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**SocketModem™**

**Embedded Modem**

**MT2456SMI-22**

**Serial Interface**

**Developer's Guide**



**SocketModem™****MT2456SMI-22  
Developer's Guide**

PN S000281A, Version A

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This device covered by one or more of the following patents: 6,031,867; 6,012,113; 6,009,082; 5,905,794; 5,864,560; 5,815,567; 5,815,503; 5,812,534; 5,809,068; 5,790,532; 5,764,628; 5,764,627; 5,754,589; 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

The Multi-Tech SocketModem supports analog data modem operation with V.22bis Fast Connect, V.42bis data compression, and V.80 synchronous access mode. The SocketModem is a space-efficient (1" × 2.5"), embedded modem that is ready-to-integrate into your applications; therefore, dramatically reducing development time and costs for system designers. The SocketModem also complies with telecom requirements globally and can be shipped worldwide.

This guide provides the information needed to effectively integrate the SocketModem into your equipment. It also includes the AT commands for the configuration and control of a data modem and the result codes that the modem issues in response to the commands.

## *Product Description*

The MT2456SMI SocketModem is a standard 64-pin modem used for integrating data communications. It is a single-port 5V or 3.3V modem that integrates a modem controller, DSP, and DAA in a 1" x 2.5" form factor and communicates to a host controller via an asynchronous serial interface.

A SocketModem kit is available. It includes one development board with an RS-232 DB-25 connector, wall power adapter, RJ-11 jack, and RS-232 cable.

## *Technical Specifications*

The SocketModem meets the following specifications:

<b>Client-to-Server Data Rates</b>	V.22 bis
<b>Client-to-Client Data Rates</b>	2400, 1200, 0-300 bps
<b>Data Format</b>	Serial, asynchronous
<b>Modem Compatibility</b>	V.22bis, V.22; Bell 212A and 103/113; ITU-T V.21 & V.23
<b>Error Correction</b>	ITU-T V.42 (LAP-M or MNP 2–4)
<b>Data Compression</b>	ITU-T V.42bis
<b>Speed Conversion</b>	Serial port data rates adjustable to 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 57,600, and 115,200
<b>Modes of Operation</b>	Full duplex over dial-up lines; data mode, command mode, and online command mode
<b>Flow Control</b>	XON/XOFF (software), RTS/CTS (hardware)
<b>Command Buffer</b>	50 characters
<b>Transmit Level</b>	–12 dBm (varies by country setting)
<b>Frequency Stability</b>	±0.01%
<b>Receiver Sensitivity</b>	–43 dBm under worst-case conditions
<b>Interface</b>	Serial ITU-T V.24 logical interface
<b>Diagnostics</b>	Local analog loop
<b>Weight</b>	0.02 Kg. (0.04 lb.)
<b>Dimensions</b>	1.045" × 2.541" × 0.680" (2.7 x 6.5 x 1.8 cm)
<b>Power Consumption</b>	Typical: 70 mA (.235 W @ 3.3V DC); Maximum: 80 mA (.264 W @ 3.6V DC)
<b>Operating Voltage</b>	Typical: 3.3V DC +/- 5%; Absolute Maximum Supply Voltage: 3.7 V DC
<b>Operational Temperature</b>	0 to +70° C ambient under closed conditions; humidity range 20% to 90% (non-condensing)
<b>Storage Temperature</b>	–10° to +85° C
<b>Intelligent Features</b>	TIA-602 command compatible V.22bis fast connect Supports V.80 Supports Fast POS 9600 Line polarity reversal detection Line current loss detection Line-in-use detection during on-hook operation Extension pickup detection Call waiting detection Caller ID (US configuration only) DTMF detection autodial, redial pulse or tone dial auto answer call status display

# Chapter 2 – Mechanical Specifications

## *Physical Dimensions*

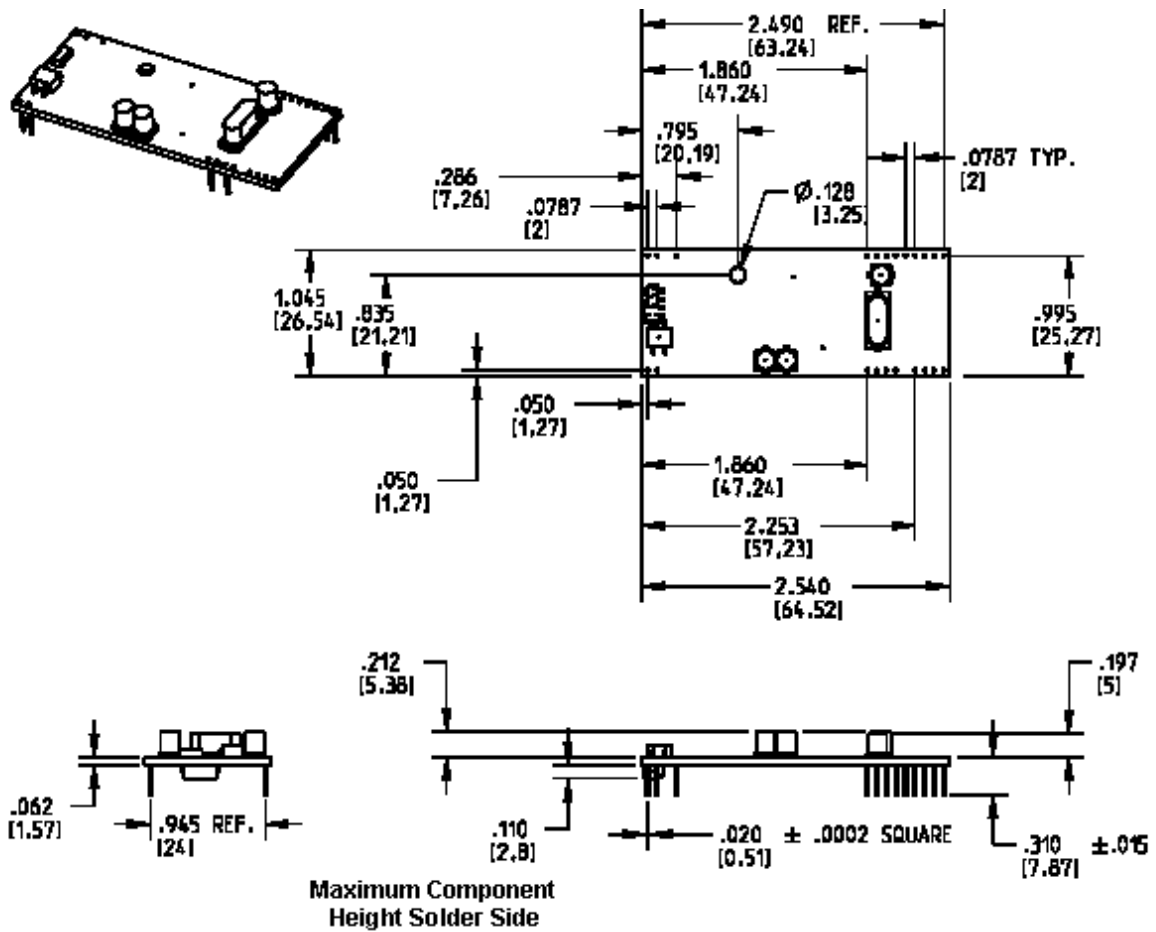


Figure 2-1. Maximum Component Height

## Pin Configurations

The **MT2456SMI** SocketModem with a serial interface use a 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.

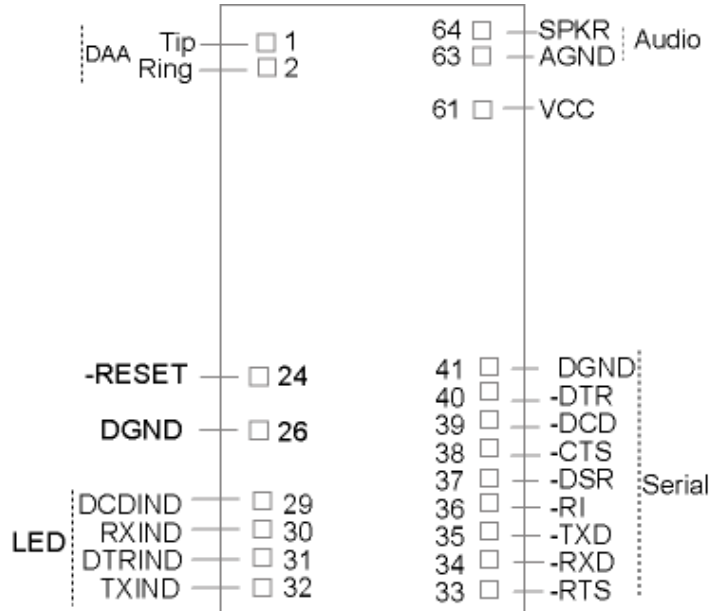


Figure 2–2. Serial SocketModem Pins

## Pin Descriptions

Pin #	Signal Name	I/O Type	Description
1	Tip	I/O	<b>Tip Signal from Telco.</b> Tip connection to the phone line (RJ11 Pin 3). SocketModem is Tip/Ring is polarity insensitive.
2	Ring	I/O	<b>Ring Signal from Telco.</b> Ring connection to the phone line (RJ11 Pin 4). SocketModem is Tip/Ring is polarity insensitive.
24	–RESET	I	<b>Modem Reset (with weak pull-up).</b> 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 250 ms 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		<b>Ground.</b>
29	DCDIND		<b>DCD LED Indicator.</b>
30	RXIND		<b>RXD LED Indicator.</b>
31	DTRIND		<b>DTR LED Indicator.</b>
32	TXIND		<b>TXD LED Indicator.</b>
33	–RTS	I	<b>Request to Send.</b> RTS signal is used for hardware flow control.
34	–RXD	O	<b>Received Data.</b> 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	<b>Transmit Data.</b> 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	<b>Ring Indicate.</b> -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	<b>Data Set Ready.</b> -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	<b>Clear To Send.</b> -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	<b>Data Carrier Detect.</b> -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	<b>Data Terminal Ready (Active Low).</b> 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		<b>Ground.</b>
61	VCC		<b>3.3V DC Power.</b>
63	AGND		<b>Analog Ground.</b> Analog ground is tied common with DGND on the SocketModem. To minimize potential ground noise issues, connect audio circuit return to AGND.
64	SPKR		<b>Speaker Output.</b> 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.



