TM Ultra

Telephone Modem

User Manual

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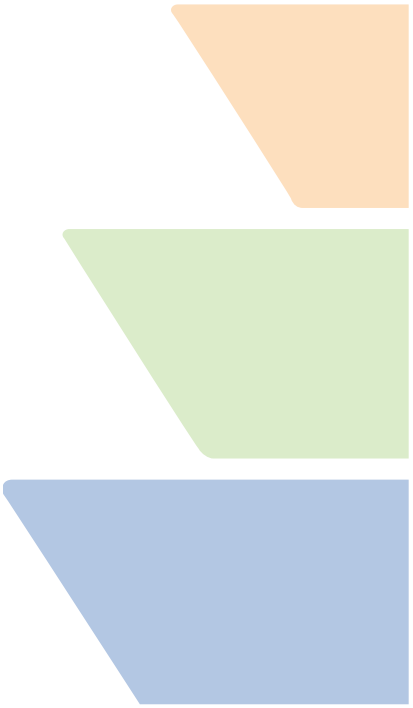
Chapter 1 Introduction



1.1 Description

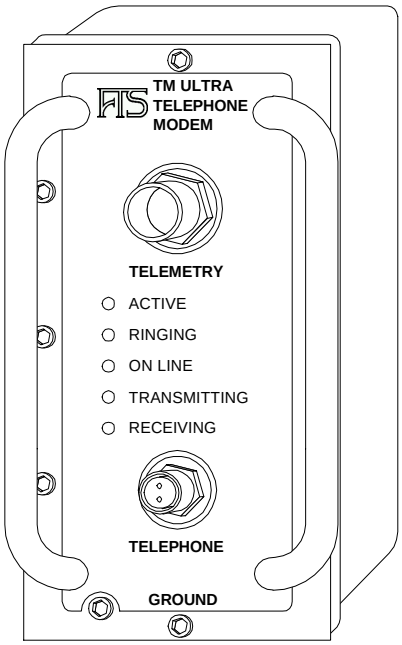


Figure 1-1: TM Ultra modem physical package

The TM Ultra is a field hardened telephone modem designed to operate under the harsh conditions found in remote monitoring applications. It supports standard modulation, error control and data compression protocols so that it can connect with any standard desktop PC modem without need for special initialization strings for the PC modem.

Connection to the telephone line and to the data terminal equipment (usually a datalogger) is via waterproof military connectors on the modem's front panel. The cast aluminum case is O-ring sealed and contains a desiccant pack to protect the internal electronics from corrosion due to moisture. The case is designed to be mounted on a wall or equipment enclosure back panel.

Three-stage surge suppression is provided on all connector pins to protect against lightning and electrostatic discharge. A heavy ground stud is also provide for connecting a site ground system to the modem. The telephone connection is also protected against power cross faults which occur when power lines accidentally come in contact with the telephone lines. This condition is commonly caused when telephone company cables are damaged during wind storms.

The TM Ultra is designed as a low power device. It operates from a 6 - 20 VDC supply and uses 260 micro amps in standby mode. When in standby mode the modem will answer incoming calls and respond to serial communications from the data terminal equipment. It will return to standby mode approximately 25 seconds after a call is completed or serial data stops. Standby mode can be disabled by asserting the DTR line.

1.2 Factory default status, performance and specs

Default connect speed	14,400 bps
Serial port data rate auto baud	enabled
Bell 212A operation	1200 bps
Parity	none
Auto answer	disabled
Command echo	on
Result codes	all enabled, except \REL codes
Dialing method	touch-tone (T)
Busy signal detection .	on (ATX4)
Full word result codes	non-extended
Pulse dial make/break ratio	39/61 - 10 psp
Test timer	0 seconds
Test modes	disabled
Inactivity timer	0 min
CTS	always active
DSR	ignored
DCD	ignored
RTS to CTS delay	0.01 seconds
DTR	always active; hangs up after transition
Long space disconnect	disabled
Speaker	enabled; off when receiving carrier
Speaker volume	low
Local modem will not grant RDL request from remote modem.	
Guard tone	disabled
Minimum DTR pulse width	0.05 s
Ring count	0
Escape code character	ASCII 43 (+)
Flash to on hook	70 ms
Auto speed detection .	enabled

