Chapter 8 OPTIONS

This chapter describes the options available to expand the functionality of the Macintosh Portable. ▪

8.1 The modem card

The following information is given to support developers who are

- Developing software to drive the Apple modem
- Developing hardware to fit into the modem slot, and the software to go with it

The modem card is an "AT" compatible 2400/1200/300 bps auto-dial, auto-answer modem. Its design is optimized for use in the Macintosh Portable. As a result, the modem requires little power while operating and has a sleep state in which only the ring detect circuitry is powered.

Summary of modem card features

The features include

- 2400/1200/300 bps data rates; meets Bell 103 and 212A, and CCITT V.21, V.22B and V.22 bis standards
- Automatic restoration of previous configuration at power up (warm start)
- Software selectable Bell 212A/103 or CCITT V.22/V.21 modes (B command)
- Data formats:

  7 data bits, 1 parity bit (even, odd, mark, or space parity), 1 stop bit

  7 data bits, no parity, 2 stop bits

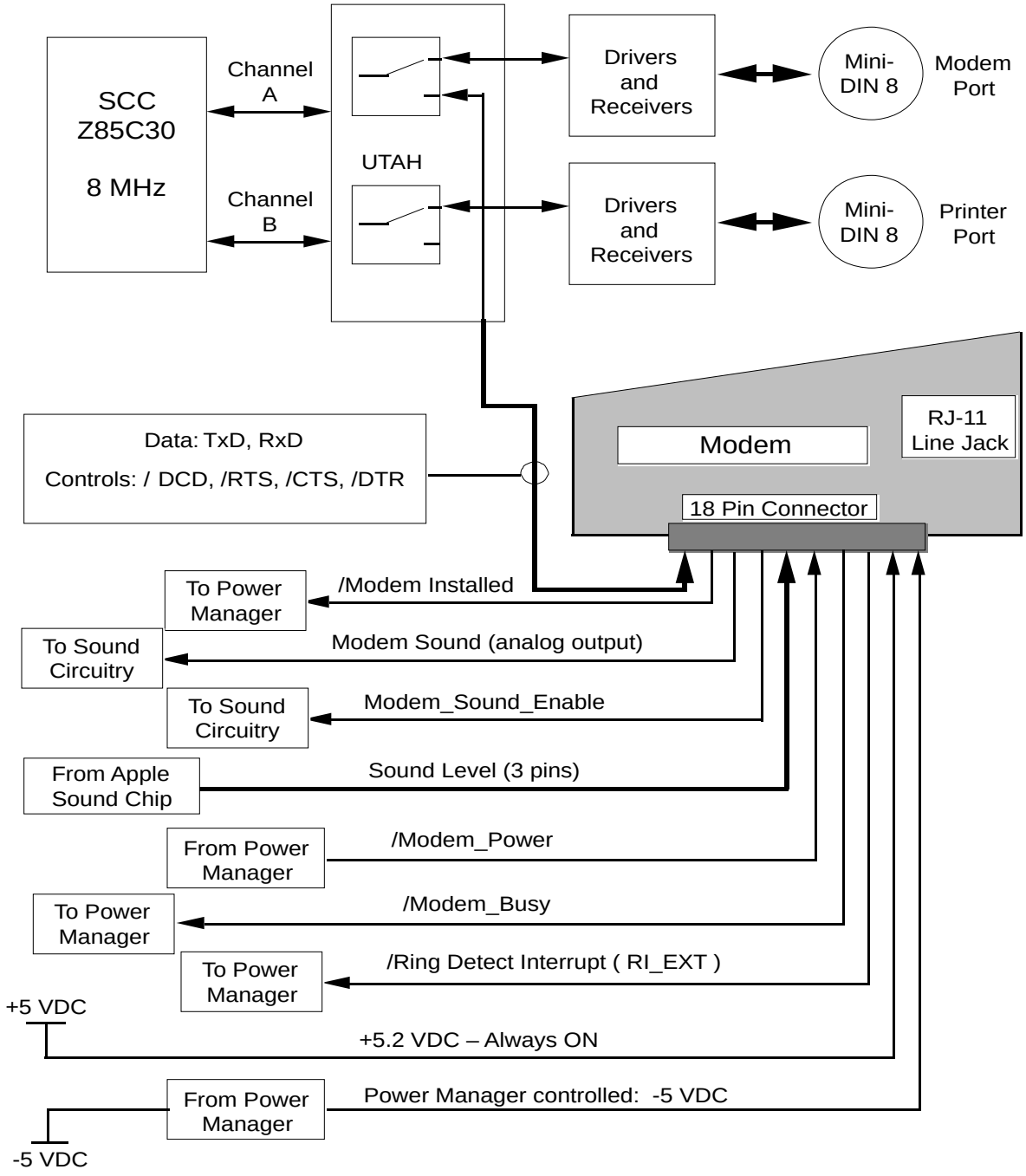
  8 data bits, no parity, 1 stop bit
- Subset of “AT” command set (Hayes 2400)
- Automatic Adaptive Equalization on the receive channel
- Asynchronous operation only
- Auto-dial and auto-answer
- Pulse and DTMF dialing
- Full call progress detection: busy, dial tone, ring, ringback, 2nd dial tone
- Local analog and digital loopback self-test, and remote digital loopback self-test with test pattern generation (AT&Tn commands)

