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**AT Commands and S Registers
as used with
MARC 2400 Baud Modems**



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COMMAND SET REFERENCE GUIDE

The standard AT Command Set is used to communicate with the MARC 2400 Baud Dial-up modems. A typical command string begins with ASCII "A" and "T" or "a" and "t". The modem uses these first two characters to determine the data rate, number of bits, and type of parity that is being used. The modem then buffers the command string in its RAM until a carriage return, [CR], is transmitted. Once the [CR] is received, the modem begins to execute, in order, all of the commands in the string. The number of characters in this string should not exceed 40. If the modem encounters an illegal command, a command that cannot be executed, or more than 40 characters, it immediately aborts the execution of the command string and issues an ERROR message. If the command string is proper, the modem will execute all commands and send an OK message.

Many of the commands require a numeric parameter. If this parameter is missing, the modem will automatically assume that the parameter is 0, if appropriate. If the parameter exceeds the expected values the modem will either abort and issue an ERROR or it will extract the modulus from the parameter based on the greatest expected value (e.g. if n is expected to be 0, 1, 2, 3, then n=5 will be treated as $n=5 \text{ Mod } 4=1$).

The modem has no non-volatile memory so it will default to the factory defaults each time power is applied or whenever a call is completed.

The modem is always in one of two modes of operation. The modem enters into Data Mode once a connection has been established with a remote modem. In Data Mode, any data transmitted from the PLC to the modem is modulated and transmitted to the remote modem; and, similarly, any data received from another modem is demodulated and sent to the PLC. The modem can be in Data Mode only when the modem has established a communications link with a remote modem (The only exception to this is during diagnostic tests - See &Tn commands). At all other times, the modem is in Command Mode. When in Command Mode, the modem will respond to AT commands issued from the PLC.

While in Data Mode, if it is necessary to issue commands to the modem without severing the communications link to the remote modem, an escape sequence may be issued from the PLC to the modem. The escape sequence consists of three escape characters followed by an AT command. The escape sequence must have a guard time before and after the three escape characters. The escape character is defined by register S2 (default is +, ASCII 043) and the guard time is defined by register S12 (default is 1 second, $50 \times 0.02\text{s}$). The default escape sequence is:

(1s) +++ (1s) AT . . .

Once the modem has been shifted into Command Mode during a data link, the modem can be returned to Data mode with the ATO command.

“AT” Command Set Summary*

Basic Commands	Function
AT	Attention Code
A	Answer Command
A/	Repeat Last Command
Bn	Communications Standard Option
C	Squelch Transmitter
D	Dial Command
En	Off-line Character Echo Option
Hn	Switch Hook Control Option
Ln	Speaker Volume Option
Mn	Speaker Control Option
On	On-line Command
P	Pulse Dial
Qn	Result Code Display Option
Sn	Select an S Register
Sn=	Write to an S Register
Sn?	Read an S Register
Vn	Result Code Form Option
Xn	Result Code Set/Call Progress Option
Yn*	Long Space Disconnect Option
+++	Escape Code Sequence
,	Pause
?	Returns Last Addressed S Register

Table 1 AT COMMANDS

Dial Modifiers	Function
P	Pulse Dial the following digits
R	After dialing, modem transmits Answer tone and awaits response from originating modem
T	Tone Dial the following digits
W	Wait For Dial Tone
;	(Semi-colon) Return to command mode after dialing
@	Wait for Quiet Answer Command
!	Flash Hook Modem pulses on-hook
,	(comma)Pause for 2 seconds
0-9	Dialing Digits/Characters
A,B,C,D	
#,*	

Table 2 DIAL MODIFIERS

AT Command Set Summary (Continued)

Ampersand Commands	Function
&Cn	Data Carrier Detect Option
&Dn	Data Terminal Ready Option
&F	Load Factory Defaults
&Gn	Guard Tone Option
&Mn*	Communications Mode Option
&Pn	Make to Break Ratio Selection
&R	Clear to send option
&Sn	Data Set Ready Option
&Tn*	Test Command Selection
&V*	Display current profile
&Xn	Synchronous Transmit Clock Source Option

Table 3 Ampersand Commands

Result Codes

Result codes are the messages that the modem sends in response to the AT commands. The result codes may be issued in verbose form (English words and phrases) or in numeric form, as selected by the Qn, Vn, Wn and Xn commands.