DTE connect speed, connect messages	
Back space character	ASCII 08 (BS)
Carriage return character	ASCII 13 (CR)
Line feed character	ASCII 10 (LF)
Wait for dial tone before dialing	2 s
Wait for carrier after dialing	50 s
Carrier detect response time	0.6 s
Escape code guard time	1 s
Pause after comma	2.0 s
Lost carrier to hang up delay	1.4 s
DTMF interdigit delay	0.095 s
Auto sync address or address detection	0
Connection detected at DTE - Highest speed 38,400bps.	
Auto retrain	enabled; 30 seconds attempt
MNP error correction	can be negotiated (&Q5)
MNP	non-extended service selected
MNP error correction block size	128 characters selected
Data compression negotiation	enabled
Transmit break length	0.3 s
Breaks	transmitted in sequence with data
Serial port flow control	enabled depending on intended use RTS/CTS

NOTE: Upon power-up modem will recall user profile 0 which may override the above Factory Defaults.

1.3 Type of service

The TM-Ultra is designed to be used on standard device telephone lines. It 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 is subject to state tariffs.

1.4 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. If 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 on the back of the modem. 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 useable on a given line.

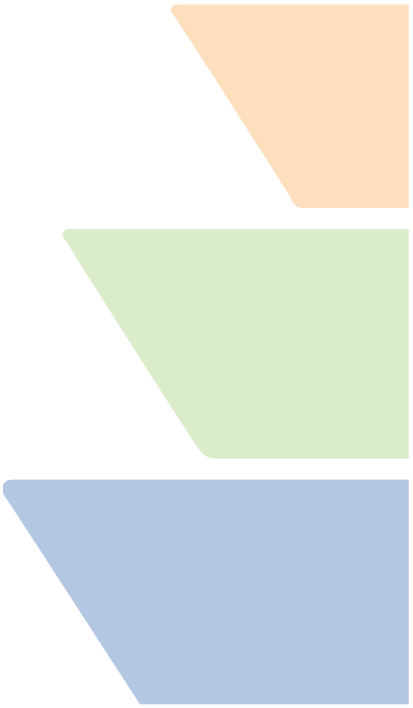
1.4.1 If problems arise

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 TM-Ultra, they should be performed by FTS Forest Technology Systems or an authorized representative of FTS Forest Technology Systems. For information contact: FTS Forest Technology Systems at any of the telephone numbers or addresses listed in the beginning of this user's manual.

Chapter 2 Installation



2.1 Pre-installation setup

Each TM Ultra unit is pre-configured at the factory to work with the datalogger it is intended for use with. Normally, your TM Ultra should work "out of the box" and you should not have to do any pre-installation setup. Only in special cases will you need the information in this section.

Pre-installation setup may be needed on TM Ultra units that are being moved to another application environment or are otherwise are misconfigured for their currently intended use. FTS is happy to perform pre-installation set-up in these cases if you wish (please contact us).

Certain customers prefer to do pre-installation setup for themselves. If you are one of these customers, you will need the custom TM Ultra setup cable sent to you from FTS and the information in the table below.

Pre-installation setup consists of sending the TM Ultra certain command strings from a PC running a terminal emulation program such as Windows Terminal or Hyperterminal. Command strings must be sent at 9600 BPS, no parity, 8 data bits, 1 stop bit.

The command strings you must send depend on the datalogger (and in some cases, the datalogger connector) with which the TM Ultra unit will be used. The question comes down to whether the datalogger uses flow control when communicating with the TM Ultra.

Consult the table below for the command strings required for your datalogger:

Dataloggers	Flow control	Command strings

FWS-12S
FWS-12S, Telemetry Port, RMX
	Enabled	`AT&F&C1&D0[cr]`
		`AT+MS=V32B,1,2400,14400,2400,14400[cr]`
		`AT\N5-K1[cr]`
		`ATS10=50S0=1[cr]`
		`AT\V1E0[cr]`
		`AT&W0&W1[cr]`

FWS-11
FWS-12S, Display Port
Axiom F6, H2, or H1, FTS Port
	Disabled	`AT&F&C1&D0[cr]`
		`AT+MS=V32B,1,2400,14400,2400,14400[cr]`
		`AT\N5-K1[cr]`
		`ATS10=50S0=1[cr]`
		`AT&K0\V1E0[cr]`
		`AT&W0&W1[cr]`

2.2 Mounting

The TM-Ultra is designed to be mounted on a 1/8-inch thick metal enclosure panel that has been punched with keyholes to accept the shoulder screws on the back of the modem case. Simply align the shoulder screws with the keyholes and slide it down until it stops. Alternately, the modem can be mounted on any reasonably flat wall surface using the mounting kit available from FTS.

