



USER GUIDE

INDUSTRIAL DATA COMMUNICATIONS

DLM4500

Dial-Up/Leased Line Modem



It is essential that all instructions contained in the User Guide are followed precisely to ensure proper operation of equipment.

Patents

This device covered by one or more of the following patents: 6,031,867; 6,012,113; 6,009,082; 5,905,794; 5,864,560; 5,815,567; 5,815,503; 5,812,534; 5,809,068; 5,790,532; 5,764,628; 5,764,627; 5,754,589; D394,250; 5,724,356; 5,673,268; 5,673,257; 5,644,594; 5,628,030; 5,619,508; 5,617,423; 5,600,649; 5,592,586; 5,577,041; 5,574,725; D374,222; 5,559,793; 5,546,448; 5,546,395; 5,535,204; 5,500,859; 5,471,470; 5,463,616; 5,453,986; 5,452,289; 5,450,425; D361,764; D355,658; D355,653; D353,598; D353,144; 5,355,365; 5,309,562; 5,301,274 Other Patents Pending.

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Introduction

The Data-Linc Group DLM4500 modem is designed to work on public dial-up telephone systems. The modem will work on both dial-up voice grade phone lines and leased lines. It connects to a normal telephone service using a RJ-11 jack (2 wire) and connects to the users equipment via a 9-pin DB-9 connector utilizing RS232 signals and screw terminals if a AE-485 (2-wire) or AE-422 (4-wire) unit.

The Data-Linc Group DLM4500 is a compact modem designed and manufactured to operate in industrial applications. It has a wide DC voltage input power range and the operating temperature range of this device is -40° to +70° C.

The mechanical and electrical specifications are listed in Appendix B.

The DLM4500 has front panel LED indicators for Power (Red), Data In from user equipment (Yellow), Data Out to users equipment (Green), and Carrier Detect (Amber).

The DLM4500 is configured using 'AT' style commands sent via the 9-pin port while the modem is in 'Command Mode'. Factory default is set at 9600 baud. All normal configurations are performed using the RS232 connection on the front panel even if the units are a AE-485 or AE-422 model.

A complete list of 'AT' commands are in appendix A. Note that all AT command character strings must end with a carriage return character (Enter key, ctrl M, 0xd hex).

Systems Examples

Diagram 1
Dial-Up

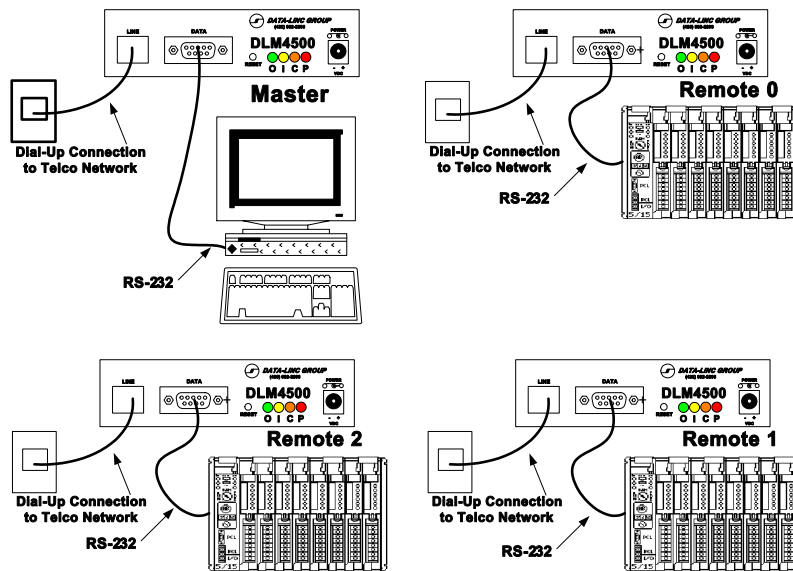
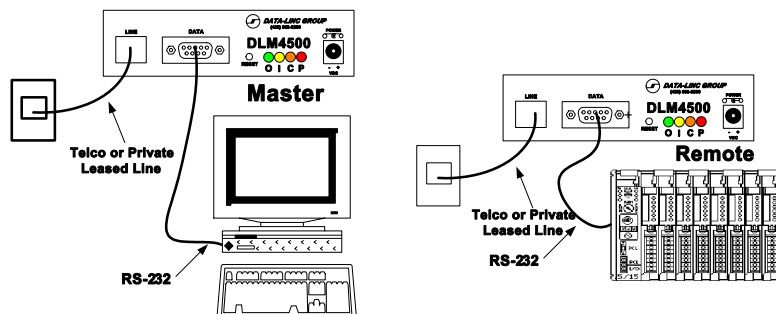


