

CASCADE MODEM

Version : 2.00
Release : 2/14/2007

Manual Revision 2.01
Release: 09/18/2012



Diamond Traffic Products, Inc.
P.O. Box 1455
76433 Alder Street
Oakridge, OR 97463

Phone : (541)-782-3903
Fax : (541)-782-2053
Email : sales@diamondtraffic.com
Web : www.diamondtraffic.com

Table of Contents

- 1. Introduction 3**
 - 1.1 QuickStart Information 3
 - 1.2 Features 4
 - 1.3 Status Indicator LED 5
 - 1.4 Installation 6

- 2. Modem Functions 7**
 - 2.1 Jumper Settings 7
 - 2.2 Automatic Speed/Format Sensing 8
 - 2.3 Modulation/Demodulation 9
 - 2.4 Error Correction/Data Compression 9
 - 2.5 Non-Volatile RAM (NVRAM) 9
 - 2.6 DAA-Telephone Line Interface 10
 - 2.7 Modem States 10
 - 2.8 RS232 Serial Interface 11
 - 2.9 Ring Detect Relay 11
 - 2.10 FCC Part 68 Information 12

- 3. Modem Control 13**
 - 3.1 AT Command Format 13
 - 3.2 Status Messages & Result Codes 14
 - 3.3 Basic AT Commands 16
 - 3.4 S-Register Summary 21
 - 3.5 AT Command Applications 23
 - 3.6 Factory Settings & Default States 24

1. Introduction

The Cascade Modem is a high performance ultra low power modem designed to be used in the field or office. The Cascade Modem version 2 is available in a 57.6K extended temperature model only.

Specifically designed for road side traffic monitoring equipment, the Cascade Modem contains many additional features to improve the quality and reliability of your data collection system. This includes an *extremely* low standby current consumption of less than 0.5mA, and a low operating current of less than 50mA when online. The modem will operate on input voltages as low as 5vdc and as high as 40vdc so it can be connected directly to your standard 6 or 12 volt battery or power supply.

The Cascade Modem also contains built in lightning surge suppression, and it has an optional 1 Amp contact closure during ring detect (for activation of other devices). Support for most standard modem communication protocols (Hayes AT command set) allows the Cascade Modem to be used in virtually any application.

This manual contains information provided by Xecom and reproduced with their permission.

1.1. QuickStart Information

The factory default settings of the modem are the following:

```
AT&FE0M1Q0V0X1\N5\Q0&C1&D2S0=2
AT\T9+GCI=B5 (COUNTRY CODE =US)
```

IMPORTANT NOTE: The default connection speed of the serial I/O of the modem is 19200 baud. Be sure to have your serial device (counter) set to 19200 as its communication rate for the Cascade Modem. This will not affect modem to modem speed rates even if they establish a slower connection.

The modem can be connected to any serial device that is compatible with Hayes modems. Connect the modem to your device and then plug in your RJ11 phone line in. Then connect the power to turn the modem on as it will boot and then flash green to indicate that it is ready for operation.

Start out by calling the modem from your PC. If you have trouble linking to the modem remotely, try lowering the baud rate on your dialing modem connection (not the counter device). Once the connection is negotiated by the modems you have a successful connection and an operating modem. After the connection is established make sure you can use the Centurion software or communications software to connect to your counter or serial device.

1.2. Features

The Cascade Modem contains the following features and functions.

(57.6K) Available in 57,600 Baud Extended Temperature Ultra Low Power

Features, Functions, & Specifications:

- Ultra low power consumption, less than 50 microamperes in standby mode and only 50 milliamps in full operation.
- Can be powered from 5.0 Volts to 40.0 Volts DC. Power can be connected to Power Input Jack.
- Leaves standby (low power) mode on any RD or Ring Activity. Fully operational in less than 3 seconds.
- Operation range from -40 to +85C.
- Humidity: 95% non-condensing.
- Supports communications with following protocols:
V.90, V.34, V.32, V.22, Bell 212, Bell 103, V.21, V.23

- FCC Part 68 Approved
- Worldwide telephone network compliance.
- UL60950 Recognition.
- The modem is resistant to lightning and other EMI/ESD related problems. 1000VAC and 1500V peak surge isolation is built in along with a high quality surge suppressor with external ground lug connection.
- Tri Color status indicator LED.
- Onboard Speaker
- Non-volatile RAM for parameter storage and configuration.
- AT Command Structure (with extensions).
- FAX Mode Support (CCITTV.29, V.27, & V.21). Supports Fax Class 1, Group 3.
- Error correction modes: V.42 LAPM, MNP 2-4.
- Data compression modes: V.42bis and MNP 5.
- Automated baud rate adaptability utilizing speed sensing, flow control, and data buffers.