To install using the mounting kit first remove the shoulder screws from the back of the case align the mounting plate with the shoulder screw holes and re-install and tighten the shoulder screws. Next hold the modem in the desired location on the wall surface and mark the position of the mounting slots on the wall. Finally drill holes at the marked positions and mount the modem using screws or bolts appropriate for the mounting surface type.

2.3 Grounding

In order for the modem's lightning protection system to operate properly the modem must be well grounded. The grounding stud on the lower left of the front panel is provided for this purpose.

Connect the grounding stud to the site ground with a short length of 12 AWG or larger ground wire. The ground wire should be routed away from other circuits with as few bends as possible. The site ground should consist of driven ground rods, Ufer ground system or buried ground radial conductors or combinations of all three. The lower the impedance of the ground connection, the better chance the modem has of surviving surges caused by lightning.

2.4 Cables

2.4.1 Telephone and telemetry connections

The TM-Ultra is always supplied with two cables. First is a cable for connecting to the telephone system. It has a two pin military style connector on one end and a common RJ-11 connector for plugging into a telephone jack on the other. The second is a telemetry cable that connects the TM-Ultra to the datalogger and in some cases to an external power supply.

First connect the two pin MS connector on the end of the telephone cable to the black connector marked **TELEPHONE** on the TM-Ultra front panel. Connect the other end of this cable to a RJ-11 telephone wall jack that is in a dry location out of the weather. Next connect the blue coded 10 pin MS connector to the blue connector marked **TELEMETRY** on the TM-Ultra front panel. Connect the green coded MS connector on the other end of this cable to the green connector marked **TELEMETRY** on the datalogger.

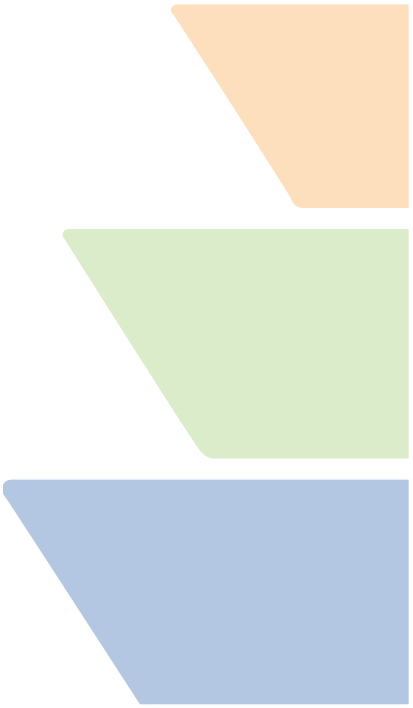
2.4.2 Power for FWS-11, FWS-12, and FWS-12S dataloggers

The power supply will be either an AC adapter or a pair of ring lugs for connecting to the station's battery pack depending, on the option ordered. Connect the power supply by plugging in the AC adapter or connecting the ring lugs to the battery terminals.

2.4.3 Power for Axiom dataloggers (F6, H1, H2)

Axiom dataloggers provide power to the TM Ultra through the telemetry port. There is no need for a separate power connection.

Chapter 3 Troubleshooting



Five status lights have been included on the front panel to help in troubleshooting. These lights are normally off when the modem is not active, to save power. They should only come on when a connection is in progress or if either the datalogger or a remote modem is attempting to establish a connection. The following is a brief description of each light's function.

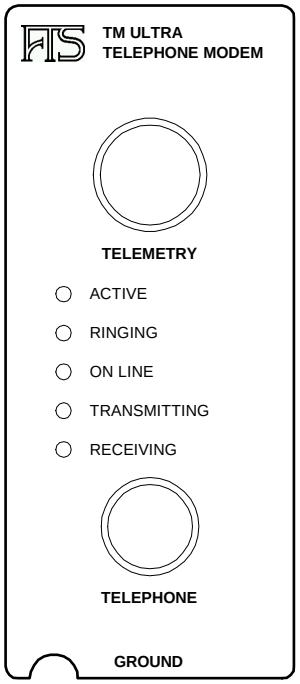


Figure 3-1: The TM-Ultra front panel.