- 40-character buffer memory
- Designed to meet FCC Part 68 and Part 15 class B
- Low power dissipation: 500 mW maximum / 450 mW typical
- ± 5 V operation
- Compact size: 14 in^2 (3 in x 4.75 in)
- Single RJ-11 phone jack
- Analog output pin for audio monitoring of modem operation
- Sleep state: requires only +5 V for ring detect circuitry and maintenance of configuration at power down
- Domestic/Canadian Data Access Arrangement (DAA) design

Hardware interface

The hardware interface between the Macintosh Portable and a modem card inserted into the modem expansion slot is illustrated in Figure 8-1.

Figure 8-1 Macintosh Portable Serial Port Configuration and Modem Interface



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The data access between the Macintosh Portable CPU and the modem is an 18–pin dual inline socket connector on the modem card. The data is at TTL levels (V_{IL} = 0 to 0.8 V; V_{IH} = 2.8 to V+; I_{OL}=1.6 mA; I_{OH}=-25 µA).

The internal connector that receives the modem card has pinouts as in Table 8-1. Table 8-2 relates signal names and functional descriptions.

Table 8-1 Modem Connector Pinout

Pin number	I/O Type	Signal Name
1	I (Input)	/Modem_Pwr (controlled through the power manager processor)
2	Ground	GND
3	I	/RTS
4	O (Output)	/DCD (Carrier Detect)
5	O	RxD (Receive Data) [to SCC RxD]
6	O	/CTS
7	O	Modem_Sound (Analog Out)
8	I	TxD (Transmit Data) [to SCC TxD]
9	O	/RI_EXT (Ring Detect Interrupt)
10	–5V	-5 VDC (controlled through the power manager processor)
11	+5 V	+5 VDC (always on)
12	I	/DTR (Data Terminal Ready)
13	I	V1 (volume control-LSbit)
14	I	V3 (volume control-MSbit)
15	I	V2 (volume control)
16	O	Modem_Ins
17	O	/Modem_Busy
18	O	MS_Enable (Modem Sound Enable)

Table 8-2 Modem Connector Signal Descriptions

Pin Number	Signal Description
Pin 1	/Modem_Pwr – This active low signal comes from the power manager. For details on the use of this pin, see the section headed “Power Control Interface”.
Pin 2	GND – Electrical ground.
Pin 3	/RTS – The Request to Send signal from the Macintosh Portable is ignored by the the modem since it is meaningless in full duplex operation. This pin is a no-connect on the modem.
Pin 4	/DCD – The behavior of the Data Carrier Detect pin depends on the state of the &C command.
Pin 5	RxD – Data received by the modem is sent to the Macintosh Portable over the RxD pin.
Pin 6	/CTS – Clear to Send is asserted whenever the modem is powered. This pin is grounded on the modem.
Pin 7	Modem_Sound – This is the analog sound output for the modem.
Pin 8	TxD – Data for the modem to transmit and commands for the modem comes from the Macintosh Portable over this serial pin.
Pin 9	/RI_EXT – This pin is used to signal the Macintosh Portable that a ring is present (see the section “Ring Detect Signal”). If the Macintosh Portable is in the sleep state, the assertion of this pin will cause the Macintosh Portable to return to the operating state and power-up the modem.
Pin 10	-5VDC – The -5V supply is guaranteed to be present whenever the /Modem_Pwr pin is asserted. However, this pin may float or go to ground anytime following the negation of /Modem_Pwr.
Pin 11	+5VDC unswitched – Whenever the Macintosh Portable has power available, this pin will supply +5.2 VDC ± 5% (see the section “Power Supply and Dissipation”).
Pin 12	/DTR – The behavior of the Data Terminal Ready pin depends on the state of the &D command (see “&D: DTR Options” under “Command Definitions”)