# Chapter 3 – Electrical Characteristics

## 3.3V and 5V Serial SocketModem

3.3V DC Characteristics (TA = 0°C to 70°C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

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

<b>Inputs</b>	<b>Input High</b>	<b>Input Low</b>	
-DTR (40), -TXD (35), -RTS (33), -RESET (24)	Min 2.0 V	Max 0.8 V	
<b>Outputs</b>	<b>Output High</b>	<b>Output Low</b>	
-DCD (39), -CTS (38), -DSR (37), -RI (36), -RXD (34) 2mA, Z <sub>INT</sub> = 120 Ω	Min 2.4 V	Max 0.4 V	
Digital Input Capacitance			50pF

## 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.

# Chapter 4 - V.22bis Commands, S-Registers, and Result Codes

The V.22bis Commands are covered in the following order in this chapter:

## Generic Modem Control Commands

Z	Soft Reset and Restore Profile
+VCID	Caller ID
+VRID	Report Retrieved Called ID
\N	Operating Mode - Error Correction
I	Identification
+GCI	Country of Installation
&F	Restore Factory Configuration (Profile)
&T	Local Analog Loopback Test
**	Load to Internal RAM

## DTE/DCE Commands

E	Echo
Q	Quiet Result Codes
V	Result Code Form
W	Connect Message Control
X	Extended Result Codes (& Call Progress Information)
&C	RLSD Option
&D	DTR Option
&K	Flow Control
&R	RTS/CTS Option
\G	Modem-to-Modem Flow Control (XON/XOFF)
+IFC	DTE-Modem Local Flow Control
+IBC	In Band Commands

## Call Control Commands

D	Dial
T	Set Tone Dial (Default)
P	Set Pulse Dial
A	Answer
H	Disconnect (Hang Up)
O	Return to On-line Data Mode
L	Monitor Speaker Volume
M	Monitor Speaker Mode Control
&G	Select Guard Tone
&P	Select Pulse Dial Make/Break Ratio
&V	Display Current Configuration and Stored Profiles
%L	Report Line Signal Level
%Q	Report Line Signal Quality
*B	Display Blacklisted Numbers
*D	Display Delayed Numbers
-STE	Set Telephony Extension
+PCW	Call Waiting Enable
+VDR	Distinctive Ring

## Modulation Control Commands

+MS	Modulation Selection
%E	Enable/Disable Line Quality Monitor
B	ITU-T or Bell

**Error Control and Data Compression Commands**

+ESR	Select Repeat
\B	Transmit Break to Remote
\K	Break Control

**Synchronous Access Mode Commands**

+ESA	Configure Synchronous Access Submode
+ITF	Transmit Flow Control Thresholds

**Fast Connect Command**

\$F	Fast Connect Control
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**Line Side Device Commands**

-TTE	Threshold Adjustments for Telephony Extension
-TRV	Tip and Ring Voltage Measurement

**A Note About Compatibility Commands**

You may notice that some commands are available but do not support any function. These commands exist for compatibility purposes only. If you enter these commands, you may receive an OK result; however, no changes are made to the configuration or control of the modem. Examples of these commands are:

**Y, &S, &V1, +VDT, and \A,**

## *V.22bis Generic Modem Control Commands*

### **Z Soft Reset and Restore Profile**

This command causes the modem to perform a soft reset and restore (recall) the factory default configuration (profile). If no <value> is specified, zero is assumed.

**Syntax** Z<value>

#### **Defined Values**

<value> Decimal number corresponding to the selected profile.

- 0 Soft reset and restore stored profile.
- 1 Same as 0; allowed for compatibility.

**Result Codes** OK <value> = 0 or 1  
ERROR Otherwise

### **+VCID Caller ID (CID)**

This command 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.

**Syntax** +VCID=<pmode>

#### **Defined Values**

<pmode> Decimal number corresponding to the selected option.

- 0 Disable Caller ID reporting. (Default).
- 1 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).
- 2 Enables Caller ID with unformatted presentation to the DTE.

#### **Reporting Current or Selected Values**

Command: +VCID?

Response: +VCID: <pmode>

Example: +VCID: 0 For the default setting.

#### **Reporting Supported Range of Parameter Values**

Command: +VCID=?

Response: +VCID: (<pmode> range)

Example: +VCID: (0-2)

### **+VRID Report Retrieved Caller ID (CID)**

This command reports the data associated with the Caller ID services in the Incoming Call Line ID (ICLID) data format for the last received call.

**Syntax** +VRID=<pmode>

#### **Defined Values**

<pmode> Decimal number corresponding to the selected option.

- 0 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).
- 1 Reports Caller ID with unformatted presentation to the DTE.

#### **Reporting Supported Range of Parameter Values**

Command: +VRID=?

Response: +VRID: (<pmode> range)

Example: +VRID: (0,1)

### **\N Operating Mode**

This command controls the preferred error-correcting mode to be negotiated in a subsequent data connection.

**Syntax** \N<mode>

#### **Defined Values**

<mode> Decimal number which corresponds to the selected mode.

- 0 Selects normal speed buffered mode (disables error-correction mode). (Forces &Q6.)
- 1 Serial interface selected - Selects direct mode and is equivalent to &M0, &Q0 mode of operation. (Forces &Q0.)

- 2 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.)
- 3 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.)
- 4 Selects LAPM error-correction mode. Failure to make an LAPM error-correction connection results in the modem hanging up. (Forces &Q5 and S48=0.)
- 5 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 <mode> = 0 to 5  
ERROR Otherwise

## I Identification

This command causes the modem to reports the requested result according to the command parameter.

**Syntax** I<value>

### Defined Values

<value> Decimal number corresponding to the selected information.

- 0 Reports product code, e.g., "2400".
- 1 Reports the least significant byte of the stored checksum in decimal. Reports 255 if the prestored checksum value is FFh.
- 2 Reports "OK".
- 3 Reports identification codes.  
RevisionName = masked firmware code version. Example: Patton Modulation = V.22bis  
Example:  
Patton-V22B
- 4 Reports OEM defined identifier string in either Hayes-compatible binary format (default), e.g.: a007040284C6002FbC60000000r10051111510120003000111170000000
- 5 Reports Country Code parameter (see +GCI).
- 6 Reports "OK".
- 7 Reports "OK".

**Result Codes** OK <value> = 0 - 7  
ERROR Otherwise

## +GCI Country of Installation

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. Additional country profiles can be uploaded and existing ones can be modified by minor firmware upgrade via SRAM patch.

**Syntax** +GCI=<country\_code>

### Country Code

Japan 00  
Argentina 01  
Taiwan 02  
New Zealand 03  
Singapore 04  
Australia 09  
Euro/NAM B5  
International 99  
Malaysia 6C  
South Africa 9F

**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).

### Reporting Current or Selected Values

Command: +GCI?

Response: +GCI: <current country\_code>

Example: +GCI: B5 The modem is set for U.S.

### Reporting Supported Range of Parameter Values

Command: +GCI=?

Response: +GCI: (<country\_code>[,<country\_code>[,<country\_code>].....])

Example: +GCI: (00,B4,B5) The modem can be set for Japan, United Kingdom, or the United States.

**&F Restore Factory Configuration (Profile)**

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.

**Syntax** &F[<value>]

**Defined Values**

<value> Decimal number corresponding to the selected configuration.

0 Restore factory configuration 0.

1 Same as 0; allowed for compatibility.

**Result Codes** OK

ERROR If the modem is connected

**&T Local Analog Loopback Test**

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.

**Syntax** &T[<value>]

**Defined Values**

<value> Decimal number corresponding to the selected option.

0 Terminates test in progress. Clears S16.

1 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.

**\*\* Load to Internal RAM**

This command allows the internal SRAM to be loaded with patch code for minor firmware upgrade including country profile customization. This process transfers the S37 file from the host computer to the modem. The data transfer is done via an ASCII transfer. A successful upload can be verified by invoking AT13 and/or AT14 command depending on which of the two were modified. The patch is erased when the power is turned off.

**Procedure**

1. Configure the communications application program for a DTE rate of 115200 bps.  
Check the modem for response by typing AT.
2. Issue AT\*\* command to initiate the download process. The following message appears:  
*Download initiated.*
3. Send the patch code (e.g., patv00028.s37). The following message appears on successful upload:  
*Modem Firmware Successfully Loaded*

## *V.22bis DTE/DCE-Modem Interface commands*

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

### **E**      **Command Echo**

The modem enables or disables the echo of characters to the DTE. The valid parameter value is written to S14 bit 1.

**Syntax** E<value>

#### **Defined Values**

<value> Decimal number corresponding to the option.

0 Disables command echo.

1 Enables command echo. (Default)

**Result Codes**    OK <value> = 0 or 1  
                      ERROR Otherwise

### **Q**      **Quiet Result Codes Control**

The command enables or disables the sending of result codes to the DTE. The parameter value, if valid, is written to S14 bit 2.

**Syntax** Q<value>

#### **Defined Values**

<value> Decimal number corresponding to the option.

0 Enables result codes to the DTE. (Default)

1 Disables result codes to the DTE.

**Result Codes**    OK <value>= 0 or 1  
                      ERROR Otherwise

### **V**      **Result Code Form**

This command selects the sending of short-form or long-form result codes to the DTE. The parameter, if valid, is written to S14 bit 3.

**Syntax** V<value>

#### **Defined Values**

<value> Decimal number corresponding to the selected option.

0 Enables short-form (terse) result codes. Line feed is not issued before a short-form result code.

1 Enables long-form (verbose) result codes. (Default)

**Result Codes**    OK <value>= 0 or 1  
                      ERROR Otherwise

### **W**      **Connect Message Control**

This command, in conjunction with S95 bits 0, 2, and 3, (bits 2 and 3 can be written directly by the host), control the format of CONNECT messages. The actual result code messages reported reflect the W command setting and the S95 bit settings.

The W parameter value, if valid, is written to S31 bits 2 and 3.

**Syntax** W<value>

#### **Defined Values**

<value> Decimal number corresponding to the selected option.

0 Upon connection, the modem reports only the DTE speed (e.g., CONNECT 19200). Subsequent responses are disabled. (Default)

1 Upon connection, the modem reports the modulation, line speed, the error correction protocol, and the DTE speed, respectively. Subsequent responses are disabled.