Verbose	Numeric	Description
OK	0	Command executed
CONNECT	1	Connection at 0-300 bps
RING	2	Ring signal detected
NO CARRIER	3	Carrier signal not detected or lost
ERROR	4	Invalid command, checksum, error in command line or command line too long
CONNECT 1200	5	Connection at 1200 bps
NO DIALTONE	6	No dial tone detected
BUSY	7	Busy detected
NO ANSWER	8	5 sec of silence not detected (dial modifier @ in effect)
CONNECT 2400	10	Connection at 2400 bps

Table 4 MODEM Result Codes

“AT” Command Definitions

Command	Definition
AT	Preceded all commands
A	Answer command - Modem will immediately go off-hook, wait 2 seconds, transmit Answer tone, and wait for response from an Originating modem in order to establish a data connection
A/	Repeat last command (This is the only command that is not preceded by “AT”).
Bn	Communication standard option 0: Selects CCITT V.22 mode when the modem is at 1200 bps, and CCITT V.21 when the modem is at 300 bps 1: Selects Bell 212A when the modem is at 1200 bps, and Bell 103 when the modem is at 300 bps
C	Dummy Command
D	Dial command - This command may only be followed by dialing digits (0-9, *, #, A-D) or dial modifiers (see Table 2). Modem goes off-hook dials the dialing digits and waits for Answer tone in order to establish data connection.
En	Off-line echo command - When in command mode, modem echoes all data from TXD to RXD 0: Echo disabled 1: Echo enabled
Hn	Switch hook control 0: Go on-hook 1: Go off-hook
Ln	Speaker Volume (no speaker on some models) 0: Lowest speaker volume 1: Low speaker volume 2: Medium speaker volume 3: High speaker volume
Mn	Speaker control (no speaker on some models) 0: Speaker always off 1: Speaker on until carrier present 2: Speaker always on 3: Speaker off during dialing and on until carrier
On	Go on-line - If the modem has established a data connection but is currently in command mode, this command switches the modem back to data mode. 0: Returns modem to a previously established state. 1: Begins an equalizer retrain sequence, then returns to on-line state.
P	Enable pulse dialing (See D Command)

"AT"Command Definitions (Continued)

Qn	Result code display option - This command enables or disables the modem's responses (or Result Codes) to the AT commands. 0: Result codes enabled 1: Result codes disabled 2: Result codes enabled in ORIGINATE mode only
Sn	Select an S Register
Sn=x	Write to an S Register Assigns the value x to S register n (n=0-27, x=0-255)
Sn?	Read an S register (n=0-27)
Vn	Result code form - Modem will respond to AT commands with either English phrases or numeric codes 0: Numeric form 1: Verbose form
Xn	Result codes and call progress option 0: Enables Result codes 0-4 only Disables busy and dial tone detect codes 6 & 7 1: Enables Result codes 0-4 and CONNECT codes; Disables busy and dial tone detect codes 2: Enables Result codes 0-4, dial tone detect (code 6), and CONNECT codes; Disables busy detect (code 7) 3: Enables Result codes 0-4, busy detect, and CONNECT codes; Disables dial tone detect 4: Enables all Result codes
Yn	Long Space Disconnect 0: Disable long space disconnect 1: Enable long space disconnect
+++	Escape Code sequence (Default-selectable with S register 2)
,	Pause for 2 seconds

AT Command Definitions (Continued)

Ampersand Commands	Definitions
&Cn	Data carrier detect (DCD) option 0: State of carrier from remote modem is ignored; DCD output is always active 1: State of carrier from remote modem is tracked; DCD output reflects state of the carrier
&Dn	Data terminal ready (DTR) option 0: Modem ignores DTR input 1: On-to-off DTR transition causes modem to switch from data mode to command mode 2: On-to-off DTR transition causes modem to go on-hook, switch to command mode, and disable auto-answer mode 3: On-to-off DTR transition causes modem to reset 4: On-to-off DTR transition causes modem to deliver all buffered data, hang-up and switch to command mode
&F	Load factory settings
&Gn	Guard tone Option 0: No guard tones 2: 550 Hz guard tone 2: 1800 Hz guard tone
&Pn	Dial pulse ratio 0: Make=39%, Break=61% for use in the United States 1: Make=33%, Break=67% for use in certain other countries
&R	CTS/RTS Option This command is overridden when serial port hardware flow control is enabled. See Qn command 0,1: CTS output is always active 2: CTS output mimics RTS input 3: CTS output follows CCITT recommendations
&Sn	Data set ready option 0: DSR output circuit always on 1: DSR output active during handshaking and while data linked to another mode, or when carrier is lost

AT Command Definitions (Continued)

&Tn*D	Diagnostic test command 0: Terminate test 1: Local analog loopback (transmit and receive in low channel). The modem's low frequency modulator is looped back to the demodulator such that data presented on the TXD input is returned to the RXD output for comparison 3: Local activated remote digital loopback (RDL). The data received from a remote modem is transmitted back to the remote modem. This command can only be activated after a data connection with a remote modem has been established. 4: Grant request from remote for RDL. Data connection must be previously established. 5: Deny request from remote for RDL test 6: Remote digital loopback test. Requests that remote modem activate RDL 7: Remote digital loopback with self-test 8: Local analog loopback with self-test
&V*	View active configuration and stored profile Modem will display current configuration, configuration stored in profile 0,

Modem S Register Summary

Register	Function
S0*	Ring to Answer
S1	Ring Count
S2	Escape Code Character
S3	Carriage Return Character
S4	Line Feed Character
S5	Back Space Character
S6	Wait for Dial Tone
S7	Wait Time for Data Carrier
S8	Pause Time for Comma
S9	Carrier Detect Response Time
S10	Lost Carrier to Hang-Up Delay
S11	DTMF Dialing Speed
S12	Escape Code Guard Time
S14*	Bit Mapped Options Register
S16	Modem Test Options
S18*	Test Timer
S21*	Bit Mapped Options Register
S22*	Bit Mapped Options Register
S23*	Bit Mapped Options Register
S25*	Delay to DTR
S26*	TRS to CTS Delay Interval
S27*	Bit Mapped Options Register

Notes:
* This S-Register is stored in the modem RAM upon receipt of the S = command so that the contents are not preserved when modem power is removed.