1.3. Status Indicator LED

The single tri color LED (Light Emitting Diode) on the modem indicates the modems current status. The following chart can be used to determine the modem status from the LED blinking pattern:

LED	Mode	Explanation
Solid green 3 seconds	Power Up	During initial power on or when modem wakes up from standby mode. LED is on for 3 seconds and modem will be ready to operate at the end of this time and will enter Active Mode.
Slow green blinking	Active	If a line is detected the modem will blink green slowly until entering sleep mode
Slow red blinking	Active, No Carrier	Modem is on and waiting for a Carrier Detect. It fully responds to commands from the device connected to it. After 5 minutes of no Rings or Character transmissions, modem will enter the standby (low power) mode.
8 second green blink	Sleep With Carrier	Modem has gone into low power mode. When a ring or transmission is detected, modem will power back on into Active mode.
8 second red blink	Sleep, No Carrier	Modem has gone into low power mode. When a transmission is detected from the serial port, modem will power back on into Active mode.
Fast yellow blinking	Ring Detected	When telephone line is ringing, the led will fast blink to indicate each ring.
Solid Green	Line Connect	A connection has been made to a remote modem. Modem is on and fully functional. After 5 minutes of no Rings or character transmissions, modem leaves this mode and enters standby mode. If carrier is lost, modem goes into Active-No Carrier mode (slow green continuous blinks).

Other Non-Standard or Error Modes:

2 blinks, pause, repeat	Active, Carrier Forced On	This mode indicates that the modem powered on and Carrier Detect went immediately active. This normally happens if the modem has not been properly initialized with the &C1 command. In this state, the connected device has no way of determining when an actual connection has been made to the modem by a remote device.
-------------------------------	------------------------------	---

1.4. Installation

The Cascade Modem is easy to install. Simply connect the telephone line, serial cable (at 19200baud), and power connector and the modem is ready to use. It is highly recommended that you connect the surge suppressor lug directly to your ground rod (earth ground) using a minimum of 18 gage wire.

When the power is connected the status LED will light for about 3 seconds and then start blinking steadily. If no calls are made to the modem or if no device (such as a traffic counter) communicates to the modem, then it will enter standby mode in about 5 minutes where the LED will flash briefly every 15 seconds.

Power Options:

The modem can always be powered through the power input jack on the side of the case. A DC voltage from 5 to 40 volts is allowed. In addition, there is a set of jumpers on the board which allow power to be fed into the modem from either the Ring Pin of the DB9 (pin 9) or through the Shield wire of the serial cable.

Newer Diamond Traffic Products traffic counters support feeding power out to the modem through the standard serial cable on pin #9 (Ring). Newer DTP counters do not need the Ring signal, so this extra pin is used to provide a convenient way to power the modem. Contact Diamond Traffic for more information on this option.

See section 2.1, Jumper Settings, for more information on selecting the power input source as well as other options.

2. Modem Functions

The following sections describe various modem functions and operations. NOTE: The letters DTE refer to the connection from the modem to the traffic counter or other device connected to the modems RS232 Serial Port (DB9). DTE stands for Data Terminal Equipment.

2.1. Jumper Settings

The modem has a block of 4 jumpers which allow customer specific configuration of several modem options. Refer to the chart below for specific information.

Label	Factory	A Setting	B Setting
MOD	B	Keeps modem on all of the time. This increases power draw to about 40mA all of the time.	Shuts modem off after 5 minutes of no TXD or Ring activity. Power draw drops to about 0.1mA when modem is off.
TRA	B	RS232 output lines stay active all of the time. This costs power (about 0.7mA) but allows devices who need these lines active to operate.	Output lines are turned off when modem is off. This saves a lot of power but will prevent CTS and other output lines from the modem from being active.
RNG	B	Connects Ring output on the DB9 to Power Input on the modem. This is useful if you want to feed power to the modem through pin 9 instead of using it as a Ring indicator (which many systems don't need).	Connects Ring output on the DB9 (Pin 9) to Ring detect on the modem module.
SHD	B	Connects the Shield of the DB9 to Power Input on the Modem.	Connects the Shield of the DB9 to Ground on the modem.

2.2. Automatic Speed/Format Sensing

The modem can automatically determine the speed and format of the data sent from the DTE. The modem can sense speeds of: (57.6k) 300, 600, 1200, 2400, 4800, 7200, 9600, 12.0k, 14.4k, 19.2k, 1038.4k, 1157.6k, 12115.2k, 13230.4k, 14245.76k, and 15307.2k

The modem can sense the following data formats:

<u>Parity</u>	<u>Data Length (No. of Bits)</u>	<u>No of Stop Bits</u>	<u>Character Length (No. of Bits)</u>
None	7	2	10
Odd	7	1	10
Even	7	1	10
None	8	1	10
Odd	8	1	11*
Even	8	1	11*

* 11 bit characters are sensed, but the parity bits are stripped off during data transmission in Normal and Error Correction modes.

The modem can sense data with mark or space parity and configures itself as follows:

<u>DTE Configuration</u>	<u>Modem Configuration</u>
7 Mark	7 none
7 space	8 none
8 mark	8 none
8 space	8 even

The modem operates in asynchronous mode and supports a 5V, RS232 - like interface - V.24 (EIA-232-D).

The resident Modulator/Demodulator supports line equalization and forward error correction required at higher speed data rates.

The Cascade Modem is trained to a selected speed with an AT [CR] training sequence. Thus, DTE, to modem interface speed, is locked in regardless of the connecting speed of a remote modem, (with minor restrictions, see the AT+MS command).

This allows for selection of a modulation speed which the modem will support. The DTE modem interface speed should be set to the highest modulation speed to avoid the use of flow control. Flow control facilitates communication with higher speed modems by the DTE so that the data is not lost.