2 Upon connection, the modem reports the DCE speed (e.g., CONNECT 2400). Subsequent responses are disabled.

**Result Codes**    OK <value> = 0, 1, or 2  
                      ERROR Otherwise

**X Extended Result Codes**

This command 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.

**Syntax** X<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 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.
- 1 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.
- 2 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 101b is written to S22 bits 6, 5, and 4, respectively.
- 3 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.
- 4 Enables reporting of busy tones; send all messages. The value 111b is written to S22 bits 6, 5, and 4, respectively. (Default)

**Result Codes** OK <value> = 0 to 4  
ERROR Otherwise

**Table of Result Codes**

Short Form	Long Form	n Value in ATXn Command				
		0	1	2	3	4
0	OK	X	X	X	X	X
1	CONNECT	X	X	X	X	X
2	RING	X	X	X	X	X
3	NO CARRIER	X	X	X	X	X
4	ERROR	X	X	X	X	X
5	CONNECT 1200	1	X	X	X	X
6	NO DIAL TONE	3	3	X	X	X
7	BUSY	3	3	3	X	X
8	NO ANSWER	X	X	X	X	X
9	CONNECT 600	1	X	X	X	X
10	CONNECT 2400	1	X	X	X	X
11	CONNECT 4800	1	X	X	X	X
12	CONNECT 9600	1	X	X	X	X
13	CONNECT 7200	1	X	X	X	X
14	CONNECT 12000	1	X	X	X	X
15	CONNECT 14400	1	X	X	X	X
16	CONNECT 19200	1	X	X	X	X
17	CONNECT 38400	1	X	X	X	X
18	CONNECT 57600	1	X	X	X	X
19	CONNECT 115200	1	X	X	X	X
22	CONNECT 75TX/1200RX	1	X	X	X	X
23	CONNECT 1200TX/75RX	1	X	X	X	X
24	DELAYED	4	4	4	4	X
32	BLACKLISTED	4	4	4	4	X
40	CARRIER 300	X	X	X	X	X
41	CARRIER 1200/75	X	X	X	X	X



Short Form	Long Form	n Value in ATXn Command				
		0	1	2	3	4
42	CARRIER 75/1200	X	X	X	X	X
46	CARRIER 1200	X	X	X	X	X
47	CARRIER 2400	X	X	X	X	X
67	PROTOCOL: V42	X	X	X	X	X
70	PROTOCOL: NONE	X	X	X	X	X
83	LINE IN USE	X	X	X	X	X
85	OFF-HOOK INTRUSION	X	X	X	X	X
86	LINE REVERSAL DETECTED	X	X	X	X	X
87	NO LINE	X	X	X	X	X

**Note:**  
An 'x' in a column indicates that the message (either the long form if verbose, or the value only for short form) will be generated when that particular value of 'n' (shown at the top of the column) has been selected by the use of ATXn. If the column is blank, then no message will be generated for that x option. A numeral indicates which less explicit message (verbose or short form) will be output for that X option.

**&C RLSD Option**

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

**Syntax** &C<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 RLSD remains ON at all times.
- 1 RLSD follows the state of the carrier. (Default)

**Result Codes** OK 0 or 1  
ERROR Otherwise

**&D DTR Option**

This command 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.

**Syntax** &D<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 DTR drop is interpreted according to the current &Qn 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.
- 1 DTR drop is interpreted according to the current &Qn 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 drop causes the modem to hang up. Auto-answer is inhibited.
- 2 DTR drop is interpreted according to the current &Qn setting as follows:
  - &Q0 through &Q6: DTR drop causes the modem to hang up. Auto-answer is inhibited. (Default)
- 3 DTR drop is interpreted according to the current &Qn setting as follows:
  - &Q0, &Q1, &Q5, &Q6: DTR drop causes the modem to perform a soft reset as if the Z command were received.
  - &Q2, &Q3: DTR drop causes the modem to hang up. Auto-answer is inhibited.

**&K Flow Control**

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

**Syntax** &K<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 Disables flow control.
- 3 Enables RTS/CTS flow control. (Default for data modem modes.)
- 4 Enables XON/XOFF flow control.
- 5 Enables transparent XON/XOFF flow control.

**Result Codes** OK <value> = 0, 3, 4, or 5  
ERROR Otherwise

**&R    RTS/CTS Option**

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.

**Syntax** &R<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 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.
- 1 In sync mode, CTS is always ON and RTS transitions are ignored. In async mode, CTS is normally ON and will turn OFF only if required by flow control.

**Result Codes**    OK <value> = 0 or 1  
                   ERROR Otherwise

**\G    Modem-to-Modem Flow Control (XON/XOFF)**

The modem enables or disables the generation or recognition of modem-to-modem XON/XOFF flow control according to the parameter supplied. The parameter value, if valid, is written to S41 bit 3.

Due to the buffering system used in the modem, modem-to-modem flow control is normally disabled.

**Syntax** \G<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 Disables modem-to-modem XON/XOFF flow control. (Default.)
- 1 Enables modem-to-modem XON/XOFF flow control.

**Result Codes**    OK <value> = 0 or 1  
                   ERROR Otherwise

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

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.

**Syntax** +IFC=[<modem\_by\_DTE>,<DTE\_by\_modem>]

**Defined Values**

<modem\_by\_DTE> Specifies the method to be used by the DTE to control the flow of received data from the modem.

- 0 None.
- 1 XON/XOFF on transmitted data (XON/XOFF on transmit data); do not pass XON/XOFF characters to the remote modem.
- 2 Circuit 133 (Ready for Receiving). (Default)
- 3 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

<DTE\_by\_modem> Specifies method to be used by the modem to control the flow of transmitted data from the DTE.

- 0 None.
- 1 XON/XOFF on received data.
- 2 CTS/RTS. (Default)

**Reporting Current or Selected Values**

Command: +IFC?

Response: +IFC: <modem\_by\_DTE>,<DTE\_by\_modem>

Example: +IFC: 2,2 For the defaults.

**Reporting Supported Range of Parameter Values**

Command: +IFC=?

Response: +IFC: (<modem\_by\_DTE> range),(<DTE\_by\_modem> range)

Example: +IFC: (0-3),(0-2)

**+IBC In Band Commands**

This command provides a mechanism by which an in-band secondary channel may be implemented. This in-band secondary channel can be utilized to transparently exchange commands and responses to/from the modem during a data connection. This is an alternative approach to using the +++ escape sequence. The +IBC command also provides a mechanism to exchange V.24 signaling via the secondary channel. The primary reason the In Band Channel is implemented is to retrieve Caller ID type II information. The supported In Band Channel command is compatible with the ITU-T V.80 standard but is not a full V.80 implementation. The V.80 protocol supported is described below. Portions of the V.80 protocol not described are not supported. Please refer Section 7 of the ITU-T V.80 standard for more details..

**Syntax** +IBC=<IB>,<105>,<106>,<107>,<108>,<109>,<110>,<125>,<132>,<133>,<135>,<142>,<hook>

**Defined Values**

- <IB> Enables or disables in-band control sequence.
  - 0 Disable in-band control sequences.
  - 1 Enable 7-bit in-band control sequences. Ignore eighth bit.
  - 2 Enable 8-bit in-band control sequences.
- <105> Enables or disables V.24 circuit type 105: RTS (Ready to Send).
  - 0 Disable in-band reporting for this circuit.
  - 1 Enable in-band reporting for this circuit.
- <106> Enables or disables the circuit type 106: CTS (Clear to Send).
  - 0 Disable in-band reporting for this circuit.
  - 2 Enable in-band reporting for this circuit.
- <125> Enables or disables the circuit type 125: RI (Ring Indicate).
  - 0 Disable in-band reporting for this circuit.
  - 1 Enable in-band reporting for this circuit.
- <other> Not supported; leave '0' for the unsupported circuit types.
- <hook> Not supported; leave '0'.

**Reporting Current or Selected Values**

Command: +IBC?

Response: +IBC=<value>.<value>,<value>,0,0,0,0,<value>,0,0,0,0

Example: +IBC=0,0,0,0,0,0,0,0,0,0,0,0

**Reporting Supported Range of Parameter Values**

Command: +IBC=?

Response: +IBC: (0-2),(0-1),(0-1),0,0,0,0,(0-1),0,0,0,0,0

**Entering and Exiting In Band Active State**

In Band Command mode will be active only when a modem connection has been made and DCD is on and the modem is not in command mode. Upon a data connection before the connect message is sent, an In Band message will be sent to the DTE to notify that all further data will be EM shielded and should be filtered. Any other time (i.e., command mode or idle mode) the DTE should allow all user data to be in pass-through mode in which the data is unfiltered.

The DTE will receive one of the following active messages:

EM<60h><26h><62h>+IBC:1 to indicate In Band is active and the server is V.92

EM<60h><26h><62h>+IBC:2 to indicate In Band is active and the server is non-V.92

Upon Hang up or escape to command mode, the In Band command mode will end and the DTE should stop filtering EM data and return to pass-through mode.

The DTE will receive the following inactive In Band message:

EM<60h><26h><62h>+IBC:0 to indicate In Band is inactive

**EM Shielding Data**

When in-band control sequences are enabled, the DTE and the modem must shield and filter data containing EM. In V.80, in-band data is shielded from normal data by an EM character represented by a <19h> or <99h>. If the DTE's data contains an EM, an additional character is inserted.

For example, sending <19h> from the DTE to the modem requires inserting a <singleEM> or <5Ch> into the data stream (e.g., <19h><5Ch>). The modem encodes this as one <19h> in the user data. On the other hand, sending <19h> from the modem to the DTE requires inserting a <singleEM> or <7Ch>. Please refer to the V.80 standard for more information.