Table 8-2 Modem Connector Signal Descriptions (Continued)

Pin Number	Signal Description
Pin 13	V1 – This is the least significant bit of the three volume control bits. This pin may remain high following the negation of /Modem_Pwr.
Pin 14	V3 – This is the most significant bit of the three volume control bits. This pin may remain high following the negation of /Modem_Pwr.
Pin 15	V2 – This is the second bit of the three volume control bits. This pin may remain high following the negation of /Modem_Pwr.
Pin 16	/Modem_Ins – This pin is always asserted (i.e., ground on the modem) whenever the modem is installed in the Macintosh Portable.
Pin 17	/Modem_Busy – This pin is asserted whenever the modem is "busy." For details on the use of this pin, see the section "Power Control Interface."
Pin 18	MS_Enable – The modem asserts the modem sound enable pin (active high) whenever it has its sound monitor "on." Sound may be heard on the speaker of the Macintosh Portable if the modem drives Modem_Sound (pin 7) without asserting MS_Enable.

Analog output

The analog output (Modem_Sound) is as follows:

Output impedance:	5 Ω Max.
Output load :	500 Ω Max.
Output voltage:	Typ. ± 0.65 V p-p
	Max. ± 1.5 V p-p
Offset voltage:	Typ. ± 3 mV
	Max. ± 15 mV

Power supply and dissipation

The modem card operates from a ± 5 VDC ± 5% Macintosh Portable supply (battery or battery and charger). The total power consumption by the modem in a fully operational state is 500 mW Max / 450 mW Typical; in the sleep state the consumption is 0.3 mW when no ring is detected and 4.5 mW when a ring is detected. The power-up reset time is less than 500 ms.

Under normal operation, +5 VDC is supplied by pin 11; -5 VDC is supplied by pin 10. During the sleep state only +5 VDC is supplied.

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Power control interface

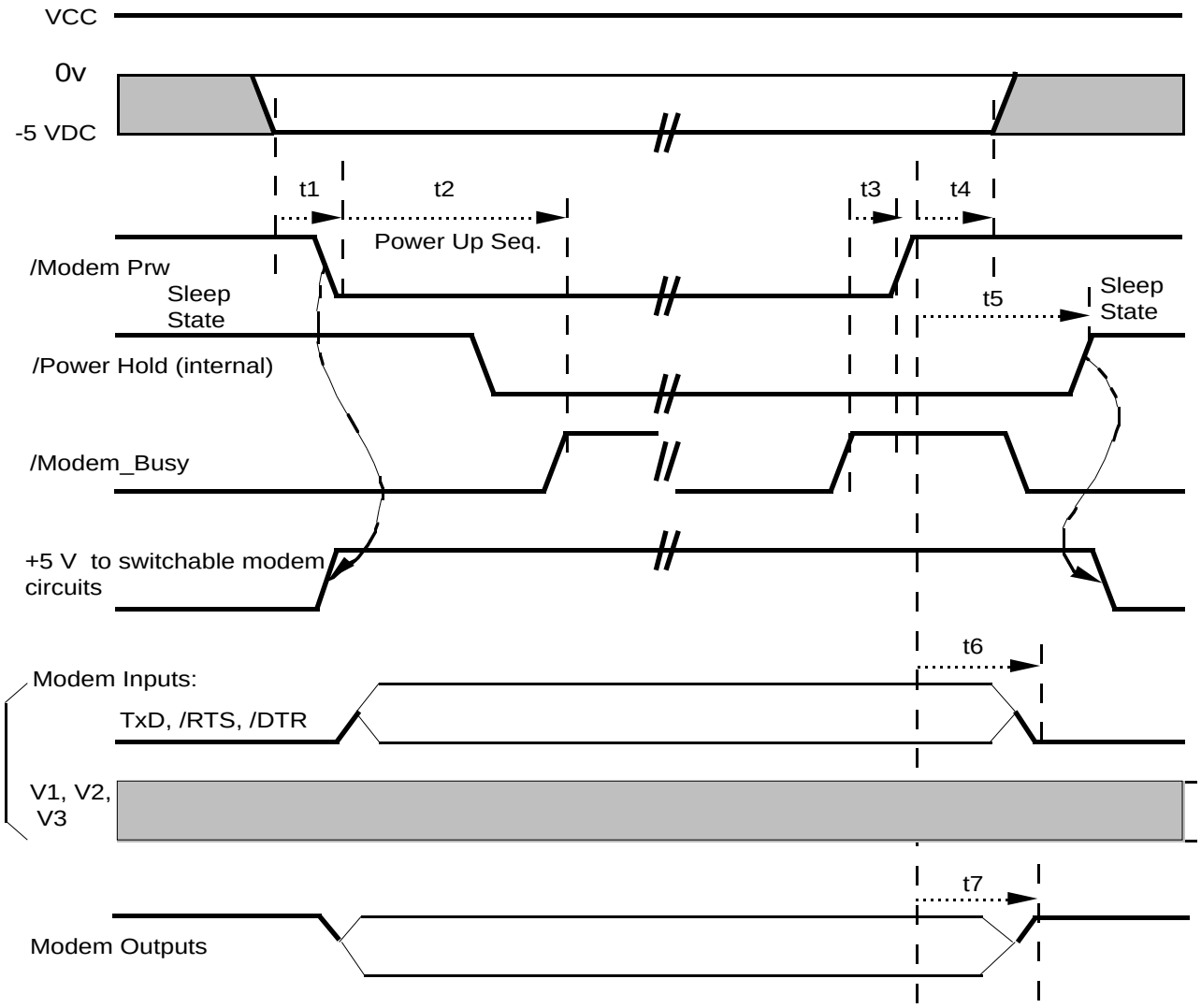
The modem is powered on or off through /Modem_Pwr and /Modem_Busy. The modem asserts /Modem_Busy whenever any of the following is true:

- the modem is executing its power-up sequence
- the modem is off-hook (for any reason)
- the modem is executing a command where "command execution" begins with the <CR> at the end of an AT command sequence or the "/" of the repeat last command sequence ("a/" or "A/")

If the modem is executing any of the self-tests, it is considered to be executing a command and therefore "busy."

The power manager processor controls the /Modem_Pwr signal (see the Power Up/Power Down Timing Diagram, Figure 8-2). If /Modem_Pwr is negated (high), the modem should immediately power-off regardless of what it is doing. The modem enters the sleep state within at most 500 ms following the negation of /Modem_Pwr (t5). Prior to sleeping, the modem forces all its outputs high (except pins 7, 16, and 18 which are driven low), stores its operating parameters and register values for restoration following sleep, and reduces its power consumption to meet the maximum sleep power limitation (see the previous section "Power Supply and Dissipation'). All inputs to the modem, except for the three volume bits and /Modem_Pwr, will be at ground within 50ns (t6) of the negation of /Modem_Pwr. The volume bits will always reflect the current volume setting.

Figure 8-2 Power Up/Power Down Timing Diagram



Time:	t1	t2	t3	t4	t5	t6	t7	t8
Min	0	–	0 *	0				
Max	–	500ms	–	–	500ms	500ms	500ms	

*** : t3 > 0 can be respected or not by the CPU**

Most often, the power manager will not negate /Modem_Pwr if the modem has /Modem_Busy asserted. However, there are times when the power manager must turn the modem off even though it is "busy." If this occurs, the modem stops its "busy" activity (e.g., goes on-hook) and performs the necessary activities in preparation for the sleep state. If it is executing a command when it is put into the sleep state, the modem should either complete the command or ignore it and restore the state prior to beginning execution of the command, whichever takes the least amount of time.

Ring detect signal

The /RI_EXT line (pin 9) is asserted during most of the AC cycle of a ring and is used to signal the Macintosh Portable CPU that a ring is present. Both ringing and pulse dialing will trigger the ring detector. The microprocessor in the modem distinguishes between a ring and pulse dialing by detecting the frequency of the signal. If the modem is powered down, the Macintosh Portable can determine whether /RI corresponds to a ring or pulse dial by powering up the modem and reading the appropriate register or looking for the "RINGING" result code.

	Rings	Pulse Dialing
Frequency	15–68 Hz	10 Hz
Duty Cycle	30–95 %	<20 %

The drive capability of the /RI output is:

V_{OH} = 2.8 V I_{OH} = -35 µA

V_{OL} = 0.5 V I_{OL} = 500 µA

Telephone network interface (Data Access Arrangement)

The telephone interface is a balanced, two-wire telephone interface design meeting FCC part 68 rules and DOC rules.