2.3. Modulation/Demodulation

The modem Modulation/Demodulation uses an industry standard modem chip set which has been adapted for use with Cascade Modem. The Modulation/ Demodulation supports the following industry modem standards:

V21 - V.21 (300 bps)
V22 - V.22 (1200 bps)
V.22B - V.22bis (1200 or 2400 bps)
V32 - V.32 (4800 or 9600 bps)
V32B - V.32bis (4800 to 14,400 bps)
V34 - V.34 (16,800 to 33,600 bps)
V90 - V.90 (to 56,000 bps)

2.4. Error Correction/Data Compression

The modem supports the following error correcting protocols:

- V.42 LAPM
- MNP 2-5

The modem supports the following data compression protocols:

- V.42bis
- MNP5

This allows data transmissions from the DTE at up to 115.2K. These DTE speeds are supported by the modem serial interface with auto baud capability. Note the maximum speed is limited by the maximum speed available from the DTE, up to 115.2kbps.

2.5. Non-Volatile RAM (NVRAM)

The modem stores the default settings in NVRAM to protect against failure on power loss or surges. The Cascade modem can store a default setup (done at the factory) to load when first powered. This factory default can be changed by the user with the following procedure. We do not recommend changing the default setup as it cannot be recovered.

The XE5690SM allows a default command string to be automatically loaded into the modem on power-up or modem reset. A series of commands loads the default command string in Hex form into the modem's EEPROM. The EEPROM has 256 bytes available for command storage.

The sequence to load the default commands into EEPROM must begin with the Boot command and ends with a double carriage return. All commands are loaded into the EEPROM in Hex form beginning with address M0000. Up to 8 addresses may be loaded with each command in the sequence.

The following example uses a typical configuration for an embedded application. ATE0 disables command echo; ATQ1 disabled modem responses, and ATSO=1 sets the modem to automatically answer on the first ring. This sequence is loaded into the modem EEPROM with the Boot command using the command sequence below. This places the modem into the desired configuration each time power is applied or the modem is reset

Boot Command Sequence

Command	Description
AT:M0000,42,4F,4F,54,0D,41,54,45	Load characters "B,O,O,T,<CR>,A,T,E" in EEPROM beginning at address M0000
AT:M0008,30,0D,41,54,51,31,0D,41	Load characters "0,<CR>,A,T,Q,1,<CR>,A" in EEPROM beginning at address M0008
AT:M0010,54,53,30,3D,31,0D,0D,0D	Load characters "T,S,0,=,1,<CR>,<CR>,<CR>" in EEPROM beginning at address M0010

2.6. DAA-Telephone Line Interface

High performance modems are extremely sensitive to the DAA (Data Access Arrangement) performance. The difference between a good modem and a fair one is in the DAA performance.

The Cascade Modem includes a specially designed low distortion DAA to achieve optimal performance over all telephone line conditions, achieving the most reliable and best performance telephone connections.

The Cascade Modem is designed to meet North American telephone standards as set by FCC Part 68 and DOC. The telephone line interface is designed to meet 1000 VAC and 1500 volt peak surge isolation, among other parameters. As such it will meet U.S. and Canadian requirements and other international requirements that specify that level of isolation.

The Cascade Modem connection to the telephone network is through a RJ11 jack using the standard Tip and Ring. These two telephone line connections must be routed to an external network for improved field reliability in hostile environments, for Canadian approval, for UL compliance, and also optionally for FCC Part 15 compliance if required.

2.7. Modem States

The modem can be in either a command mode or a data mode. When the modem is idle, it is in the command state. When a data call is in progress it is in the data mode state. The modem does not recognize commands when in the data mode.

To recognize commands the computer must send an "escape sequence" to the modem that forces it out of the data mode and into the command mode. The escape sequence consists of a "guard time" (a period where no characters are sent to the modem), followed by 3 escape characters, followed by a "guard time" again.

At power up the guard time is set to 1 second minimum and the escape character is set as "+". These two parameters can be modified via registers S2 and S12. The modem will stay off-hook with its carrier on after the escape sequence is received. It returns an OK status message when it is ready to accept commands. You may reenter the data mode by issuing the ONLINE command ATO[CR].

2.8. RS232 Serial Interface

The modem uses a standard DB9 style RS232 interface connector. This supports a full RS-232C/V.24 serial interface.

The modem is controlled by sending it serial commands over the TXD (transmit) and can be monitored by serial status messages returned on RXD (receive).

RS232 DB9 Pinout:

Pin #	In/Out	Name	Function
1	Out	DCD	Data Carrier Detect
2	Out	RXD	Received Data
3	In	TXD	Transmit Data
4	In	DTR	Data Terminal Ready
5	-	GND	Ground
6	Out	DSR	Data Set Ready
7	In	RTS	Ready To Send
8	Out	CTS	Clear To Send
9	In/Out	RNG	Ring Output or Power Input
	-	Shield	Ground or Power Input

2.9. Ring Detect Relay

The Cascade Modem can be purchased with an optional 1 Amp Relay Contact Closure. This circuit activates for approx. 2 seconds each time the phone rings, and provides a way for the user to connect other devices or systems to the modem which need a signal indicating a Ring. The most common usage of this feature is to perform an automatic power on of Peek 241 counters.

Connector

Pin #	Wire Color	Function
1	Green	Common Connection
2	Blue	Normally Open
3	Tan	Normally Closed
4	Black	Ground

NOTE: Unless absolutely necessary, do not connect the Ground pin to anything. It is preferable to keep the ground isolated in this case.

2.10. FCC Part 68 Information

The part 68 rules require the following or the equivalent information be provided to the end user of equipment containing a pre-approved modem module.