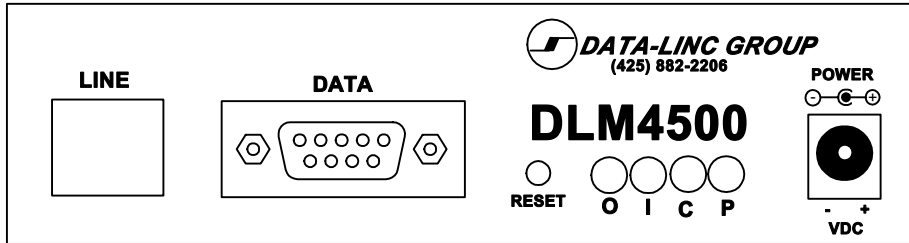
Diagram 2
Leased Line



Connection Points and LED Descriptions

Figure 1

Front Panel Connections – (Left to Right)



RJ-11 — Phone Line

DB-9 — Data Port RS232

- pin 1 CD Out (Carrier Detect)
- pin 2 Data Out
- pin 3 Data In
- pin 4 DTR In (Data terminal ready)
- pin 5 Signal Ground
- pin 6 DSR Out (Data set ready)
- pin 7 RTS In (Request to send)
- pin 8 CTS (Clear to send)
- pin 9 N/C

Push-Button Switch — Modem Reset

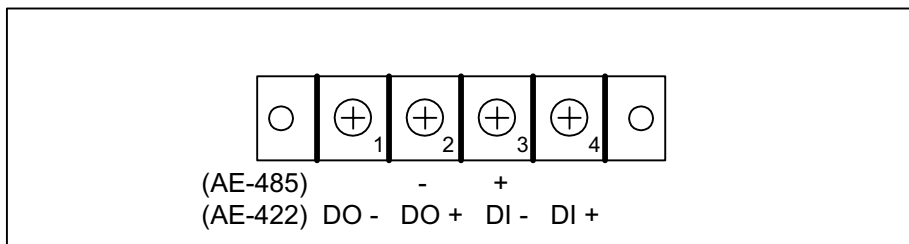
Led Array

- O - Green (data out/line in)
- I - Yellow (data in/line out)
- C - Amber (line carrier detect)
- P - Red (DC power)

2-Position Terminal Block — DC Power In (note the polarity + and -)

Figure 2

Rear Panel Connections – AE-485 and AE-422 (when option is installed)



- | | | | |
|---|-----------------------|---|-------------------|
| 1 | AE-485 | 1 | AE-422 |
| 2 | N.C. | 2 | DO - (Data Out -) |
| 3 | I/O - (Data in/out -) | 3 | DO + (Data Out +) |
| 4 | I/O + (Data in/out +) | 4 | DI - (Data In -) |
| 5 | N.C. | 5 | DI + (Data In +) |

Equipment Connections

The DLM4500 can be purchased with three types of serial interfaces. RS232 only (standard), AE-422 4-wire (optional), or AE-485 2-wire (optional). All units have the RS232 connector on the front. This is always used to configure the modem. The AE-422 and AE-485 connections are on the rear of the unit. The units can have the RS232 connected at the same time as the AE-485 or AE-422, but you can not send data into both the front and rear connections at the same time or data collisions will occur.

RS232

The front RS232 connection is built as a DCE configuration.

For a RS232 connection, use a cable that matches the user equipment. If the users equipment is also a DCE device a null modem cable must be used. If it is a DTE device then a straight through cable will work.