“S” Register Definitions

The S registers can be read or written by using the S command. To write to an S register use the command:

ATSn=x[CR]

where n is the register number and x is the value to be assigned. To read an S register use the command:

ATSn?[CR]

Many of the S registers are duplicates of other AT commands. These registers provide the user with a simple method to query the status of several profile parameters.

Reg	Name and Description	Range	Default	Units
0	Ring to auto-answer Modem will automatically answer an incoming call after x rings. When x=0, auto-answer is disabled.	0-255	0	rings
1	Ring Count x=number of incoming rings. x resets to zero after each call	0-255	0	rings
2	Escape character While in data mode, three escape characters preceded and followed by S12 Guard Time will cause modem to switch to command mode.	0-255	043	ASCII
3	Carriage return character [CR]	0-127	013	ASCII
4	Line feed character [LF]	0-127	010	ASCII
5	Backspace character [BS]	0-127	008	ASCII
6	Wait before dialing after off-hook	2-255	2	sec.
7	Wait for carrier After dialing or answering, modem will attempt connection for x seconds before aborting.	1-255	30	sec.
8	Pause time for comma dial modifier When using “,” in dial command, modem will pause x seconds.	0-255	2	sec.
9	Carrier detect response time Carrier must be present this long before modem responds.	1-255	6	0.1sec
10	Lost carrier hang up delay If, during an established connection, carrier is disrupted for this long, modem hangs up	1-255	14	0.1sec.
11	DTMF dialing speed	50-255	95	0.001sec
12	Guard time (See S2)	0-255	50	0.02sec.

“S” Register Definitions (Continued)

Reg	Name and Description	Range	Default	Units
14	Bit mapped options Bit 0 reserved Bit 1 0 E0 is selected 1 E1 is selected Bit 2 0 Q0 is selected 1 Q1 is selected Bit 3 0 V0 is selected 1 V1 is selected Bit 4 reserved Bit 5 0 T is selected Bit 6 reserved Bit 7 0 Answer mode 1 Originate mode	--	10 (OAH)	--
16	Modem test options See also &Tn command Bit 0 0 local ALB disabled 1 local ALB enabled (&T1) Bit 1 reserved Bit 2 0 local DL disabled 1 local DL enabled (&T3) Bit 3 0 RDL off 1 RDL in progress (&T6) Bit 4 0 RDL not active 1 RDL request from distant end is in service Bit 5 0 RDL w/self-test disabled 1 RDL w/self-test enabled (T8) Bit 6 0 ALB w/self-test disabled 1 ALB w/self-test enabled (&T8) Bit 7 reserved	--	0 (OOH)	--
18	Modem test timer	0-255	0	sec.

"S" Register Definitions (Continued)

Reg	Name and Description	Range	Default	Units
21	Bit mapped options Bit 0 0 &J0 is selected 1 &J1 is selected Bit 1 reserved Bit 2 0 &R0 is selected 1 &R1 is selected Bit 4,3 00 &D0 is selected 01 &D1 is selected 10 &D2 is selected 11 &D3 is selected Bit 5 0 &C0 is selected 1 &C1 is selected Bit 6 0 &S0 is selected 1 &S1 is selected Bit 7 0 Y0 is selected 1 Y1 is selected	--	0 (OOH)	--
22	Bit mapped options Bit 1,0 00 Reserved 01 L1 is selected 10 L2 is selected 11 L3 is selected Bit 3,2 00 M0 is selected 01 M1 is selected 10 M2 is selected 11 M3 is selected Bit 5,4 00 X1 is selected 01 X2 is selected 10 X3 is selected 11 X4 is selected Bit 6 0 X0 is selected 1 X1-X4 is selected Bit 7 0 &P0 is selected 1 &P1 is selected	--	118 (76H)	--

"S" Register Definitions (Continued)

23	Bit mapped options Bit 0 0 &T5 is selected 1 &T4 is selected Bit 3,2,1 000 0-300 bps DTE speed 001 1200 bps 010 2400 bps 011 4800 bps 100 7200 bps 101 9600 bps 110 19.2 Kbps 111 38.4 Kbps Bit 5,4 00 even parity 01 space parity/no parity 10 odd parity 11 mark Bit 7,6 00 &G0 is selected 01 &G1 is selected 10 &G2 is selected	--	27 (1BH)	--
25	Detect DTR change (on-line state)	0-255	5	0.1sec.
26	RTS to CTS delay interval	0-255	1	0.01sec.
27	Bit mapped options Bit 0-5 reserved Bit 6 0 B0 is selected 1 B1 is selected Bit 7 reserved	--	64 (40H)	--

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