- **Type of Service**

The Cascade Modem is designed to be used on standard device telephone lines connects to the telephone line by means of a standard jack called the USOC RJ-11C (or USOC FJ45S). Connection to telephone company provided coin service (central office implemented systems) is prohibited. Connection to party lines service subject to state tariffs.

- **Telephone Company Procedures**

The goal of the telephone company is to provide you with the best service it can. In order to do this, it may occasionally be necessary for them to make changes in their equipment, operations or procedures. These changes might affect your service or the operation of your equipment, the telephone company will give you notice, in writing, to allow you to make any changes necessary to maintain uninterrupted service. In certain circumstances, it may be necessary for the telephone company to request information from you concerning the equipment which you have connected to your telephone line. Upon request of the telephone company, provide the FCC registration number and the ringer equivalence number (REN); both of these items are listed on the equipment label. The sum of all of the RENs on your telephone lines should be less than five in order to assure proper service from the telephone company. In some cases, a sum of five may not be usable on a given line.

- **If Problems Arise**

If any of your telephone equipment is not operating properly, you should immediately remove it from your telephone line, as it may cause harm to the telephone network. If the telephone company notes a problem, they may temporarily discontinue service. When practical, they will notify you in advance of this disconnection. If advance notice is not feasible, you will be notified as soon as possible. When you are notified, you will be given the opportunity to correct the problem and informed of your right to file a complaint with the FCC. Contact your telephone company if you have any questions about your phone line. In the event repairs are ever needed on the Cascade Modem they should be performed by Diamond Traffic Products or an authorized representative.

For information contact:

Diamond Traffic Products
P.O. Box 1455
76433 Alder Street
Oakridge, OR 97463
(541) 782-3903
sales@diamondtraffic.com

3. Modem Control

3.1. AT Command Format

The Cascade Modem may be controlled by sending serial ASCII command sequences. After execution of the command, the modem returns a status message to indicate command is executed.

Training the Modem

The modem must be trained to match the DTE speed and parity so that it is able to recognize serial asynchronous commands sent to it. The modem is trained by sending it the following three character sequence.

AT[CR]

Where: A and T is upper case, [CR] represents carriage return. The modem will respond with one of the following status messages, depending on whether it is optioned for abbreviated or English status messages:

O[CR] (Abbreviated form)
[CR][LF][OK][CR][LF] (English form)

Where: [CR] represents carriage return (ASCII 13), [LF] represents line feed (ASCII 10). The modem may be retrained any time while it is idle.

Another attention sequence "A/" is much like the "AT" sequence except it repeats the previously entered command specified with an "AT" prefix. When given, it must also be in upper case ASCII. No carriage return is needed.

The modem will come up in its default state - 19200 baud on power up, or when reset is initiated by the command (ATZ). If desired, any speed, error correction, or data compression can be locked in, using the AT\Nn and/or AT+Ms command.

THE COMMAND FORMAT

Typical commands consist of three elements, the attention sequence, the commands themselves, and a terminating carriage return.

AT[commands][CR]

When entering commands to the modem, the backspace character - control-H (ASCII 8) - can be used to edit mistakes. "AT" and "A/" may not be edited however.

Multiple commands may be placed in the command line. A command line may be as long as 37 characters, excluding AT. The command below instructs the modem to configure itself to not echo characters in the command mode (E0) and then go to answer mode. Note the lack of punctuation between string commands, and spaces are ignored.

ATE0A[CR]

The modem supports the AT Command set with extensions and can operate with industry standard communication software. The commands are compatible with TR302.2/88-08006.

3.2. Status Messages & Result Codes

The modem responds with a status message after each command is executed and result codes after a modem connection is made or attempted. The status messages may either be up to two digits (terse), followed by a carriage return or may be a carriage return and line feed with a message in English (verbose) followed by a carriage return and line feed. Short form and long form respectively

All AT commands, other than dialing commands, will be responded to with either an OK (0) if the command is valid or accepted; or with an error (4) if the command is not recognized. All other messages fall in the category of call progress status or result codes. Such as: Ring (2) - while the remote modem is being called, each ring will be signaled to the DTE. No answer (8) will indicate a failed connection attempt. When the modem connects, result codes will be signaled to the DTE.

Result codes from 1 - 102 are shown below.

The (default) connect messages 10 - 24 and 52-69 indicate a connection at a given DTE speed, not Carrier (Line) speed. Certain subsets of status and result codes can be specified by the ATXn command. The basic status code subsets are enabled with the Xn command. Where n=0,1,2,3,4, 5(all) the status codes can be in message form or result code form. See the detailed description of the ATXn command for result code options.