One eight-wire RJ-45 type jack is included and wired as follows:

Pin 4 for TIP signal
Pin 5 for RING signal

Pins 1, 2, 3, 6, 7, and 8 are not used.

The jack on the rear of the modem card is an RJ-11 type. This allows a common RJ-11 plug used on single-line telephone equipment to be be inserted, completing the connection of a phone to the modem.

Standards information for reference

The following compilations of signal characteristics are provided for reference only.

Compatibility and modulation

Standard	Speed (bps)	Modulation	Baud
CCITT V.22 bis		2400	QAM 600
CCITT V.22B		1200	DPSK 600
CCITT V.21	300/110	FSK	300/110
Bell 212A	1200 bps	DPSK	600
Bell 103	300/110 bps	FSK	300/110

Transmit carrier frequencies

V.22 bis/V.22/212A	Transmit Carrier
Originate	1200 Hz
Answer	2400 Hz

Bell 103	Mark	Space
Originate	1270	1070
Answer	2225	2025

V.21	Mark	Space
Originate	980	1180
Answer	1650	1850

Guard tone frequencies and transmit levels (CCITT only)

1800 Hz ± 20 Hz @ 6 ±1 dB below the transmit carrier level.
550 Hz ± 20 Hz @ 3 ±1 dB below the transmit carrier level.

Answer tone frequency

V.22 bis/V.22/V.21	2100 Hz
Bell 103/212A	2225 Hz

Received signal frequency tolerance

Offset frequency ± 7 Hz

Command Definitions

The modem implements the commands listed below. The commands can be either uppercase or lowercase characters. However, the attention characters must be either all uppercase or all lowercase (i.e., “AT” or “at”). The action in response to a command often depends upon the operating state of the modem, either local command (command) or on-line:

- local command state—In the local command state, *commands* are issued by the Macintosh Portable to set up the link parameters. The modem listens while a command is being entered and does not execute the command until the command terminating character, specified in register S3, is received. The only exceptions to this rule are the “A/” or “a/” command and the escape command.
- on-line state—The modem goes on-line after connecting with the remote terminal. In the on-line state, *data* is transmittted or received.

1. **AT**: Attention Code

All commands must begin with the attention code AT. If not set, the speed and parity of the Macintosh Portable interface are determined from this command. The remainder of the command line contains commands for the modem.

2. **A/**: Repeat Last Command

The A/ command instructs the modem to repeat the last command line. A/ is used in place of the AT command. A command termination character (register S3, default of <CR>) is not required for execution of this command.

3. +++: Return to the Local Command State (Escape Command)

The escape command, which consists of [Escape Guard Time (S12)][three escape characters (S2)][Escape Guard Time (S12)], is used to force the modem back to the local command state from the on-line state. The actual escape character is specified by register S2, expressed as the ASCII decimal value of the escape character (default is 43 = “+”). After the escape command is executed, the modem sends an “OK” result code to host. The escape guard time is the required delay time prior to and following the three escape characters. The guard time is determined by the value of the S12 register. The default setting is S12 = 50 = 1 second (one unit = 20 ms).

Example (S12 = 50, S2 = 43):

Wait at least one second after the last character entered.

Enter: +++

Wait at least one second for the modem’s response.

Response from modem: OK

4. **A**: Enter Answer Mode

The “A” command forces the modem to go off-hook in the Answer mode and starts sending the answer tone, regardless of the value of register S0. If no carrier signal is received from the phone line within the number of seconds specified by register S7 (default of 30 seconds), the modem goes on-hook, sends the “NO CARRIER” result code to the Macintosh Portable, and returns to the local command state. This command must be the last command on a command line. Pressing any key aborts this command.

5. **Bn**: Communication Protocol Compatibility

The “B” command determines which protocol is used to connect at 300 or 1200 bps.

B0: CCITT V.21 or V.22 compatibility.

B1: Bell 103 or 212A compatibility (default).

The B command is ignored when the modem is communicating at 2400 bps.

[Cn command deleted]

6. **Ds**: Dialing

The dialing command takes the form Ds where s is a string of characters. In the simplest form, s consists of actual dial (or DTMF) characters. This set of dial characters for the modem consists of digits (0 to 9), “A”, “B”, “C”, “D”, “*”, and “#”. However, there are several dial modify commands that can be part of the dial string that allow the modem to perform special dialing functions. These additional commands can precede, be embedded in, or follow the actual number to be dialed.

