall the identifier consist entirely of dashes). The responsible party shall define this identifier.

Label Physical Characteristics

The information required above shall be permanently affixed and legible without magnification. It may be 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 shall be able to last for the expected lifetime of the equipment and shall not be readily detachable.

Labeling Continuity and Changes

The labeling content and format requirements in effect when a product was approved shall be effective for the life of the product. The labeling content and format requirements in effect at approval shall also continue to be effective for modified products. However, the responsible party shall have the option of conforming a product's labeling to current content and format requirements at any time.

Other Label Requirements

The label shall be placed in one of the following locations in a location where it can be found after installation:

- on an outside surface
- inside a readily available access door or panel
- on another readily accessible surface

For example, the label should not be placed on the rear of a permanently wall-mounted device in a manner such that it is not readily accessible.

Regulatory Requirements for Canada

The following requirements are established under section 69.3 of the *Telecommunications Act* for purposes of section 5 of the *Telecommunications Apparatus Regulations*.

Registered equipment shall bear the following identifying marks, and the Declaring Party shall ensure that these marks are permanently affixed to the equipment:

(a) The registration number — Specifications of this mark are given in the document: *Self-Marking of the Certification/Registration Number on Terminal Equipment — Application Procedure and Agreement*; and

(b) The model identification number under which the product was registered.

A statement of compliance with Industry Canada requirements, such as the one given below, shall accompany each unit of equipment whether registered under this procedure or previously certified:

"This product meets the applicable Industry Canada technical specifications"

For terminal equipment intended for connection to loop-start or ground-start interfaces, the Ringer Equivalence Number (REN) must be calculated as per Section 1.8 of CS-03, Part I. A REN higher than that determined may be assigned by manufacturers to allow for production variations. The REN must be marked on the terminal equipment itself or added to the note below. A note similar to the following shall accompany each unit of equipment whether registered under this procedure or previously certified:

"The Ringer Equivalence Number is an indication of the maximum number of devices 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 RENs of all the devices does not exceed five".

Pursuant to section 69.3 of the *Telecommunications Act*, Certified or self-declared TE will bear a valid identifying certification or registration number. The marking of the certification or registration number on the product shall be as follows:

(a) TAC holder/DP will be responsible for permanently affixing the certification/registration number on the TE. The certification/registration number (see example below) identifies Certified or self-declared TE to the public, representatives of the telecommunications common carriers, the Department, and other interested parties. The letter height must be no less than 1.5 mm and the letters must be legible without magnification.

(b) For integrated devices, e.g. a modem or one that is intended to become a sub-assembly of host equipment e.g. a data terminal, computer etc. that are designed to interface directly with the network, the certification/registration number shall be affixed to the integrated device itself.

(c) The certification/registration number for a packaged TE will denote that the total package has been registered. However, the marking will normally be placed on that unit of the package, which connects to the network. For example, in a PBX, the marking will be placed on the common equipment, which connects to the network, rather than on plug-in components which may be added later. The Terminal Equipment List will show the common equipment but not the standard station apparatus or any proprietary station apparatus.

(d) The marking format of the certification/registration number is as follows:
    IC: XXXXXX-YYYYYYYY
    Where:
    - The letters "IC" have no other meaning or purpose than to identify the Industry Canada certification/registration number, and
    - "XXXXXX-YYYYYYYY" is the certification/registration number; "XXXXXX" is the Company Number[1] (CN); it consists of up to six alphanumeric characters (A-Z, 0-9) assigned by Industry Canada; and "YYYYYYYY" is the Unique Product Number (UPN); it consists of up to eight alphanumeric characters (A-Z, 0-9) assigned by the applicant. Other characters, (such as & # *-) may not be used. Alphabetic characters must be capitalized.

    Note: The Company Number of registered equipment ends with an alphabetic character.

(e) Certification Numbers granted prior to the implementation of the above marking format are grandfathered.

(i) For previously certified TE, the self-marking format shall consist of the old certification number preceded by "IC:" For example, if the certification number is "123 1234 A", then the self-mark would read "IC: 123 1234 A".

(ii) For a new model that is registered to a family of previously certified TE, the self-marking format shall be:

IC: XXXXXX-ZZZZZZZZ

Where:

- "XXXXXX" is the Company Number, as in (d) above ; and
- "ZZZZZZZZ" is either the old certification number minus the old company number, or a new Unique Product Number assigned by the applicant. For example, if a new model is registered to the family of products with certification number "123 1234 A", and that the Company Number for the registration is "123A", then the self-mark for this new model would read "IC: 123A-1234 A". If the applicant decides to replace "1234 A" with a new UPN, say "5678", then the self-mark would read "IC: 123A-5678".

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.

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.

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 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.

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 Statement

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

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.

$C \, \epsilon$

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.

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