**Table of Supported V.80 Commands**

Command	Hex Codes	Description
<b>Supported V.80 DTE-to-DCE Commands</b>		
<extend0> <length> <control> <rest of command>	<40h> <42h>	The DCE decodes this as a sequence of 3 + (<length>-1Fh).
<105off> <105on>	<42h> <43h>	Circuit 105 is OFF. Circuit 105 is ON.
<singleEMp> <doubleEMp>	<58h> <59h>	The DCE decodes this as one <99h> in user data. The DCE decodes this as <99h><99h> in user data.
<singleEM> <doubleEM>	<5Ch> <5Dh>	The DCE decodes this as on <19h> in user data. The DCE decodes this as <19h><19h> in user data.
<poll>	<5Eh>	The DCE decodes this command and deliver a set of status commands, one for each circuit enabled.
<b>Supported V.80 DCE-to-DTE Commands</b>		
<extend0> <length> <status> <rest of command>	<60h> <62h>	The DCE decodes this as a sequence of 3 + (<length>-1Fh).
<106off> <106on>	<62h> <63h>	Circuit 106 is OFF. Circuit 106 is ON.
<125off> <125on>	<6Ah> <6Bh>	Circuit 125 is OFF. Circuit 125 is ON.
<singleEMp> <doubleEMp>	<76h> <77h>	The DCE encodes this as one <99h> in user data. The DCE encodes this as <99h><99h> in user data.
<singleEM> <doubleEM>	<7Ch> <7Dh>	The DCE encodes this as on <19h> in user data. The DCE encodes this as <19h><19h> in user data.

**In Band Processing of AT Commands**

When in-band control sequences are enabled, the modem responds to EM shielded AT commands via the extend-0 CONTROL sequence. This command may be used to transmit any AT commands to the modem as follows:

EM <extend-0> <length> <CONTROL> <AT Command without AT and trailing carriage return>

Upon receipt of an in-band command, the modem responds with the extend-0 STATUS REPORT sequence. This sequence will contain the response to the AT command issued via the CONTROL sequence with the trailing <cr> <lf> omitted:

EM <extend-0> <length> <STATUS> <AT Command response without trailing LF>

Example: Send +VRID=2 command to the modem and respond with terse caller ID:

EM <60h> <27h> <42h> +VRID=2

**Note:** <length> is 27h corresponding to 27h-1Fh=8. This is the length of the sequence following the <length> octet.

The modem responds to this command by transmitting the caller ID information to the DTE via the in-band sequence:

EM <60h> <length> <62h> <raw caller ID information>

EM<60h><22h><62h>OK

In this case, the <length> octet is the actual length of the raw caller ID + 1 + 1Fh.

**In Band Signaling of CTS and Ring Indicate (Circuit 106 and Circuit 125)**

Whenever the V.24 circuit selected via the +IBC command changes, the modem will send an unsolicited EM shielded frame to the DTE to inform the DTE of the new state. This is used for CTS and RI. For MOH applications, the DTE is specifically interested in circuit 125 (Ring Indicate).

When RI is asserted, the sequence EM <125on> or 19h 6Bh is sent to the DTE.

When RI is de-asserted, the sequence EM <125off> or 19h 6Ah is sent to the DTE.

## *V.22bis Call Control Commands*

### **D Dial**

This command 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.

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 while in progress (but before the completion of the handshake) upon receipt of any DTE character.

#### **Dial Modifiers**

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

**Syntax** D<string>

#### **Defined Values**

<string> Character 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 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 Pulse dial the numbers that follow until a "T" is encountered. Affects current and subsequent dialing. Some countries prevent changing dialing modes after the first digit is dialed.

T Tone dial the 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.

! Flash. The modem will go on-hook for a time defined by the value of S29. Country requirements may limit the time imposed.

W 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 (U.S.) or S6 (other countries), the modem will abort the rest of the sequence, return on-hook, and generate an error message.

@ 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 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 (U.S. models) or S6 (other countries), the modem will abort the rest of the sequence, return on-hook, and generate an error message.

, 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.

**T Set Tone Dial Default**

This command 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

**P Set Pulse Dial Default**

This command 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

**A Answer**

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 country-specific requirements.

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.

**H Disconnect (Hang-Up)**

This command initiates a hang up sequence. It may not be available for some countries due to PTT restrictions.

**Syntax** H<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 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.
- 1 If on-hook, the modem will go off-hook and enter command mode. For U.S., the modem will remain off-hook. For other countries, the modem will return on-hook after a period of time determined by S7.

**Result Codes** OK <value> = 0 or 1.  
ERROR Otherwise.

**O Return to On-Line Data Mode**

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

**Syntax** O<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 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 (+++).
- 1 Enters on-line data mode with a retrain before returning to on-line data mode.

**Result Codes** OK <value> = 0 to 1 and a connection exists  
ERROR Otherwise, or if not connected

**L Speaker Volume**

This command sets the speaker volume control. The parameter value, if valid, is written to S22 bits 0 and 1.

**Syntax** L<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 Low volume.
- 1 Low volume. (Default)
- 2 Medium volume.
- 3 High volume.

**Result Codes** OK <value> = 0 to 3  
ERROR Otherwise

**M Speaker Control**

This command selects when the speaker will be on or off. The parameter value, if valid, is written to S22 bits 2 and 3.

**Syntax** M<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 Speaker is always off.
- 1 Speaker is on during call establishment, but off when receiving carrier. (Default)
- 2 Speaker is always on.
- 3 Speaker is off when receiving carrier and during dialing, but on during answering.

**Result Codes** OK <value> = 0 to 3  
ERROR Otherwise

**&G Select Guard Tone**

This command 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.

**Syntax** &G<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 Disables guard tone. (Default)
- 1 Disables guard tone.
- 2 Selects 1800 Hz guard tone.

This command may not be permitted in some countries.

**Result Codes** OK <value> = 0 to 2  
ERROR Otherwise

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

This command determines the make/break ratio used during pulse dialing. It is only effective if the appropriate bit to enable this command is set through the country profile.

The default is country-dependent. The parameter value, if valid, is written to S28 bits 3 and 4.

**Syntax** &P<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0 Selects 39%-61% make/break ratio at 10 pulses per second. (Default)
- 1 Selects 33%-67% make/break ratio at 10 pulses per second.
- 2 Selects 39%-61% make/break ratio at 20 pulses per second.
- 3 Selects 33%-67% make/break ratio at 20 pulses per second.

**Result Codes** OK <value> = 0 to 3  
ERROR Otherwise

**&V Display Current Configuration and Stored Profiles**

This command reports the current (active) configuration.

**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 S11:085 S12:050 S18:000 S25:005 S26:001 S36:007
S38:020 S46:138
S48:007 S95:000
OK
```

**IV Single Line Connect Message Enable**

This command enables or disables the single line connect message format as follows:

**Syntax** \V<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

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

1 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 or PROTOCOL (+ER:) 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., 2400.

Modulation = "V21" for V.21 modulation.

"B103" for Bell 103 modulation.

"B212" for Bell 212A modulation.

"V22" for V.22 modulation.

"V22B" for V.22bis modulation.

"V23C" for V.23 modulation.

Note: Modulation is omitted for all other modulations.

Protocol = "NONE" for no protocol.

"ALT" for Microcom Network Protocol.

"LAPM" for LAP-M protocol.

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., 2400.

**%L Report Line Signal Level**

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 Code** OK

**%Q Report Line Signal Quality**

Reports the line signal quality (DAA dependent). Returns the higher order byte of the EQM value. Based on the EQM value, retrain may be initiated if enabled by %E1.

Example: AT%Q

015

**Result Codes** OK if connected  
ERROR if not connected, or connected in 300 bps or V.23 modes

**\*B Display Blacklisted Numbers**

This command requests the modem to return a list of blacklisted numbers to the DTE. The format of the response is shown by the example below. Permanently forbidden numbers as defined by country requirements will not appear on this list. If no numbers are blacklisted, only the OK result code is issued.

**Syntax** \*B

**Example**

NO. - PHONE NUMBER -

-----

1; 4175537660

2; 8288924961

3; 3887278862

4; 3124839442

5; 6284664

OK



**\*D Display Delayed Numbers**

This command causes the modem to send a list of the delayed numbers together with the delay associated with each. The modem will return a list of delayed telephone numbers as defined in the \*B command. The format of the response is shown by the example below (delay times are shown as hours:minutes:seconds). If no numbers are delayed, only the OK result code is issued.

**Syntax** \*D

**Example**

NO. - PHONE NUMBER -DELAY