Result Codes

XE5690SM Responses		
Digits	Verbose	Description
0	OK	Command Successful
1	CONNECT	300 bps or higher connection
2	RING	Ring signal detected
3	NO CARRIER	Carrier not detected
4	ERROR	Error in command line
5	CONNECT 1200	1200bps Connection
6	NO DIAL TONE	No dial tone detected
7	BUSY	Busy signal detected
8	NO ANSWER	Remote does not answer
9	RINGING	Ringback signal detected
10	CONNECT 2400	2400bps Connection
11	CONNECT 4800	4800bps Connection
12	CONNECT 9600	9600bps Connection
14	CONNECT 19200	19200 bps Connection
15	CONNECT 7200	7200 bps Connection
16	CONNECT 12000	12000 bps Connection
17	CONNECT 14400	14400 bps Connection
18	CONNECT 16800	16800 bps Connection
19	CONNECT 21600	21600 bps Connection
20	CONNECT 24000	24000 bps Connection
21	CONNECT 26400	26400 bps Connection
22	CONNECT 28,800	28800 bps Connection
23	CONNECT 31200	31200 bps Connection
24	CONNECT 33600	33600 bps Connection
30	CIDM	Caller ID Detected
31	FLASH	Hookswitch Flash detected
32	STAS	UK Caller ID Alert detected
33	X	Over current Condition

40	BLACKLIST FULL	The buffer for storing blacklisted numbers is full
41	BLACKLISTED	Attempted Number is Blacklisted
42	NO LINE	No Telephone line is connected to the modem
43	LINE IN USE	The attached Telephone line is in use
52	CONNECT 56000	56000 bps Connection
60	CONNECT 32000	32000 bps Connection
61	CONNECT 48000	48000 bps Connection
63	CONNECT 28000	28000 bps Connection
64	CONNECT 29333	29333 bps Connection
65	CONNECT 30666	30666 bps Connection
66	CONNECT 33333	33333 bps Connection
67	CONNECT 34666	34666 bps Connection
68	CONNECT 36000	36000 bps Connection
69	CONNECT 37333	37333 bps Connection
70	PROTOCOL: NONE	No Link Protocol negotiated
77	PROTOCOL V.42	V.42 error correction protocol negotiated
79	PROTOCOL V.42bis	V.42bis data compression protocol negotiated
80	PROTOCOL:ALTERNATE, + CLASS 2	MNP2 error correction negotiated
81	PROTOCOL:ALTERNATE, + CLASS 3	MNP3 error correction negotiated
82	PROTOCOL:ALTERNATE, + CLASS 4	MNP4 error correction negotiated
83	PROTOCOL:ALTERNATE, + CLASS 5	MNP5 error correction negotiated
90	CONNECT 38666	38666 bps Connection
91	CONNECT 40000	40000 bps Connection
92	CONNECT 41333	41333 bps Connection
93	CONNECT 42666	42666 bps Connection
94	CONNECT 44000	44000 bps Connection
95	CONNECT 45333	45333 bps Connection
96	CONNECT 45666	45666 bps Connection
97	CONNECT 49333	49333 bps Connection
98	CONNECT 50666	50666 bps Connection
99	CONNECT 52000	52000 bps Connection
100	CONNECT 53333	53333 bps Connection
101	CONNECT 54666	54666 bps Connection
102	UN-OBTAINABLE NUMBER	DTMF Dial attempt on Pulse only Line

3.3. Basic AT Commands

The XE5690SM uses “AT” commands for configuration and control. This section describes the AT command format and lists the commands, registers and result codes.

Command Mode: The XE5690SM enters command mode on power-up, reset, a lost connection, or receipt of the escape code. In command mode the modem accepts commands from the host on transmit data. Appropriate result codes are returned on received data.

Command Line Format

AT commands follow a strict format. Each command line, except A/, begins with the prefix AT. The “A” and “T” may be both uppercase or both lowercase but cannot be of different cases. The modem determines data rate of the host equipment by measuring the width of the incoming bits of the “A” and “T”.

Multiple commands may be combined into a single command line of up to 48 characters. Commands are executed in the sequence they appear upon receipt of a carriage return. Spaces inserted into the command line are not placed in the buffer.

The command line can be edited with a backspace before it is executed. The backspace erases the previous character in the command line. Register ‘S5’ allows the user to select a character other than backspace to edit the command line.

If the command buffer overflows, the modem issues an “ERROR” result code, and the command line is not executed. Register ‘S3’ allows the user to select a character other than a carriage return to terminate the command line.

Re-Execute Last Command – The A/ command causes the modem to re-execute the last command line. This is the only command which does not require the “AT” prefix.

Omitted Parameters – Most commands include a parameter which determines how the functions will be set. When the command parameter is omitted from the command string, it is assumed to be a ‘0’.

Escape Characters – A 3 character escape sequence may be entered to switch the modem into command mode while on line. The escape character, set by Register ‘S2’, must be entered 3 times in succession to execute the escape. An ‘AT’ command must then be entered within the period defined by S12 to enter command mode. The default escape sequence is ‘+++’.

Result Codes – The modem issues a result code after each action. Result codes may be sent as full words, one, two or three digit numeric codes, or may be disabled all together. Each result code ends with a carriage return when numeric result codes are chosen. When full word result codes are chosen, a Line Feed and Carriage Return precede and follow each result code.

XE5690SM Responses

The XE5690SM allows a default command string to be automatically loaded into the modem on power-up or modem reset. A series of commands loads the default command string in HEX form into the Modem's EEPROM. The EEPROM has 256 bytes available for command storage.

The sequence to load the default commands into EEPROM must begin with the Boot command and ends with a double carriage return. All commands are loaded into the EEPROM in Hex form beginning with address M0000. Up to 8 addresses may be loaded with each command in the sequence.

The following example uses a typical configuration for an embedded application. ATE0 disables command echo; ATQ1 disables modem responses. And ATS0=1 sets the modem to automatically answer on the first ring. This sequence is loaded into the modem EEPROM with the Boot command using the command sequence below. This places the modem into the desired configuration each time power is applied or the modem is reset.