AE-422

The AE-422 connections consist of a wire pair for data out, and a wire pair for data in. Both pairs have a plus (+) and a minus (-) polarity. To make a AE-422 connection, wire the DLM4500 Data In pair to the Data out from connecting equipment. Verify that the Data-In LED on the front panel is not on. If it is on all the time turn the wire pair over (reversed polarity). Data Linc Group AE-422 usually connects the '+' to an A contact and connects the '-' wire to a B contact.

Now send some data characters out of the connected equipment. The Data-In LED should flash. If it does not, check that the Data OUT from your equipment is connected to the Data-IN on the rear of the DLM4500.

If the DLM4500 In LED flashes then connect the DLM4500 Data-Out wire pair to the connecting equipment. Note the polarity of the connection made to the Data-In lines above. Use the same polarity on the Data-Out connection. Verify the plus and minus polarity.

If no LED's blink, then some things can be wrong are: (Note: At high baud rates the blinking may be very fast and faint.)

- a. The modem is not connected to the equipment. -Check the cables.
- b. DC power is missing or wired backwards-Check the power supply.
- c. The equipment you are using is set for the wrong communications port. Match the programs port settings to the computers physical port number that the cable is plugged into.
- d. The equipments program is not running.
- e. The AE-422 wire pairs are not cross-connected TX-to-RX and RX-to-TX, or either wire pair in inverted (+and – lines are swapped backwards). Note that there are 7 ways to miss connect the 2 pairs, and only one way to connect them correctly.
- f. The communications port is not an RS-422 device, or if using an RS-422 converter the converter is broken or needs power.

AE-485

The AE-485 connection is made with one wire pair. This pair has a plus (+) and a minus (-) polarity. After connecting the wire pair, send some data out of the connected equipment. The Data-In LED on the front panel should flash. If it does not, invert the wire pair and try again. Data-Linc Group AE-485 usually connects the '+' to an A contact and connects the '-' wire to a B contact.

If no LED's blink, then some things that could be wrong. (Note: at high baud rates the blinking may be very fast or faint.)

- a. The modem is not connected to the equipment. -Check the cables.
- b. DC power is missing or wired backwards -Check power supply.
- c. The equipment you are using is set for the wrong communications port. Match the programs port settings to the computers physical port number that the cable is plugged into.
- d. The equipments program is not running.
- e. The AE-485 wire pair is inverted (+and – lines are swapped backwards).
- f. The communications port is not an RS-485 device, or if using an RS-485 converter the converter is broken or needs power.

Dial Up Quick Start and Testing

The following setup procedure is for a DLM4500 in Dial-Up mode. It assumes that two phone jacks of dial-up lines are available

1. Unpack the modem(s).
2. Verify that you have all of the parts and cables to power and connect the modem to your equipment. You must be using a PC with an RS232 serial communication port. All three versions of the DLM4500 can be configured via the RS232 port.
3. Start a terminal program from the PC. Use a program like Hyperterminal or Procomm. Set the communications settings in the terminal program. You must set or verify the setting for at least the following parameters:
 - Serial Communications Port Number
 - Speed: Baud Rate
 - Character ormat: Parity, Number of Data bits, Number of Stop bits (n,8,1)
 - Handshake / Flow Control: None