7. **P**: Pulse Dial

The P command determines the use of pulse dialing The dialing speed is fixed at 10 pulses per second. The Make/Break ratio is determined by the AT&Pn command . Any dial characters following the P command are dialed using pulse dialing until the T command is issued. This command can appear anywhere in the dial string.

8. **T**: Touch-Tone Dial (DTMF)

The T command determines the use of touch-tone, or DTMF, dialing. The dialing speed is fixed at 70 ms for duration of tone and 70 ms for the blank period. Any dial characters following the T command are dialed using DTMF dialing until the P command is issued. This command can appear anywhere in the dial string.

9. **R**: Reverse Mode

The **R** command changes the modem from Originate mode to Answer mode after the dialing process is complete. This command is used only at the end of the dial string.

10. **, (comma)**: Pause

The comma (,) command introduces the delay time before dialing the next dial character or executing the next command in the dial string. The pause time is the value of the S8 register.

11. **W**: 2nd Dial Tone Detect

The W command is used to automatically detect the second dial-tone. If the second dial-tone has been detected by the modem before the S7 register time delay, the modem continues dialing the rest of the dial characters in the dial string. If no dial tone is received the modem goes on-hook, returns the "NO DIAL TONE" result code to the Macintosh Portable, and enters the local command state. This command is valid only when the result code command, X , is in X2 or X4 mode. This command can be embedded anywhere in the dial string.

Example: ATDT9W5551234

12. **@**: Wait for Quiet Answer Before Dialing

The @ command forces the modem to wait out the S7 register time delay for at least one ring followed by 5 seconds of silence (indicating the call has been answered) before continuing execution of the dial string. This command can be embedded anywhere in the dial string.

This command is used to access a system that requires entering additional dial characters after answering the initial call.

Example: ATDT5551234@9876543

13. **!**: Flash

This command causes the modem to go on-hook for 0.5 sec and then back off-hook, as if you had depressed the switch-hook button on the telephone set. This command can be placed anywhere in the dial string.

14. **; (semicolon)**: Return to Local Command State after Dialing

The semicolon (;) command must be put at the end of the dialing command. It forces the modem back to the local command state after dialing a number.

15. **En**: Echo Off/On

This command controls the echoing of characters sent to the modem from the Macintosh Portable back to the Macintosh Portable when the modem is in the local command state.

E0: Disable the echo of characters sent by the Macintosh Portable.

E1: Enable the echo of characters sent by the Macintosh Portable (default).

16. **Fn**: Half/Full Duplex

This command controls the echoing of characters sent to the modem from the Macintosh Portable back to the Macintosh Portable when the modem is in the on-line state.

F0: Enable the local echo when the modem is on-line.

F1: Disable the local echo when the modem is on-line (default).

17. **Hn**: Off/On Hook

H0: Force the modem on-hook (hanging up the phone).

H1: Force the modem off-hook (picking up the phone).

18. **In**: Information on Product Code/Checksum

I0: Requests the product code. The product code contains 3 digits in the form 24X (X= code revision number).

I1: Requests a checksum on the firmware. The first two digits are the checksum of the microcontroller ROM. The last two digits are the checksum of the DSP ROM.

This command is valid only when the modem is idle (not connected).

19. **Mn**: Speaker Off/Auto/On

M0: Disable speaker.

M1: Sets the speaker “ON” until carrier is detected (default).

M2: Sets the speaker always “ON”.

20. **O**: Return to On-line State

The O command is used to return to the on-line state after using the escape command to enter the local command state.

21. **Qn**: Quiet/Vocal Mode

Q0: Sends the result codes to the Macintosh Portable (default).

Q1: Disables the sending of result codes to the Macintosh Portable.

22. **Sn?**: Check Contents of Register n

The Sn? command (n= register number) is used for checking the contents of a register and sending the value to the Macintosh Portable. The result is always expressed as a three-digit number, where the leading digits or all digits may be zero.

23. **Sn**=X: Set Register n to Value X

The Sn=X command is used to change the value of register n. To change the value of a register, the Macintosh Portable sends the string “ATSn=X” where n is the register number and X is the value to which the register should be set.

24. **Vn**: Numeric/Verbal Result Codes

V0: The modem sends the result code in numeric form.

V1: The modem sends the result code in verbal (English) form (default).

25. **Xn**: Active Result Codes

X0: Send the 0 to 4 result codes (compatible with Smartmodem 300).