Boot Command Sequence	
Command	Description
AT:M0000,42,4F,4F,54,0D,41,54,45	Load characters "B,O,O,T,<CR>,A,T,E," in EEPROM beginning at address M0000
AT:M0008,30,0D,41,54,51,31,0D,41	Load characters "0,<CR>,A,T,Q,1 <CR>,A" in EEPROM beginning at address M0008
AT:M0010,54,53,30,3D,31,0D,0D,0D	Load characters "T,S,0,=,1,<CR>,<CR>,<CR>" in EEPROM beginning at address M0010

XE5690SM AT Commands

An asterisk (*) indicates the Factory default

A - Answer command

D - Dial Command

0-9,A-D,#,* = Dialing Digits
 P = Pulse dial
 T = Tone dial
 W = Wait for dial tone
 , = Pause for the duration of S8
 ! = Switch hook flash
 ; = Return to the command state

En - Command Echo

n=0 Do not echo commands
 n=1 Enable command echo *

Hn - Switch Hook Control

n=0 Switch hook relay opens
 n=1 Switch hook relay closes

In - Modem Identification

Mn - Speaker Activity

n=0 Speaker off
 n=1 Speaker until carrier received
 n=2 Speaker remains on
 n=3 speaker on after dialing until DCD active

On - Online

n=0 Return On Line with no retrain*
 n=1 Initiate retrain while returning On line
 n=2 Initiate rate renegotiation while returning On line

Qn - Responses

n=0 Send Responses *
 n=1 No Responses

Sr? - Interrogate Register

Sr=n - Set Register Value

S\$ - List values of all S-Registers

Vn - Result Codes

n=0 Numeric Result Codes
 n=1 English Word Result Codes

Xn - Result Code Set

n=0 Responses 0-4
 n=1 Responses 0-5 & 10
 n=2 Responses 0-6 & 10
 n=3 Responses 0-5, 7 & 10
 n=4 Responses 0-8 & 10
 n=5 All Responses

Z - Reset

&Gn – Maximum Data Rate Selection

- n=3 1200 bps
- n=4 2400 bps
- n=5 4800 bps
- n=6 7200 bps
- n=7 9600 bps
- n=8 12000 bps
- n=9 14400 bps
- n=10 16800 bps
- n=11 19200 bps
- n=12 21600 bps
- n=13 24000 bps
- n=14 26400 bps
- n=15 28800 bps
- n=16 31200 bps
- n=17 33600 bps

&Hn – Protocol Selection

- n=0 V.90 with auto fallback to 300 bps *
- n=1 V.90 with fallback to 28,800 bps
- n=2 V.34 with automatic fallback to 300 bps
- n=3 V.34 only (33,600 bps to 2400 bps)
- n=4 V.32bis w/Automatic fallback to 300 bps
- n=5 V.32bis only (14,400 to 4800) bps
- n=6 V.22bis (2400 or 1200 bps)
- n=7 V.22 (1200 bps)
- n=8 Bell 212 (300 bps)
- n=9 Bell 103 (300 bps)
- n=10 V.21 (300 bps)
- n=11 V.23 (1200/75 bps)

&S – Display current AT& settings.

&Tn – Modem Test Modes

- n=0 Cancel Test Mode
- n=3 Initiate Analog Loopback

&Z – Sleep Mode; wake on Incoming Ring

%B – Report Blacklisted Numbers

%C – V.42bis Data Compression

- N=0 Data Compression Disabled *
- N=1 Bidirectional Data Compression Enabled
- N=2 Data Compression Transmit Only
- N=3 Data Compression Receive Only

%On – Answer Mode

- n=1 Answer in Answer Mode*
- n=2 Answer in Originate Mode

%Vn – Shared Line Use

- n=0 No auto detection of local line status*
- n=2 Check line voltage before going off-hook.
“NO LINE” response if line is unavailable
and “LINE IN USE” if line is off hook.

%% – Display current AT% settings.

\Bn – Character Length

- n=0 6N1; 6 data bits, no parity, 1 stop bit
- n=1 7N1; 7 data bits, no parity, 1 stop bit
- n=2 7P1; 7 data bits, 1 stop bit, parity set by
“AT\P” command
- n=3 8N1; 8 data bits, no parity, 1 stop bit, *
- n=5 8N1; 8 data bits, 1 stop bit, parity set by
“AT\P” command
- n=6 8X1; 8 data bits, 1 stop bit, 1 escape bit
enabling 9th bit escape mode.

\Nn – Error Control Mode

- n=1 Normal Mode
- n=2 MNP Required
- n=3 V.42 auto reliable mode *
- n=4 LAPM required for connection
- n=5 V.42 or MNP required

\Pn – Parity Setting

- n=0 Even Parity selected*
- n=1 Space Parity selected
- n=2 Odd Parity selected
- n=3 mark Parity selected

\Qn – Modem to DTE Flow Control

- n=0 No Flow Control
- n=2 CTS Flow Control only *
- n=3 RTS/CTS Flow Control
- n=4 XON/XOFF Flow Control

\Tn – DTE Rate

n=0 300 bps
N=1 600 bps
N=2 1200 bps
N=3 2400 bps
N=4 4800 bps
N=5 7200 bps
N=6 9600 bps
N=7 12.0 kbps
N=8 14.4 kbps
N=9 19.2 kbps
N=10 38.4 kbps
N=11 57.6 kbps
N=12 115.2 kbps
N=13 230.4 kbps
N=14 245.76 kbps
N=15 307.2 kbps
N=16 Autobaud on AT command*