ACTIVE	This light is on when power is applied and the modem is not in sleep mode. The modem will not be in sleep mode immediately after power is applied, if a ring signal has been detected within the last 25 seconds, if the logger has sent data to the modem in the last 25 seconds, if the DTR line is being held on or if a connection is in progress.
RINGING	This light will flicker briefly when a ring signal is detected on the telephone line. That is, when the modem is being called. The ACTIVE light should come on almost immediately after this light flickers as the modem comes out of sleep mode.
ON LINE	This light will come on and stay on when a connection with a remote modem is established. If the RINGING light flickers followed by the ACTIVE light coming on but the ON LINE light does not come on, then the modem is unable to establish a connection. This may be due to the modem not being in auto answer mode, the remote modem not being in a compatible mode, or a poor telephone line.
TRANSMITTING	This light will come on when the datalogger sends data to the modem. If the modem is not active (ACTIVE light off) when this light flickers the modem should immediately become active in order to process the data from the logger.

RECEIVING	This light will come on when the modem sends data to the datalogger. If a remote connection is established and this light flickers periodically before the call is dropped, it is probably due to the modem not being able to wake up the datalogger. This could be caused by a damaged cable to the datalogger, a low power supply voltage to the datalogger, or a damaged datalogger.

Chapter 4 Specifications

Power Supply Voltage:	6-20 VDC
Power Consumption (@ 12 VDC)	133 mA when off hook 126 mA when on hook 0.26 mA quiescent
Electrical protection	Three stage transient suppression on all input and output termination's for lightning and electrostatic discharge protection. Self healing power cross protection on Telephone line connection: 110VAC Tip to Ring, 110VAC Tip or ring to ground. Self healing reverse polarity power supply protection.
Operating temperature range:	-40 to +85 C
Approvals/Certifications	FCC part 68 approved
Interoperability	Connects with commercially available modems without special initialization commands.
Connect time including dialing:	15 - 20 s
Connection speeds	300, 1200, 2400, 4800, 9600 or 14400 bps
Modulation	V.34bis, V.34 V.DC, V.32bis, V.32, V.22bis, V.22A/B, V.23, V.21, Bell 212A and Bell 103
Error Correction	V.42 LAMP, MNP 2-4 and MNP 10 enhanced throughput cellular
Data Compression	V.42bis and MNP 5
Modem Control Protocol	AT command structure with extensions
Lines	DTE interface supports txd, rxd, rts, cts, dtr and dsr lines.
Adaptability	Automatic baud rate adaptability

Chapter 5 AT commands

5.1 Overview

5.1.1 AT commands

An "AT command" is an ASCII string that can be sent to the modem to set its configuration or instruct it to perform certain actions. Each such command must begin with the characters AT.

This chapter outlines the key information on AT commands as it applies to the TM Ultra. For full details, see the FTS external document numbered "701-Cermetek Modem AT-Commands-S-Register-Rev-H4-1."

5.1.2 Definitions

A command line is a string of characters sent from a controller (e.g., a computer) to the modem while the modem is in a command state. A command line has a prefix, a body, and a terminator.

Each command line (with the exception of the A/ command) must begin with the character sequence AT and must be terminated by a carriage return (denoted [CR]).

Commands entered in upper case or lower case are accepted, but both the A and T must be of the same case, i.e., "AT" = ASCII 065, 084 or "at" = ASCII 097, 116.

The body is a string of commands restricted to printable ASCII characters (032-126). Space characters (ASCII 032) and control characters other than [CR] (ASCII 013) and [BS] (ASCII 010) in the command string are ignored.

The default terminator is the ASCII [CR] character. Characters that precede the AT prefix are ignored.

Example

AT**E0A**[CR]

E0A is the body of the command.

5.1.3 Entering and editing AT commands

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.

5.1.4 AT command set

See Page 14 for a summary list of AT commands.

5.1.5 Status messages and 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.

Status messages may either be terse (one or two decimal digits, followed by a carriage return) or may be verbose (a carriage return and line feed, followed by a message in English, followed by a carriage return and line feed). See Table 5-1 below.

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. Examples:

- 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, non-extended, from 9 - 35 are listed in Table 5-1 below. Result codes extended beyond 35 can be optionally selected with the ATXn command and status register S95. It is recommended that the non-extended result codes be used in all cases. The (default) connect messages 9 - 17 indicate a connection at a given DTE speed, not Carrier (Line) speed. Hence a TM-Ultra will connect at maximum speed of 19,200 (15). Certain subsets of status and result codes can be specified by the ATXn command.