```
-----
1; 8264734660 2:00:00
2; 7532634661 2:00:00
3; 2587334662 0:02:00
4; 7532651663 0:03:25
5; 7459931664 0:01:45
OK
```

**-STE= Set Telephony Extension**

The -STE command enables/disables Line-in-Use, Extension Pickup, and Remote Hangup detection features.

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

**Syntax** -STE=<value>

**Defined Values**

<value> Decimal number corresponding 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

**Reporting Current or Selected Values**

Command: -STE?

Response: -STE: <value>

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

**Reporting Supported Range of Parameter Values**

Command: -STE=? Show available options.

Response: -STE: 0-7

**Result Codes** OK <value> = 0-7  
ERROR Otherwise

**Behavior in Data Mode**

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. 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.

**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 onhook, 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.

**Case 2: Modem off-hook, Extension Pick-up**

If the modem is connected and another extension goes off-hook, the modem will send a GSTN Cleardown to the remote modem and then immediately hang-up. Due to the noise possibly being added to the line when a telephone extension is picked-up, a GSTN Cleardown may or may not successfully be received by the remote mode. If the GSTN Cleardown is not received successfully by the remote modem, the remote modem may attempt a retrain until the retrain fails and the remote modem drops the line. In any case, the modem will send a NO CARRIER message to the DTE immediately after sending the GSTN Cleardown. A result code of 25 will be left in the S86 register. Because the extension is off-hook, the modem cannot flash the hook for the central office to generate a dial tone. In this case, the user must flash the extension handset to obtain a 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 S86=25. A line reversal can also be simulated by simply pulling out the telephone line during a connection.

**+PCW Call Waiting Enable**

This command controls the operation of the modem in the presence of call waiting.

**Syntax** +PCW=<value>

**Defined Values**

<value> Decimal number corresponding to the selected operation.

0 Collect caller ID information if enabled by +VRID. Toggle V.24 circuit 125. (Default)

1 Hang-up.

2 Ignore call waiting.

**Result Codes** OK <value> = 0, 1, or 2  
ERROR Otherwise

**Reporting Selected Value(s)**

Command: +PCW?

Response: +PCW: <value>

Example: +PCW: 0 For the default setting.

**Reporting Supported Range of Parameter Values**

Command: +PCW=?

Response: +PCW: (<value> range)

Example: +PCW: (0,1,2)

**+VDR Distinctive Ring**

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 <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. Modem will produce a RING event code after <report>/10 seconds after the falling edge of the ring pulse (i.e., after 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

## *V.22bis Modulation Control Commands*

### **+MS Modulation Selection**

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>]]]]]]

#### **Table of +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.22bis	V22B	2400 or 1200
V.23	V23C	1200

#### **Defined Values**

<carrier> A string which 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>.

<automode> A numeric value which enables or disables automatic modulation negotiation (e.g., V.22bis).  
 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. 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. 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.)

#### **Reporting Current or Selected Values**

Command: +MS?

Response: +MS:<carrier>,<automode>,<min\_tx\_rate>, <max\_tx\_rate>,<min\_rx\_rate>,<max\_rx\_rate>

Example: +MS: V22B, 1,300,2400,300,2400

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

#### **Reporting Supported Range of Parameter Values**

Command: +MS=?

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),(0,1),(300-2400),(300-2400),(300-2400),(300-2400)

#### **Result Code**

OK Valid subparameter string

ERROR Otherwise

**%E     Enable/Disable Line Quality Monitor and Auto-Retrain**

Controls whether or not the modem will automatically monitor the line quality and request a retrain (%E1). 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.

**Syntax** %E<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0   Disable line quality monitor and auto-retrain.
- 1   Enable line quality monitor and auto-retrain. (Default)

**Result Codes**

OK <value> = 0 or 2.

ERROR Otherwise.

**B        ITU-T or Bell**

When the modem is configured to allow either option, the modem will select Bell or ITUT modulation for a line speed connection of 300 or 1200 bps. Any other line speed will use an ITU-T modulation standard. The parameter value, if valid, is written to S27 bit 6..

**Syntax**

B<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

- 0   Selects ITU-T operation at 300 or 1200 bps during Call Establishment and a subsequent connection. (Default)
- 1   Selects Bell operation at 300 or 1200 bps during Call Establishment and a subsequent connection.
- 2   Selects V.23 half-duplex operation at 1200 bps during Call Establishment and a subsequent connection.
- 3   Disables V.23 half-duplex operation.

**Result Codes**

OK <value> = 0 or 3

ERROR Otherwise

## *V.22bis Error Control and Data Compression Commands*

### **+ESR Selective Repeat**

This extended-format numeric parameter controls the use of the selective repeat (SREJ) option in V.42.

**Syntax** +ESR=[<value>]

Decimal number 0 specifying that SREJ is not used.

#### **Reporting Current or Selected Values:**

Command: +ESR?

Response: +ESR: <value>

Example: +ESR: 0 For default setting

### **+ETBM Call Termination Buffer Management**

This extended-format compound parameter controls the handling of data remaining in modem buffers upon call termination. It accepts three numeric subparameters:

**Syntax** +ETBM=[<pending\_TD>[,<pending\_RD>[,<timer>]]]

#### **Defined Values**

<pending\_TD> Decimal number 0 specifying that 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.

#### **Reporting Current or Selected Values**

Command: +ETBM?

Response: +ETBM: <pending\_TD>,<pending\_RD>,<timer>

Example: +ETBM: 0,0,0

#### **Reporting Supported Range of Parameter Values**

Command: +ETBM=?

Response: +ETBM: (<pending\_TD> range),(<pending\_RD> range),(<timer> range)

Example: +ETBM: (0),(0),(0)

### **\B Transmit Break to Remote**

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.

**Syntax** \B<value>

#### **Defined Values**

<value> Decimal number corresponding to the selected option.

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.

**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.

**\K Break Control**

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.

**Syntax** \K<value>

**Defined Values**

<value> Decimal number corresponding to the selected option.

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 on-line 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 0 to 5

ERROR Otherwise

## *V.22bis Synchronous Access Mode Commands*

Three commands support Synchronous Access Mode:

+ES enables and disables Synchronous Access Mode in the client or central site modem. Enabling Synchronous Access Mode enables the use of the 8-bit command characters of the Draft ITU-T Recommendation V.80 (See the table under the +IBC command - Data Communication over the Telephone Network. In-Band DCE Control Command).

+ESA configures the operation of the Synchronous Access Submode

+ITF selects Transmit Flow Control Thresholds

### **+ESA Configure Synchronous Access Submode**

The operation of the Synchronous Access sub-Mode is configured by the +ESA parameter..

This extended-format compound parameter is used to control the manner of operation of the Synchronous Access Mode in the modem. It accepts six numeric subparameters:

#### **Syntax**

+ESA=[<trans\_idle>[,<framed\_idle>[,<framed\_un\_ov>[,<hd\_auto>[,<crc\_type>[,<nrzi\_en>[,<syn1>[,<syn2>]]]]]]]]]

#### **Defined Values**

<b>&lt;trans_idle&gt;</b>	Specifies the bit sequence transmitted by the modem when a transmit data buffer under run condition occurs, while operating in Transparent sub-Mode. The options are: 0 In Transparent sub-Mode, modem transmits 8-bit SYN sequence on idle. Modem receiver does not hunt for synchronization sequence (default and fixed).
<b>&lt;framed_idle&gt;</b>	Specifies the bit sequence transmitted by the modem when a transmit data buffer under run condition occurs immediately after a flag, while operating in Framed sub-Mode. The options are: 0 In Framed sub-Mode, modem transmits HDLC flags on idle (default and fixed).
<b>&lt;framed_un_ov&gt;</b>	Specifies the actions undertaken by the modem when a transmit data buffer under run or overrun condition occurs immediately after a non-flag octet, while operating in Framed sub-Mode. 0 In Framed sub-Mode, modem transmits abort on under run in middle of frame (default). 1 In Framed sub-Mode, DCE transmits a flag on under run in middle of frame, and notifies DTE of under run or over run.
<b>&lt;hd_auto&gt;</b>	This subparameter should not be commanded.
<b>&lt;crc_type&gt;</b>	Specifies the CRC polynomial used while operating in Framed sub-Mode. The options are: 0 CRC generation and checking disabled (default). 1 In Framed sub-Mode, the 16-bit CRC is generated by the modem in the transmit direction, and checked by the modem in the receive direction.
<b>&lt;nrzi_en&gt;</b>	Specifies if Non Return to Zero Inverted (NRZI) encoding is to be used by the modem for transmit and receive data. The options are: 0 NZRI encoding and decoding disabled (default and fixed).