2E = Czech Republic
31 = Denmark
35 = Ecuador
3C = Finland
3D = France
42 = Germany
46 = Greece
50 = Hong Kong
51 = Hungary
53 = India
57 = Ireland
58 = Israel
59 = Italy
61 = South Korea
69 = Luxembourg
6C = Malaysia
73 = Mexico
7B = Netherlands
7E = New Zealand
82 = Norway
87 = Paraguay
89 = Philippines
8A = Poland
8B = Portugal
92 = Singapore
9F = South Africa
A0 = Spain
A5 = Sweden
A6 = Switzerland
B4 = United Kingdom
B5 = United States*
B8 = Russia
FE = Taiwan

\Vn – Connect Response

n=0 Issue Connect and Protocol Responses *
n=2 Issue Connect Response only
n=4 Issue Connect and Protocol Responses
with both transmit and receive data rates.

:I – Read Interrupts

Reports the lower 8 bits of User Register U70.
Reading the Interrupts clears them and resets
the /INT pin.

:M#### - Load Boot Command to EEPROM
beginning at address #####

:R – Read all User Registers

:Rnn – Read user Register nn

:Unn,xxxx – Write hex value xxxx to User Register
nn. To write to multiple User Registers in one
command line, address the first register in the
sequence. Subsequent values will be loaded into
successive registers. The :U command uses the
format AT:Unn, xxxx, yyyy, zzz, ... <CR> to load
multiple registers.

+CGI=n – Country Configuration

0 = Japan
9 = Australia
A = Austria
F = Belgium
16 = Brazil
1B = Bulgaria
20 = Canada
26 = China
27 = Columbia

+GCI? – Report Country Configuration

+MS – Select Modulation

AT+MS sets the modulation and data rates to be supported by the modem. The command format is: AT+MS=a,b,c,d,e,f<CR>

a – modulation type

V21 – V.21 (300 bps)

V22 – V.22 (1200 bps)

V.22B – B.22bis (1200 or 2400 bps)

V32 – V.32 (4800 to 9600 bps)

V32B – V.32bis (4800 to 14,400 bps)

V34 – V.34 (16,800 to 33,600 bps)

V90 – V.90 (to 56,000 bps)

b- Automode Detection

0 – Automatic Negotiation Disabled

1 – Automatic Negotiation Enabled

c – Min receive data rate (300-56000 bps)

d – Max receive data rate (300-56000 bps)

e – Min transmit data rate (300-56000 bps)

f – Max transmit data rate (300-56000 bps)

+VCID=n – Caller ID Enabled

n=0 No Caller ID*

n=1 Formatted Caller ID Data presented

n=2 Raw Caller ID Data presented

+VCDT=n – Caller ID Type

n=0 On only after first ring

n=1 CID Always On

n=2 UK CID Format

n=3 Japanese CID Format

3.4. S-Register Summary

S0 Answer on *n*th Ring: S0 sets the modem to automatically answer on the *n*th ring. Setting S0 to 0 disables automatic answer.

Range: 0 to 255
Units Rings
Default 0

S1 Ring Count: S1 is a read-only register showing the number of rings detected. If no ring is detected within 8 seconds, S1 is reset.

Range: 0 to 255
Units Rings
Default 0

S2 Escape Character: S2 sets the ASCII escape character. Values of 0-127 select valid characters; values from 128 to 255 disable the escape sequence.

Range: 0 to 255
Units ASCII Character
Default 43 (+)

S3 Line Termination Character: S3 determines the ASCII Character which will terminate commands and modem responses.

Range: 0 to 127
Units ASCII Character
Default 13 (Carriage Return)

S4 Line Feed Character: S4 sets the ASCII Character to act as a line feed character in modem responses.

Range: 0 to 127
Units ASCII Character
Default 10 (Line Feed)

S5 Backspace Character: S5 defines the ASCII character used as a backspace to edit the command line.

Range: 0 to 127
Units ASCII Character
Default 8 (Back Space)

S6 Dial Tone Wait Time: S6 determines how long the modem waits for dial tone before dialing. The Dial Tone Wait Time cannot be set to less than two seconds.

Range: 0 to 255
Units Seconds
Default 2

S7 Wait for Carrier After Dialing: S7 Determines how long the modem waits for a valid carrier signal after dialing.

Range: 0 to 255
Units Seconds
Default 80

S8 Comma Pause Time: S8 defines the duration of the pause initiated by a comma in the dialing string. The pause is generally used when waiting for a second dial tone.

Range: 0 to 355
Units Seconds
Default 2

S9 Carrier Detect Response Time: S9 establishes the length of time the remote modem's carrier must be present to be recognized as valid.

Range: 0 to 255
Units 0.1 Seconds
Default 6

S10 Carrier Off Disconnect Delay: S10 selects how long carrier must be lost before the modem disconnects. If S10 is smaller than S9 or S10 is set to 255, the modem will not disconnect on any loss of carrier.

Range: 0 to 255
Units 0.1 Seconds
Default 14

S12 Escape Code Guard Timer: S12 sets the escape sequence guard timer. If characters are received before or after the escape sequence, within the guard timer, the modem aborts the escape and remains in data mode.