The basic status code subsets are enabled with the X*n* command, *n* = 0, 1, 2, 3, 4. Status codes can be in message form or result code form. See the detailed description of the **ATXn** command for result code options.

Extensions to the basic set can be specified by Register S95, which covers result codes 40 - 81.

Options with S95 are:

- Enable compression result codes 66, 67, 69 Enable error protocol result codes 76, 77, 80, 81
- Enable carrier result codes 40 - 58
- Enable DCE rather than DTE speed result codes 59 - 64
- To obtain a detailed status report of a given modem communication, use the AT\V1 command. When this command has been executed at setup the modem will return a connect message on line consisting of:
  `<DTE speed> <modulation> <error protocol> <line speed of connection>`

Table 5-1: Status messages and result codes

Terse	Verbose	Result Codes (ATXn)				
		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 0600	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

Terse	Verbose	Result Codes (ATXn)				
		0	1	2	3	4
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
25	MESSAGE-WAITING					
32	BLACKLISTED	4	4	4	4	X
33	FAX	X	X	X	X	X
35	DATA	X	X	X	X	X
40	+MRR:300	X	X	X	X	X
42	+MRR: 600	X	X	X	X	X
44	+MRR: 1200/75	X	X	X	X	X
45	+MRR: 75/1200	X	X	X	X	X
46	+MRR: 1200	X	X	X	X	X
47	+MRR: 2400	X	X	X	X	X
48	+MRR: 4800	X	X	X	X	X
49	+MRR: 7200	X	X	X	X	X
50	+MRR: 9600	X	X	X	X	X
51	+MRR: 12000	X	X	X	X	X
52	+MRR: 14400	X	X	X	X	X
66	+DR: ALT	X	X	X	X	X
67	+DR: V.42B	X	X	X	X	X
68	+DR: V44	X	X	X	X	X
69	+DR: NONE	X	X	X	X	X
70	+ER: NONE	X	X	X	X	X
77	+ER: LAPM	X	X	X	X	X
80	+ER: ALT	X	X	X	X	X
81	+ER: ALT-CELLULAR	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
91	CONNECT 31200	X	X	X	X	X
130	+ILRR	X	X	X	X	X

134	+MCR: B103	X	X	X	X	X
135	+MCR: B212	X	X	X	X	X
136	+MCR: V21	X	X	X	X	X
137	+MCR: V22	X	X	X	X	X
138	+MCR: V22B	X	X	X	X	X
139	+MCR: V23	X	X	X	X	X
139	+MCR: V23C	X	X	X	X	X
140	+MCR: V32	X	X	X	X	X
141	+MCR: V32B	X	X	X	X	X
210	+MRR: 25333	X	X	X	X	X
211	+MRR: 26667	X	X	X	X	X
212	+MRR: 25333	X	X	X	X	X
213	+MRR: 22666	X	X	X	X	X
214	DIGITAL LINE DETECTED	X	X	X	X	X

Note: X in a column indicates that the message will be generated when that particular value of 'n' (shown at the top of the column) has been selected by the use of ATXn. A numeral indicates which less explicit message (verbose or terse form) will be output for that X option.

5.2 Selected AT commands

This table includes only the most common AT commands and those used in the pre-installation setup (section 2.1). For full details, see the FTS external document numbered "701-Cermetek Modem AT-Commands-S-Register-Rev-H4-1."

Command	Function	
A/	Re-execute command	
A	Go off-hook and attempt to answer a call	
B0	Select V.22 connection at 1200bps	
B1	Select Bell 212A connection at 1200bps	
C1	Return OK message	
Dn	Dial modifier	
	P	Pulse Dial
	T	Touch Tone Dial
	W	Wait for Dial Tone
	;	Return to Idle State
	@	Wait for Quiet Answer Command
	!	Flash Hook
	,	Pause
	0-9/ABCD	Dial Digits/Characters
	&	Wait for credit card dial tone
	^	Toggles calling tone
	L	Redial last number