X1: Send the 0 to 5 and 10 result codes (modem does not detect Busy, Ring back, or Dial tone signals).

X2: Send the 0 to 5, 6 and 10 result codes (all CONNECT result codes active and detection of dial tone before dialing occurs; modem does not detect Busy or Ring back signals).

X3: Send the 0 to 5, 7, 10, and 11 result codes (modem detects Busy and Ring back signals; Dial tone is not detected).

X4: Send all result codes (default).

Result codes are shown in Table 8-3:

■ **Table 8-3** Result codes

Verbal	Numerical	Description
OK	0	Command completed
CONNECT	1	Connection established *
RING	2	Incoming ring detected
NO CARRIER	3	No connection or carrier drop
ERROR	4	Bad command
CONNECT 1200	5	Connection established at 1200 bps
NO DIAL TONE	6	Dial tone not detected in S7 seconds
BUSY	7	Busy tone detected
CONNECT 2400	10	Connection established at 2400 bps
RINGING	11	Ringback signal detected

Note

* The “CONNECT” result code, for X0, means a connection was established at 300, 1200, or 2400 bps. However, for X1 to X4, this result code means a connection was established at 300 bps.

26. **Yn**: Long Space Disconnect (Remote Disconnect)

This command allows the modem to disconnect if it receives a continuous BREAK (SPACE) signal for longer than 1.6 seconds from a remote modem. If the modem receives the long space, the modem will reply with a continuous BREAK (SPACE) for 4 seconds prior to going on-hook.
Y0: Disable the long space disconnect (default).
Y1: Enable the long space disconnect.

27. **Z**: Reset

The Z command performs a software reset and applies all of the default values to the other commands. This command affects the modem as if it experienced a power-on reset. Also, any commands remaining on the original command line after the Z command are ignored.

28. **&C**: DCD Options
&C0: DCD line (pin 4 of 18 pin interface) follows the actual carrier.
&C1: DCD line is always asserted (default).

29. **&D**: DTR Options
&D0: Modem ignores the \x\to /DTR line pin 12 (default).
&D1: Modem follows \x\to /DTR from the Macintosh Portable.

30. **&Gn**: Guard Tones

This command specifies whether a guard tone should be transmitted and, if so, what frequency should be used. Guard tones are used in some telephone systems to allow proper data transfer over the network. Guard tones are not used in the USA.
&G0: Disables guard tone (default).
&G1: Sets 550 Hz guard tone.
&G2: Sets 1800 Hz guard tone.

31. **&Ln**: Switched/Leased Line

This command affects the modem's use of timeouts during the handshake at the beginning of a connection.
&L0: Selects switched (dial-up) line (default). All timeouts are active according to the definition of the handshake protocols.
&L1: Selects leased line. All timeouts are ignored during the handshake process.

The &L1 setting may be useful for people using the modem on a leased line where no "calls" will be made or received on the line.

32. **&Pn**: Pulse Dial Make/Break Ratio

&P0: Make = 39%, Break = 61%; for use in the United States and Canada (default).
&P1: Make = 33% , Break = 67%; for use in United Kingdom and Hong Kong.

Dial Pulse specifications	&P0	&P1
Break ratio	61%	67%
Break length	61 ms	67 ms
Dial pulse rate	10 pps	10 pps
Dial pulse length	100 ms	100 ms
Interdigit time	789 ms	783 ms

33. **&Tn**: Self Tests

The following diagnostic tests are provided:

Modem type	Test Method
Bell 212A/103; CCITT V.21	Local Analog Loopback w/o Self-Test: &T1 Local Analog Loopback with Self-Test: &T8 Local Digital Loopback (no Self-Test mode): &T3
V.22 and V.22 bis	Local Analog Loopback w/o Self-Test: &T1 Local Analog Loopback with Self-Test: &T8 Local Digital Loopback (no Self-Test mode): &T3 Remote Digital Loopback w/o Self-Test: &T6 Remote Digital Loopback with Self-Test: &T7 Respond to Remote Digital Loopback request: &T4 Ignore a Remote Digital Loopback request: &T5

&T0: Terminate the Self-Test
Used to terminate loopback test modes using self-test pattern generation and error checking.

&T1: Local Analog Loopback
Initiates a Local Analog Loopback test. The escape sequence must be entered to terminate this test. This mode tests the local modem and the local data terminal equipment.

&T3: Local Digital Loopback
Initiates a Local Digital Loopback test. The modem echoes characters back to the Macintosh Portable exactly as received.