<b>&lt;syn1&gt;, &lt;syn2&gt;</b>	Specifies the octet value(s) to be used while performing character-oriented framing. <syn1> is to be commanded to 255 (FFh); <syn2> is not to be commanded.

#### **Reporting Selected Options**

The modem reports the selected options in response to the following command:

+ESA?

The response is:

+ESA:

<trans\_idle>,<framed\_idle>,<framed\_un\_ov>,<hd\_auto>,<crc\_type>,<nrzi\_en>,<syn1>,<syn2>

Example:

+ESA?

+ESA: 0,0,0, ,0,0,255, For the defaults.

#### **Reporting Supported Options**

The modem reports the supported options in response to the following command:

+ESA=?

The response is:

+ESA: (list of supported <trans\_idle> values), (list of supported <framed\_idle>values),(list of supported <framed\_un\_ov> values), (list of supported <hd\_auto>values),(list of supported <crc\_type> values), (list of supported <nrzi\_en> values),(list of supported <syn1> values), (list of supported <syn2> values)

Example:

+ESA=?

+ESA: (0),(0),(0-1), ,(0-1),(0),(255),

**+ITF Transmit Flow Control Thresholds**

The +ITF command determines the flow control thresholds used by the modem for transmit data from the DTE. This optional compound parameter allows the DTE to determine the input buffer size in the modem for data on circuit 103 (transmit data) from the DTE, to control the thresholds used for flow control of such data, and to control how often the modem reports to the DTE the number of octets in this buffer. The DTE can adjust its own thresholds for flow control of data on circuit 104 (received data) from the modem.

**Syntax** +ITF=[<off>[,<on>[,<report\_period>]]]

**Defined Values**

<off> Determines the threshold, in octets, above which the modem will generate a flow off signal. Applicable in Synchronous Access and Frame Tunneling modes. Default <off> value is 255.

For the <on> and <off> subparameters, the input buffer is assumed to reside between the modem's V.24 interface and the Synchronous Access protocol layer; i.e., the buffer count includes all octets, including EM codes, received from the DTE, with the exception of DC1 and DC3 if these are used to signal <modem-by-DTE> flow control.

The modem returns the ERROR result code if the DTE specifies that the <off> subparameter be set to a value less than or equal to the <on> subparameter; in this case, the current parameter value settings are not modified.

<on> Determines the threshold, in octets, below which the modem will generate a flow on signal. Applicable in Synchronous Access and Frame-Tunneling modes. Default <on> value is 64.

<report\_period> Not supported. A fixed value of zero is used and reported.

**Reporting Selected Options**

The modem sends a string of information text to the DTE consisting of selected options in response to the following command:

+ITF?

The response is:

+ITF: <off>,<on>,<report\_period>

Example:

+ITF?

+ITF: 255,64,0 Default values

**Reporting Supported Options**

The modem sends a string of information text to the DTE consisting of supported options in response to the following command:

+ITF=?

The response is:

+ITF: (list of supported <off> values),(list of supported <on> values),(list of supported <report\_period> values)

Example:

+ITF=?

+ITF: (0-255),(0-255),(0)

The maximum reported <off> value is the input transmit data buffer level at which the modem signals a transmit data overrun indication to the DTE.



## *V.22bis FastConnect Command*

### **\$F      Fast Connect Control**

This command allows configuring of the client modem to connect to a central site modem that supports non-standard V.22 and V.22bis Fast Connect protocols.

**Syntax**      \$F<n>

#### **Defined Values**

- <n>      Decimal number which specifies the initial requested mode of operation when the modem is operating as the originator. The options are:
- 0      Normal connection (Default)
  - 1      Fast Connect without answer tone
  - 2      Reserved
  - 3      Fast Connect with answer tone

## *V.22bis Line Side Device Commands*

### **-TTE Threshold Adjustments for Telephony Extension**

This command allows the host to set/tune the telephone line voltage level drop threshold necessary for the modem to determine Line-in-Use, Extension Pickup, and Remote Hangup conditions. An ATZ or AT&F will load default values.

#### **Syntax**

-TTE=<Line-in-Use voltage drop threshold>,<Extension Pickup voltage drop threshold>, <Remote Hangup voltage drop threshold>

#### **Defined Values**

Range =(0-9999), (0-9999), (0-9999)

Units: 1/10 volt

<Line-in-Use voltage drop threshold>

default: 1000 (10.00 V drop while modem onhook)

<Extension Pickup voltage drop threshold>

default: 200 (2.00 V drop while modem offhook) this value must be less than the Remote Hangup voltage drop threshold

<Remote Hangup voltage drop threshold>

default: 500 (5.00 V drop while modem offhook) this value must be greater than the Extension Pickup voltage drop threshold

AT-TTE? Queries current setting

#### **Notes:**

1. All thresholds are difference thresholds. Example: The line would be considered "in use" if the Tip & Ring Voltage dropped by 10.00 volts. Another Example: If the modem is off hook and the voltage drops by more than 2.50 volts, then the modem would consider the condition as an extension pick up.
2. The <Remote Hangup voltage drop threshold> must always be less than the <Extension Pickup voltage drop threshold). Otherwise, the extension pickup will not function.

### **-TRV Tip and Ring Voltage Measurement**

This command measures and reports the telephone line voltage level at Tip and Ring while on-hook or in off-hook command mode. If an application does not want to enable the telephony extension features through the -STE command, the voltage value may be obtained using the -TRV command instead. This is also a very useful debug command.

#### **Syntax**

-TRV

#### **Defined Values**

Units: Volts

#### **Response**

xx.yy Example: A value of 30.50 indicates 30.50 V.

OK The lowest value reported by the modem is 1.40 V based on conversion formula.

## *V.22bis S-Parameters*

The S-Parameters are summarized in the S-Parameter Table along with their default values which may be loaded at any time by using the Z command. Registers or register fields quoted as “reserved” are reserved for current or future use by the firmware or are permanently overridden by PTT limitations. For the latter, control of the equivalent functionality is available with Blacklisting options.

All bit-mapped registers are read-only. The appropriate AT command, which controls the relevant bits in the S-Parameter should be used to change the value.

### **S - Read/Write S-Parameter**

The modem selects an S-Parameter, performs an S-Parameter read or write function, or reports the value of an S-Parameter.

- n      Establishes S-Parameter n as the last register accessed.
- n=v    Sets S-Parameter n to the value v.
- n?     Reports the value of S-Parameter n.

The parameter n can be omitted, in which case the last S-Parameter accessed will be assumed. The S can be omitted for AT= and AT?, in which case the last S-Parameter accessed will be assumed. For example:

ATS7 establishes S7 as the last accessed register.

AT=40 sets the contents of the last register accessed to 40.

ATS=20 sets the contents of the last register accessed to 20.

If the number "n" is outside the range of the S-Parameters available, the modem will return the ERROR message. If the value "v" is outside the range permitted for a given SParameter, the modem will return the ERROR message. Input and output are always in decimal format. Note that some S-Parameters are read-only.

In some cases, writing to the S-Parameter will appear to be accepted but the value will not actually be written.

Due to country restrictions, some commands will be accepted, but the value may be limited and replaced by a maximum or minimum value.

Minimum, maximum, and default values for S-Parameters may be altered by inserting a country profile using patch code.

## Summary of S-Parameter Defaults

Register	Function	Range/Units	Default*
S0	Rings to Auto-Answer	0-255 rings	0
S1	Ring Counter	0-255 rings	0
S2	Escape Character	0-255 ASCII	43
S3	Carriage Return Character	0-127 ASCII	13
S4	Line Feed Character	0-127 ASCII	10
S5	Backspace Character	0-255 ASCII	8
S6	Wait Time before Blind Dialing or for Dial Tone	2-255 s	2
S7	Wait Time for Carrier, Silence, or Dial Tone	1-255 s	50
S8	Pause Time for Dial Delay Modifier	2-255 s	2
S9	Carrier Detect Response Time	1-255 0.1 s	6
S10	Lost Carrier To Hang Up Delay	1-255 0.1 s	14
S11	DTMF Tone Duration	50-255 0.001 s	85
S12	Escape Prompt Delay (EPD)	0-255 0.02 s	50
S14	General Bit Mapped Options Status		138 (8Ah)
S16	Test Mode Bit Mapped Options Status		0
S19	Reserved		0
S20	Reserved		0
S21	V.24/General Bit Mapped Options Status		52 (34h)
S22	Speaker/Results Bit Mapped Options Status		117 (75h)
S23	General Bit Mapped Options Status		0
S24	Sleep Inactivity Timer	0-255 s	0
S25	Delay to DTR Off	0-255 s or 0.01 s	5
S26	RTS-to-CTS Delay	0-255 0.01 s	1
S27	General Bit Mapped Options Status		73 (49h)
S28	General Bit-Mapped Options Status		0
S29	Flash Dial Modifier Time	0-255 10 ms	70
S30	Disconnect Inactivity Timer	0-255 10 s	0
S31	General Bit-Mapped Options Status		192 (C0h)
S36	LAPM Failure Control		7
S38	Delay Before Forced Hangup	0-255 s	20
S39	Flow Control Bit Mapped Options Status		3
S40	General Bit-Mapped Options Status		104 (68h)
S41	General Bit-Mapped Options Status		195 (C3h)
S86	Call Failure Indication	0-26	21
S91	PSTN Transmit Attenuation Level	0-15 dBm	10 (Country dependent)
S95	Extended Result Codes Control		0

\* Default values may be modified using patch code.