	*	Star digit - tone dialing
	S=n	Dial the number and store in directory. N=0 to 3
E0	Turn off command echo	
E1	Turn on command echo	
F0	Select auto-detect mode (equivalent to N1)	
F1	Select V.21 or Bell 103	
F2	Reserved	
F3	Select V.23 line modulation	
F4	Select V.22 or Bell 212A 1200bps line speed	
F5	Select V.22bis line modulation	
F6	Select V.32bis or V.32 4800 line modulation	
F7	Select V.32bis 7200 line modulation	
F8	Select V.32bis or V.32 9600 line modulation	
F9	Select V.32bis 12000 line modulation	
F10	Select V.32bis 14400 line modulation	
H0	Initiate a hang-up sequence	
H1	If on-hook, go off-hook and enter command mode	
&C0	Force RLSD active regardless of the carrier state	
&C1	Allow RLSD to follow the carrier state	
&D0	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6. The modem ignores DTR	
&D1	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6. Asynchronous escape	
&D2	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6. The modem hangs up	
&D3	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6. The modem performs soft reset	
&F0	Restore factory configuration 0	
&F1	Restore factory configuration 1	
&K0	Disable DTE/DCE flow control	
&K3	Enable RTS/CTS DTE/DCE flow control	
&K4	Enable XON/XOFF DTE/DCE flow control	
&K5	Enable transparent XON/XOFF flow control	
&K6	Enable both RTS/CTS and XON/XOFF flow control	
\N0	Select normal speed buffered mode	
\N1	Select direct mode	
\N2	Select reliable link mode	
\N3	Select auto reliable mode	
\N4	Force LAPM mode	
\N5	Force MNP mode	
\V0	Connect messages are controlled by the command settings X, W, and S95	
\V1	Connect messages are displayed in the single line format	
+MS	Select modulation	

&W0	Store the active profile in NVRAM profile 0
&W1	Store the active profile in NVRAM profile 1
-K0	Disable MNP 10 extended services
-K1	Enable MNP 10 extended services
-K2	Enable MNP 10 extended services detection only

5.3 S-register summary

Register	Function	Range	Units	Saved	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 for Dial Tone	2-255	s		2
S7	Wait Time for Carrier	1-255	s		50
S8	Pause Time for Dial Delay Modifier	0-255	s	*	2
S9	Carrier Detect Response Time	1-255	0.1s	*	6
S10	Carrier Loss Disconnect Time	1-255	0.1s	*	14
S11	DTMF Tone Duration	50-255	0.001s	*	95
S12	Escape Prompt Delay	0-255	0.02s	*	50
S13	Reserved	-	-		-
S14	General Bit Mapped Options Status	-	-	*	138 (8Ah)
S15	Reserved	-	-		-
S16	Test Mode Bit Mapped Options Status (&T)	-	-		0
S17	Reserved	-	-		-
S18	Test Timer	0-255	s	*	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		-	*	62 (3Dh)
S24	Reserved	-	-		-
S25	Delay to DTR Off	0-255	s or .01s		5
S26	RTS-to-CTS Delay	0-255	0.01s		1
S27	General Bit Mapped Options Status	-	-	*	73 (49h)
S28	General Bit Mapped Options Status	-	-	*	0
S30	Disconnect Inactivity Timer	0-255	10s		0
S31	General Bit Mapped Options Status	-	-	*	194 (C2h)
S32	XON Character	0-255	ASCII		17 (11h)
S33	XOFF Character	0-255	ASCII		19 (13h)
S34-S35	Reserved	-	-		-
S36	LAPM Failure Control	-	-	*	7

S37	Line Connection Speed	-	-	*	0
S38	Delay before Forced Hang-up	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)
S42-S45	Reserved	-	-		-
S46	Data Compression Control	-	-	*	138
S48	V.42 Negotiation Control	-	-	*	7
S82	LAPM Break Control	-	-		128 (40h)
S86	Call Failure Reason Code	0-255	-		-
S95	Result Code Messages Control	-	-	*	0

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

5.4 Modem states - dial a number "D"

The modem can be in either a command mode or a data mode. When the modem is idle it is in the command state. The Dial command takes the form `D`*n*, where *n* is a string of data characters. In the simplest form, *n* will be only the digits of the phone number to be dialed.

When a call is in progress the modem is in the data mode state. The modem does not recognize commands when in the data mode. For the modem 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 (see section 5.3).

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 re-renter the data mode by issuing the ONLINE command `ATO[CR]`.

Example: Dial number.

Enter: `AT D5554567`

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.

5.5 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. Since a modem communicates data serially, and most host products handle data in a parallel format, a UART is needed to make parallel-factory serial-to-serial and serial-to-parallel translations. The 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: `AT DT9, 1234567;`

Result: `OK`

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 (the modem will not auto-answer)

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

`S0=255` ANSWER ON RING 255