&T4: Enable the Remote Digital Loopback
Enables the modem to respond to a remote modem attempting to place it in the digital loopback test. If a remote modem places the local modem in the remote digital loopback mode, the local modem will echo characters back to the remote modem exactly as received from the remote modem.

&T5: Disable the Remote Digital Loopback
Disables the modem from responding to a remote modem attempting to place it in the digital loopback mode.

&T6: Remote Digital Loopback
Initiates a Remote Digital Loopback test. In this mode, characters sent to the remote modem are echoed back to the local modem exactly as they were received by the remote modem. This mode tests both local and remote modems and the telephone circuit.

&T7: Remote Digital Loopback with Self-Test
Initiates a Remote Digital Loopback with self-test data pattern generation and error checking.

&T8: Local Analog Loopback with Self-Test
Initiates a Local Analog Loopback with self-test data pattern generation and error checking.

&T9: Constellation Point Output / Data Output
Toggles between constellation point output and data output modes.

The tests using the internal self-test pattern (&T7 and &T8) end after the Macintosh Portable issues an &T0 or H0 command or the register S18 time delay expires. The self-test data pattern is an internally generated alternate binary ones-and-zeros signal. In the self-test modes, an error counter will count the number of errors and send the final result to the Macintosh Portable. The maximum number of errors that can be counted is 255.

34. **%A**: Read A/D Converter

Upon receiving this command, the modem returns the current value of the A/D converter in the analog front end. The result is a three digit decimal number.

Example: AT%A<CR> (command)
nnn (current ADC value, 3 digit decimal)
OK

35. **%Bnnn?**: Read Microcontroller RAM Location

This command causes the modem to read the microcontroller RAM location nnn, where nnn is the RAM address in decimal (range is 0 to 255), and return the value of the location as a three digit decimal number (rang 0 to 255).

Example: AT%Bnnn?<CR>(command)
mmm (Current data at RAM address nnn)
OK

36. **%Bnnn**=yyy: Write Data yyy to Microcontroller RAM

This command causes the modem to write the value yyy (3 digit decimal, 0 to 255) to the microcontroller RAM location nnn (3 digit decimal, 0 to 255).

Example: AT%Bnnn=yyy<CR> (Command)
OK

NOTE: This command must be used with caution. The microcontroller is actively using the RAM into which the value yyy may be written; disturbing this data may cause unpredictable results.

37. **%Cnnn?**: Read DSP RAM Location

This command causes the modem to read the word at the digital signal processing (DSP) RAM location specified by nnn (three digit decimal, 0 to 255) and return the value as two three-digit decimal numbers ranging 0 to 255. The first number represents the high data byte, and the second represents the low data byte.

Example: AT%Cnnn? (Command)
mmm (High DSP RAM data byte)
www (Low DSP RAM data byte)
OK

38. **%Cnnn**=xxx,yyy: Write data xxx,yyy to DSP RAM

Upon receiving this command, the modem writes the data xxx to the high data byte and yyy to the low data byte at DSP RAM location nnn. xxx, yyy, and nnn are all three digit decimal numbers ranging 0 to 255.

Example: AT%Cnnn=xxx,yyy<CR> (Command)
OK

NOTE: This command must be used with caution. The DSP is actively using the RAM into which the value xxx,yyy may be written; disturbing this data may cause unpredictable results.

39. **%Dnnn**: Set AGC Level

This command causes the automatic gain control (AGC) in the analog front end to be set the decimal value nnn (range 0 to 255).

Example: AT%Dnnn (Command)
OK

40. **%E**: Test Microcontroller and DSP RAM

This command causes the modem to test select portions of DSP RAM and all of microcontroller RAM using the "Triple Bit RAM Test Algorithm." The modem returns the result (OK or ERROR) for each of the RAM tests with the result of the DSP RAM test first. The response to this command is issued at 2400 bps after an effective reset of the modem to its factory default state.

Example 1:
```
AT%E    (Command)
OK      (DSP RAM test passed)
OK      (Microcontroller RAM test passed)
```

Example 2:
```
AT%E    (Command)
OK      (DSP RAM test passed)
ERROR (Microcontroller RAM test FAILED)
```

Example 3:
```
AT%E    (Command)
ERROR (DSP RAM test FAILED)
OK      (Microcontroller RAM test passed)
```

41. Missing Parameter

A missing parameter is evaluated as zero.
Example: ATF = ATF0