Range: 0 to 127
Units ASCII Character
Default 10 (Line Feed)

S14 Wait for Dial Tone Delay: S14 determines how long the modem will wait for dial tone when the W dial modifier is used.

Range: 0 to 255
Units Seconds
Default 12

S24 Sleep Inactivity Timer: S24 sets the length of inactivity before the modem enters sleep mode. Zero disables sleep mode.

Range: 0 to 255
Units Minutes
Default 0

S30 Disconnect Inactivity Timer: S30 sets how long the modem remains on line with no data flowing. Zero disables the timer.

Range: 0 to 255
Units Minutes
Default 0

S38 Hang Up Delay Timer: S38 determines the maximum delay between receipt of ATH0 command and modem disconnect.

Range: 0 to 255
Units Seconds
Default 20

S40 Test Data Pattern: S40 sets the test pattern to be used by the AT&T4 and AT&T5 commands.

0 = All Spaces (0)
1 = A Marks (1)
2 = Random Data

S41 V.34 Symbol Rate: S41 sets the V.34 test pattern symbol rate to be used by the AT&T4 and AT&T5 commands.

0 = 2400 symbols/second 2400-21,600 bps
1 = 2743 symbols/second 4800-26,400 bps
2 = 2800 symbols/second 4800-26,400 bps
3 = 3000 symbols/second 4800-28,800 bps
4 = 3200 symbols/second 4800-31,200 bps
5 = 3429 symbols/second 4800-33,600 bps*

S42 Blacklisting: S42 controls the Blacklisting in the XE5690SM. Blacklisting regulates how frequently the modem can unsuccessfully dial a number. An attempt to dial beyond the limit will result in a receipt of the 'BLACKLISTED' result code.

S42 = 0 Disabled
S42 = 1 Enabled

S43 Dial Attempts before Blacklisting: S43 determines how many dial attempts will be allowed before Blacklisting blocks a call.

Range: 0 to 4
Units Number of Calls
Default 4

S44 Blacklisting Timer: S44 sets the duration of the Blacklisting period.

Range: 0 to 255
Units Seconds
Default 180

S50 Minimum Off-Hook Duration: S50 determines the minimum length of time the modem will remain off-hook. An attempt to drop the line before this timer expires will be ignored by the modem.

Range: 0 to 255
Units Seconds
Default 3

3.5. AT Command Applications

Pause

When placing a call from an office with a telephone connected to a PBX it may be necessary to dial an access code (usually the digit 9) to get an outside line. Inserting a comma in the telephone number commands the modem to pause for a specific length of time. The factory default pause time is 2 seconds.

Example : Dial 9, pause, dial number.

Enter : ATDT9, T1234567

Multiple commas may be used for a greater delay time.

Touch Tone and Pulse Dialing "T" and "P"

The modem can use DTMF (touch-tones) "T," or dial pulses "P" when dialing a telephone number. If the dial command does not specify which type to use, the modem defaults to the type last specified. The power-on default value is T.

Example : Pulse dial 9, pause, touch-tone dial number

Enter : ATDP9, T1234567

Redial Last Number "A/"

Use A/, the repeat command, to redial the last telephone number dialed when a busy signal is received.

Return to Command State ";"

The modem can be forced to reenter the command state after dialing (without hanging up) by ending the dial command with a semicolon. This is useful when using the modem as an auto dialer.

Example : Touch-tone dial 9, pause, dial number, return for command.

Enter : ATDT9;1234567

Automatic Answering

The S0 register controls the number of rings that must occur before the modem answers a call. The register may range in value from 0-255.

S0=0 DO NOT ANSWER TELEPHONE

S0=1-254 ANSWER ON RING 1 TO RING 254

S0=255 ANSWER ON RING 255

*When S0 is set to 0, the modem will not auto-answer.

Dial a Number "D"

The Dial command takes the form Dn, where "n" is a string of characters. In the simplest form, "n" will be only the digits of the phone number to be dialed.

Example : Dial number.

Enter : ATD5554567

In response to this command, the modem dials the telephone number "555-4567" and then waits for carrier from a distant modem. If no carrier is detected within a given time (the default time is 30 seconds), the modem automatically releases the line and sends a NO CARRIER result code.

If carrier is detected, the modem gives a CONNECT result code and goes on-line, permitting communication with the distant modem.

The Dial Command may also be issued without a telephone number. ATD causes the modem to pick up the telephone line without dialing a number.

3.6. Factory Settings & Default States

Diamond Traffic Products pre-initializes all modems with the following command sequence:

57.6k Baud Model:

```
AT&FE0M1Q0V0X1\N5\Q0&C1&D2S0=2
AT\T9+GCI=B5 (COUNTRY CODE =US)
```

This sets the entire correct modem configuration into non-volatile memory so that it works on power up. This can also be sent through the Centurion Software in the modem setup initialization lines or through any terminal program manually.

These settings can be summarized as follows:

- &F Restore factory defaults (see below).
- E0 Do not echo commands
- M1 Speaker on until carrier received
- Q0 Turn On Result Codes
- V0 Short form (number) responses
- X1 Use results codes 0-5 & 10 (Extended Result Codes)
- \N5 Error control V.42 or MNP required
- \Q0 No flow control enabled
- &C1 Make carrier signal match actual state.
- &D2 Hangup modem on DTR transition.
- S0=2 Answer phone after two rings.