## **S-PARAMETER DEFINITIONS**

### **S0 - Number of Rings to Auto-Answer**

S0 sets the number of the rings required before the modem automatically answers a call.

Setting this parameter to zero disables auto-answer mode.

Range: 0-255 rings

Default: 0

### **S1 - Ring Counter**

S1 is incremented each time the modem detects a ring signal on the telephone line. S1 is cleared if no rings occur over an eight second interval.

Range: 0-255 rings

Default: 0

### **S2 - Escape Character**

S2 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, i.e., no escape character will be recognized.

Range: 0-255, ASCII decimal

Default: 43 (+)

### **S3 - Carriage Return Character**

S3 sets the command line and result code terminator character. Pertains to asynchronous operation only.

Range: 0-127, ASCII decimal

Default: 13 (Carriage Return)

### **S4 - Line Feed Character**

S4 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.

Range: 0-127, ASCII decimal

Default: 10 (Line Feed)

### **S5 - Backspace Character**

S5 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.

Range: 0-32, ASCII decimal

Default: 8 (Backspace)

### **S6 - Wait Time before Blind Dialing or for Dial Tone**

S6 operation is country dependent.

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. (U.S.)
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. (Other countries.)

The modem always pauses for a minimum of 2 seconds, even if the value of S6 is less than 2 seconds.

Range: 2-255 seconds

Default: 2

### **S7 - Wait Time for Carrier, Silence, or Dial Tone**

S7 operation is country dependent.

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. (U.S.)

Range: 1-255 seconds

Default: 50

**S8 - Pause Time For Dial Delay**

S8 sets the time, in seconds, that the modem must pause when the “,” dial modifier is encountered in the dial string.

Range: 2-255 seconds

Default: 2

**S9 - Carrier Detect Response Time**

S9 is supported for backwards compatibility only. No value can be written. Responds with default value.

Range: 6 tenths of a second

Default: 6 (0.6 second)

**S10 - Lost Carrier To Hang Up Delay**

S10 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.

Range: 1-255 tenths of a second

Default: 14 (1.4 seconds)

**S11 - DTMF Tone Duration**

S11 operation is country dependent.

1. For U.S., S11 sets the duration of tones in DTMF dialing (has no effect on pulse dialing).
2. For other countries, S11 is a country parameter loaded via patch code.

Range: 50-255 milliseconds

Default: 95 (95 milliseconds)

**S12 - Escape Prompt Delay (EPD)**

S12 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.

Range: 0-255 1/50 of a second

Default: 50 (1 second)

**S14 - General Bit Mapped Options Status**

S14 indicates the status of command options.

Default: 138 (8Ah) (10001010b)

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)

**S16 - Test Mode Bit Mapped Options Status**

S16 indicates the test in progress status.

Default: 0

- Bit 0 Local analog loopback.
  - 0 = Disabled. (Default)
  - 1 = Enabled. (&T1)
- Bit 1 Not used
- Bit 2 Local digital loopback
  - 0 = Disabled (default)
  - 1 = Enabled (&T3)
- Bit 3 Remote digital loopback (RDL) status
  - 0 = Modem not in RDL
  - 1 = RDL in progress
- Bit 4 RDL requested (AT&T6)
  - 0 = RDL not requested (default)
  - 1 = RDL requested (&T6)
- Bit 5 RDL with self test
  - 0 = Disabled (default)
  - 1 = Enabled (&T7)
- Bit 6 Local analog loopback (LAL) with self test
  - 0 = Disabled (default)
  - 1 = Enable (&T8)
- Bit 7 --- Not used

**S19 - Reserved**

S19 is supported for backwards compatibility only. No value can be written. Responds with default value.

Range: None

Default: 0

**S20 - Reserved**

S20 is supported for backwards compatibility only. No value can be written. Responds with default value.

Range: None

Default: 0

**S21 - V.24/General Bit Mapped Options Status**

S21 indicates the status of command options.

Default: 52 (34h) (00110100b)

- Bits 0 - 1 Telephone Jack Control (&Jn).
  - 0 = &J0 selected. (Default)
  - 1 = &J1 selected.
  - 2 = &J2 selected.
  - 3 = &J3 selected.
- 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 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.

**S22 - Speaker/Results Bit Mapped Options Status**

S22 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.

**S23 - General Bit Mapped Options Status**

S23 indicates the status of command options.

Default: 0

Bits 0-6 Not used.

Bits 6-7 Guard tone (&Gn).

0 = None (&G0). (Default)

1 = None (&G1).

2 = 1800 Hz (&G2).

**S24 - Sleep Inactivity Timer**

S24 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 S24 is zero, neither DTE line nor telephone inactivity will cause the modem to enter the sleep mode.

Range: 0-255 seconds

Default: 0

**S25 - Delay To DTR Off**

S25 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.

Range: 0-255 (1 second for synchronous modes 1; 0.01 second otherwise)

Default: 5

**S26 - RTS to CTS Delay**

S26 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.

Range: 0-255 hundredths of a second

Default: 1



**S27 - Bit Mapped Options Status**

S27 indicates the status of command options.

Default: 73 (49h) (01001001b)

Bits 0,1,3 Synchronous/asynchronous selection (&Mn/&Qn).

<b>31</b>	<b>0</b>	
0 0	0	= &M0 or &Q0.
0 0	1	= &M1 or &Q1.
0 1	0	= &M2 or &Q2.
0 1	1	= &M3 or &Q3.
10	0	= Reserved.
1 0	1	= &Q5. (Default)
11	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 ITU-T/Bell mode select (Bn).

0 = ITU-T mode (B0).

1 = Bell mode (B1). (Default)

Bit 7 Reserved.

**S28 - Bit Mapped Options Status**

S28 indicates bit mapped options status.

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). (Default)

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

**S29 - Flash Dial Modifier Time**

S29 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.

Range: 0-255 10 ms intervals

Default: 70 (700 ms) for U.S.

**S30 - Disconnect Inactivity Timer**

S30 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.

Range: 0-255 tens of seconds (0-2550 seconds)

Default: 0 (disabled)

**S31 - Bit Mapped Options Status**

S31 indicates bit mapped options status.

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).

**S36 - LAPM Failure Control**

Default: 7 (00000111b)

Bits 0-2 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.

- 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

**S37 - Desired Line Connection Speed**

S37 specifies the desired line connection speed.

Default: 0

Bits 0-3 Desired line connection speed. This is linked with the Fn command. If an invalid number is entered, the number is accepted into the register, but S37 will act as if the default value has been entered.

- 0 = Attempt automode connection (F0). (Default.)
- 1-3 = Attempt to connect at 300 bps (F1).
- 4 = Reserved.
- 5 = Attempt to connect at V.22 1200 bps (F4).
- 6 = Attempt to connect at V.22bis 2400 bps (F5).
- 7 = Attempt to connect at V.23 (F3).

Bits 4-7 Reserved

**S38 - Delay Before Forced Hang Up**

S38 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.

1. 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.
2. 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.

Range: 0-255 seconds

Default: 20

**S39 - Flow Control Bit Mapped Options Status**

Default: 3 (00000111b)

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.

**S40 - General Bit Mapped Options Status**

S40 indicates the status of command options.

Default: 104 (68h) (01101000b)

Bits 0-2 Reserved.

Bits 3-5 Break Handling (\Kn).

- 0 = \K0.
- 1 = \K1.
- 2 = \K2.
- 3 = \K3.
- 4 = \K4.
- 5 = \K5. (Default)

Bits 6-7 Reserved.

**S41 - General Bit Mapped Options Status**

S41 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 Auto retrain (%En).

0 = Retrain disabled (%E0).

1 = Retrain enabled (%E1). (Default)

Bit 3-7 Reserved.

**S48 - V.42 Negotiation Action**

The V.42 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-Register, but S48 will act as if 128 has been entered.

Default: 7

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.

**S82 - Break Handling Options**

Break Signals provide a way for the user to get the attention of the remote modem. The break type depends on the speed application. LAPM specifies three methods of break signal handling; in sequence, expedited, and destructive. If an in number is entered, it is accepted into the S register, but S82 will act as if the default value has been entered.

Range: 3,7, or 128

Default: 128

S82 = 3 Expedited: Modem sends a break immediately; data integrity is maintained ahead of and after the break.

S82 = 7 Destructive: Modem sends a break immediately; data being processed by each modem at the time of the break is destroyed.

S82 =128 In sequence: Modem sends a break in sequence with any transmitted data; data integrity is maintained both ahead of and after the break (default)

**S86 - Call Failure Reason Code**

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. Code definitions are:

Range: 0-26

Default: 21

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 clear-down.

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.

**S91 – PSTN Transmit Attenuation Level**

S91 sets transmit attenuation level from 0 to 15 dBm for the PSTN mode, resulting in a transmit level from 0 to -15 dBm.

Range: 0 to 15 dBm (Corresponding to 0 to -15 dBm transmit level.)

Default: 10 (-10 dBm transmit level.)

**S95 - 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 W command determines the corresponding actual result code reporting (see W command).

Default: 0

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 2-7 Reserved.

## *V.22bis Result Codes*

The modem responds to commands from the DTE and to activity on the line by signaling to the DTE in the form of result codes. .

Two forms of each result code are available: long-form, an English-like "verbose" response, and short-form, a data-like numeric response (included in parentheses following the long-form). The long-form code is preceded and terminated by the sequence < CR> < LF>. The short-form is terminated by < CR>, only with no preceding sequence. If result messages are suppressed, nothing is returned to the DTE. The long-form results codes can be modified by the OEM through the .INF file.

### ***Table of Result Code Definitions***

<b>Code</b>	<b>Message</b>	<b>Meaning</b>
0	OK	A command line has been executed.
1	CONNECT	For X command values specifying no speed reporting, the modem has connected to the line and either the line speed is 300 bps and line speed is enabled, or the DTE speed is 300 bps and DTE speed reporting is enabled.
2	RING	An incoming ring signal is detected on the line. What qualifies as a ring signal is determined by country-dependent parameters, modifiable through patch code.
3	NO CARRIER	Sent when attempting to establish a call if: <ol style="list-style-type: none"> <li>1. Ringback is detected and later ceases but no carrier is detected within the period of time determined by register S7, or</li> <li>2. No ringback is detected within the period of time determined by register S7.</li> </ol> Also sent when the modem auto-disconnects due to loss of carrier. For X0, sent for the following conditions: <ol style="list-style-type: none"> <li>1. If busy tone detection is enforced, busy or circuit busy has been detected.</li> <li>2. If dial tone detection is enforced or selected, dial tone has not been detected.</li> </ol>
4	ERROR	Sent during an attempt to execute a command line if any of the following conditions occur: <ol style="list-style-type: none"> <li>1. The command line contains a syntax error.</li> <li>2. The modem cannot execute a command contained in the command line, i.e., the command does not exist or is not supported.</li> <li>3. A command parameter within the command line is outside the permitted range.</li> </ol> For X0, X1, X2, and X3, this message is sent instead of DELAYED and BLACKLISTED.
5	CONNECT 1200	The modem has connected to the line and either the line speed is 1200 bps and DCE speed reporting is enabled, or the DTE speed is 1200 bps and DTE speed reporting is enabled.
6	NO DIAL TONE	For X2 and X4, the modem has been instructed to wait for dial tone during dialing but none is received.
7	BUSY	For X3 and X4, if busy tone detection is enforced, the busy (engaged) signal is detected on the line when the modem is attempting to originate a call.
8	NO ANSWER	The modem is attempting to originate a call if a continuous ringback signal is detected on the line until the expiration of the timer S7.
9	CONNECT 600	The modem has connected to the line, the DTE speed is 600 bps, and DTE speed reporting is enabled.
10	CONNECT 2400	The modem has connected to the line and either the line speed is 2400 bps and DCE speed reporting is enabled, or the DTE speed is 2400 bps and DTE speed reporting is enabled.
11	CONNECT 4800	The modem has connected to the line, the DTE speed is 4800 bps and DTE speed reporting is enabled.
12	CONNECT 9600	The modem has connected to the line, the DTE speed is 9600 bps and DTE speed reporting is enabled.
13	CONNECT 7200	The modem has connected to the line, the DTE speed is 7200 bps and DTE speed reporting is enabled.
14	CONNECT 12000	The modem has connected to the line the DTE speed is 12000 bps and DTE speed reporting is enabled.
15	CONNECT 14400	The modem has connected to the line, the DTE speed is 14400 bps and DTE speed reporting is enabled.

Code	Message	Meaning
16	CONNECT 19200	The modem has connected to the line, the DTE speed is 19200 bps and DTE speed reporting is enabled.
22	CONNECT 75TX/1200RX	The modem has established a V.23 originate connection and line speed reporting is enabled.
23	CONNECT 1200TX/75RX	The modem has established a V.23 answer connection and line speed reporting is enabled.
24	DELAYED	For X4, sent when a call fails to connect and the number dialed is considered 'delayed' due to country blacklisting requirements.
32	BLACKLISTED	For X4, sent when a call fails to connect and the number dialed is considered 'blacklisted'.
59	CONNECT 16800	The modem has connected to the line, the DTE speed is 16800 bps and DTE speed reporting is enabled.
61	CONNECT 21600	The modem has connected to the line, the DTE speed is 21600 bps and DTE speed reporting is enabled.
62	CONNECT 24000	The modem has connected to the line, the DTE speed is 24000 bps and DTE speed reporting is enabled.
63	CONNECT 26400	The modem has connected to the line, the DTE speed is 26400 bps and DTE speed reporting is enabled.
64	CONNECT 28800	The modem has connected to the line, the DTE speed is 28800 bps and DTE speed reporting is enabled.
83	LINE IN USE	The modem attempted to go off-hook when an extension was already occupying the line.
84	CONNECT 33600	The modem has connected to the line, the DTE speed is 33600 bps and the DTE speed reporting is enabled.
91	CONNECT 31200	The modem has connected to the line DTE speed is 31200 bps and the modem is to report the DTE speed upon connecting.
<b>Notes:</b> <ol style="list-style-type: none"> <li>1. See Vn for result code selection, i.e., short form (result code) or verbose/extended (result message).</li> <li>2. See Wn for extended connect message control.</li> <li>3. See S95 for extended result code enabling options (which override some Wn commands).</li> <li>4. See Xn for extended result code subset enabling options.</li> <li>5. See \Vn for single line connect message enable options.</li> </ol>		

# Appendix A – Test/Demo Card Information

## Block Diagram

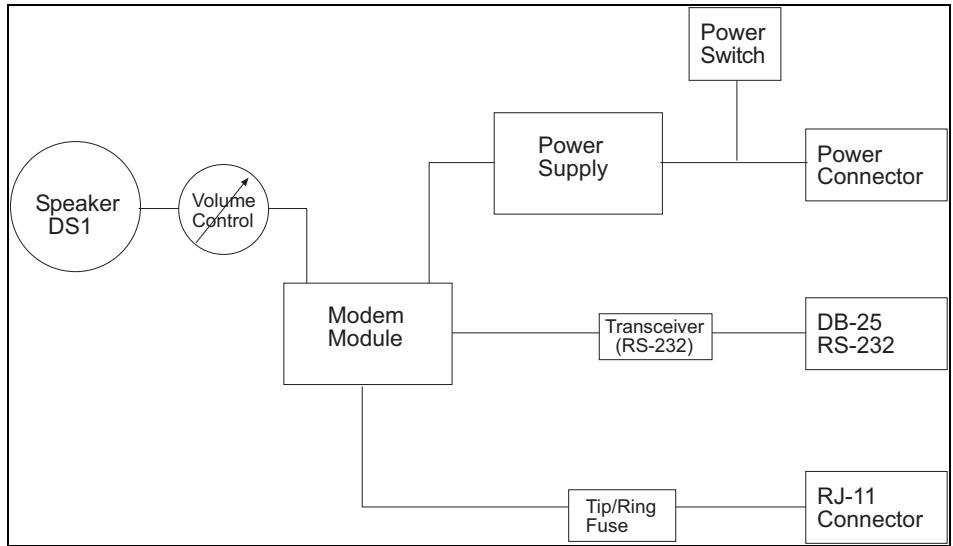


Figure A-1. Serial Test/Demo Board Block Diagram

# Appendix B - Product Approvals, Compliance, and Layout Considerations

## *Product Safety and EMC Approvals*

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

### **Country Certifications**

While this device can be configured for specific country operation, doing so DOES NOT constitute country approval. This modem is not approved in or configured for operation in all countries. The following list displays the country approvals as of April 1, 2003.

This information can be deemed reliable, but is not guaranteed. All information is subject to change. Contact your Multi-Tech Systems, Inc. sales representative or call the world headquarters at 800-328-9717.

Country	Country Code
US	B5
Canada	B5
Austria	B5
Belgium	B5
Cyprus	B5
Denmark	B5
Finland	B5
France	B5
Germany	B5
Greece	B5
Iceland	B5
Ireland	B5
Italy	B5
Liechtenstein	B5
Luxembourg	B5
Netherlands	B5
Norway	B5
Portugal	B5
Spain	B5
Sweden	B5
Switzerland	B5
UK	B5
<b>More planned.</b>	

**Note:** See the AT+GCI command. **Reporting** uses of this command will show you the current country code and the country profiles stored in the modem's ROM.

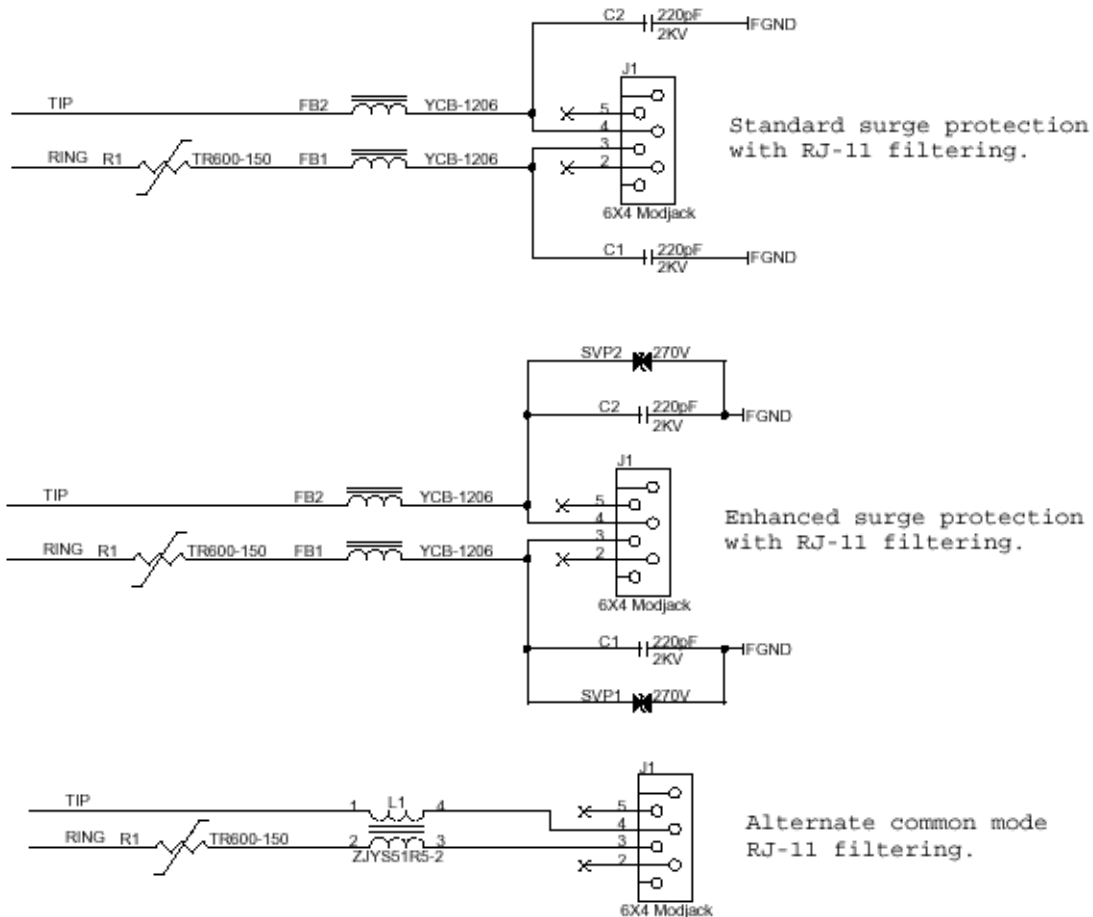


# Regulatory Design Considerations

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**

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 – 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 3<sup>rd</sup> edition protection against over-voltage from power line crosses.

**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

## Safety

All creepages and clearances for the MT2456SMI have been designed to meet requirements of safety standards EN 60950. 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.

# SocketModem Placement

This figure illustrates where to place the SocketModem on a typical application. It must be placed so that the analog end is near the phone jack.

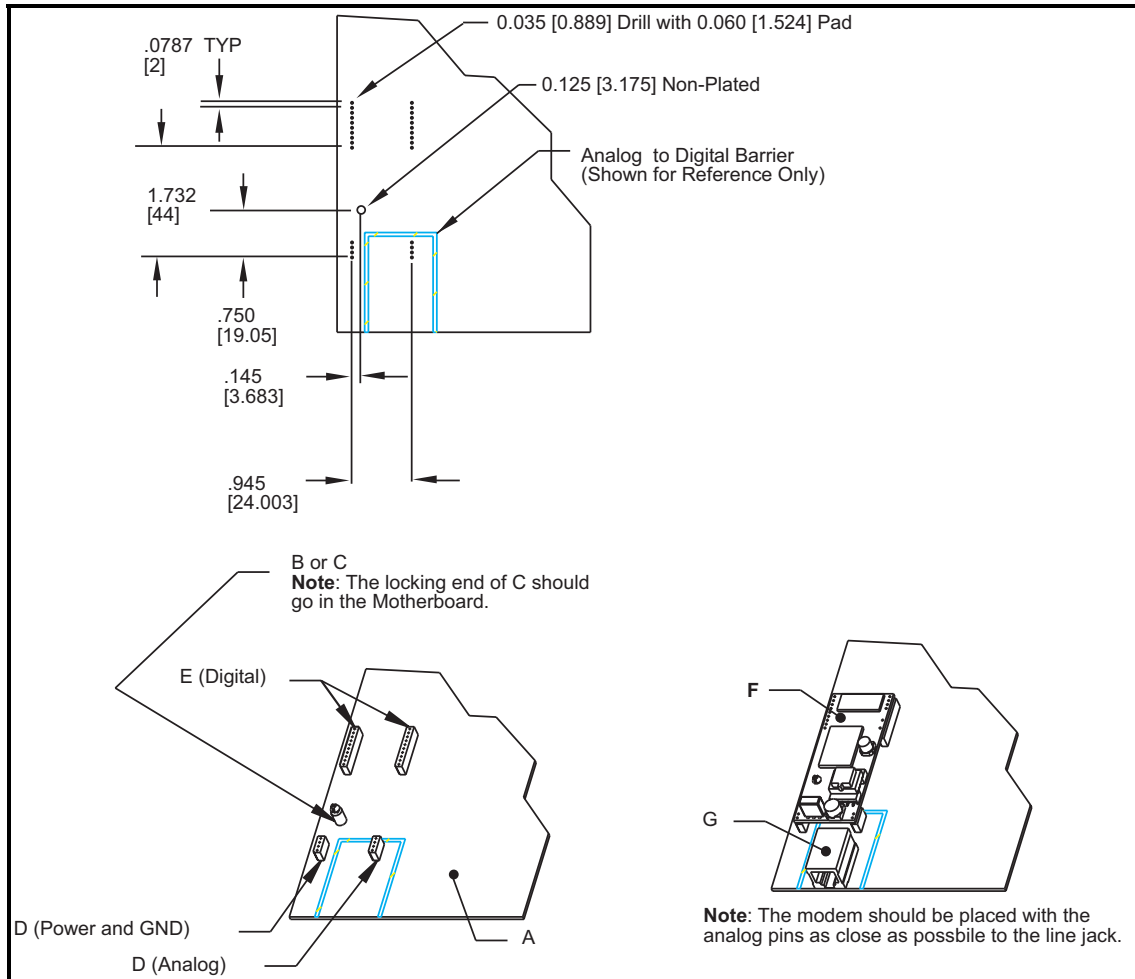


Figure B-3. SocketModem Placement

**Note: The dimensions in this diagram are examples only. See the mechanical drawing in Chapter 2 for true dimensions.**

## Key

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

**Note:** The analog to digital barrier is really a safety isolation barrier between TNV and SELV.

# Compliance

## Multi-Tech Systems, Inc. Compliance

This section discusses Multi-Tech's SocketModem compliance with 47 CFR Part 68 and Industry Canada CS-03 Telecom regulations.

## Telecom 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 FCC rules and the requirements adopted by the ACTA. Located on this equipment is a label that contains, among other information, the FCC registration number and ringer equivalence number (REN) for this equipment or a product identifier in the format US:AAAEQ##TXXXX. 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 FCC 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: MT2456SMI-22  
 Registration No: US: AU7MD04B2456  
 Ringer Equivalence: 0.4B  
 Modular Jack (USOC): RJ11C or RJ11W (single line)  
 Service Center in USA: Multi-Tech Systems, Inc.  
 2205 Woodale Drive  
 Mounds View, MN 55112  
 U.S.A.  
 (763) 785-3500  
 (763) 785-9874 Fax

### **Label Content and Format**

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##TXXX**

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.

XXX 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.

## Telecommunications Regulations 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. e.g. 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<sup>1</sup> (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.

<sup>1</sup> **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 Règlement 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.

## ***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.



## ***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.

## ***South African Statement***

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



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