Figure 3

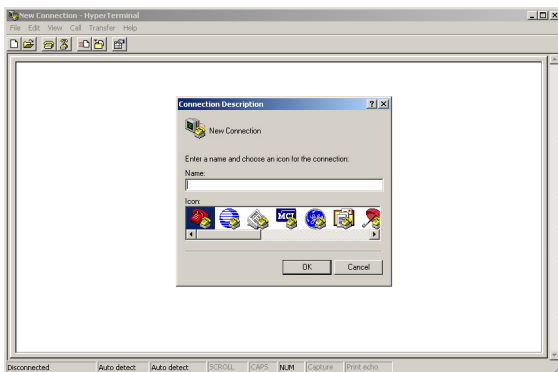


Figure 4

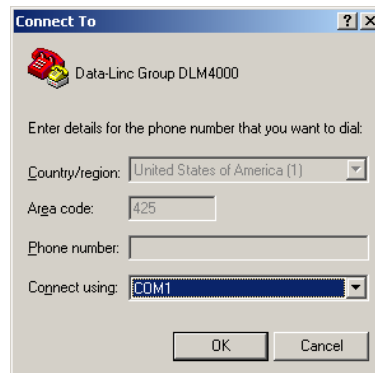
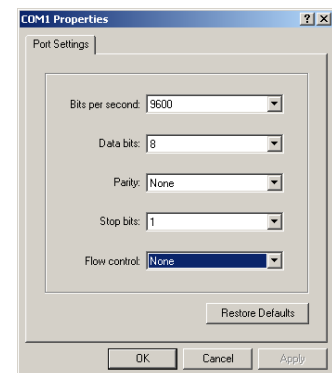


Figure 5



4. Apply DC power to the DLM4500. Check the Power LED. It must be ON. If not check:
 - a. DC power is off or disconnected. Check for the presence of a nominal 12 volts DC on the power connector.
 - b. DC power is wired backwards. Check the source voltage with a voltmeter.
5. Reset the modem by pressing the Reset button on the front of the unit. This resets the modem and returns the AT command set to "last stored values" in NVRAM. The modem is ready to accept setup commands.
6. Connect the computer to the DLM4500 with a straight through 9 pin cable. **DO NOT CONNECT THE PHONE LINE YET.** Check that only the RED Power LED is On.
7. Type the command string '**AT**', then the **Enter** Key. The modem must reply with the characters 'OK'. If this does not happen, recheck step 6 above.
8. The DLM4500 will be configured to your application if the information was supplied to Data-Linc Group during the order process. If not the Baud Rate and other paramater should be checked before connecting the modems (See Quick Configuration for help)
9. Get the phone number of the modem you want to connect with. Connect a standard phone to the phone line. Pick up the phone handset and verify that you get a dial tone. then remove the phone line from the phone and plug it into the DLM4500.
10. Type the command string "ATDTxxx xxx xxxx" then the **Enter** Key. This is the standard dial string. (where the x's(x) are replaced with the 7 or 10 digit phone number)

11. The modem will now take the phone line Off-hook and dial when the dial tone is received. The speaker will make several noises including the dial tone. If a connection is made the modems speaker will go off, the Amber (carrier) LED will illuminate and 'Connect xxxx' will display, where xxxx is the baud rate, and after that will display the error correction modes if any is used.. If using a terminal program the modem will automatically be set in data transfer mode.

Failure to make a connection can be the result of:

- a. Wrong phone number. Use a regular phone to dial the number and listen to the response.
 - b. No matching modem at the other end of the phone line.
 - c. Other modem must be set to answer the phone.
 - d. Other modem must be turned on.
 - e. Other modem must be plugged in.
 - f. This modem must be commanded to dial.
 - g. Connected software must support a modem and must dial out.
 - h. Modems at each end must have matching or compatible settings
12. Data can now be sent in either direction.or if a jumper is placed in the DB-9 Connector between pins 2 and 3 any data sent from the master to the remote will be looped back. In this "Loopback" test the I and O LED's should be blinking when data is being sent back to the originating PC.
 13. Disconnect the call. To set the modem into command mode while in data mode, send the escape sequence characters [pause] +++ [pause] then wait for "OK". Then type **ATH(enter)** to hang up an existing call. Unit will respond with "OK".

■ End Dial-Up Quick Start and Testing

Leased Line Quick Start and Testing

The following setup procedure is for a DLM4500 in Leased Line mode. It assumes that two phone jacks of leased line or phone cord wire is available for testing.

1. Unpack the modem(s).
2. Verify that you have all of the parts and cables to power and connect the modem to your equipment. You must be using a PC with an RS232 serial communication port. All three versions of the DLM4500 can be configured via the RS232 port.
3. Start a terminal program from the PC. (Note: See Dial-Up Quick Start and Testing of setup help)
4. Apply DC power to the DLM4500. Check the Power LED. It must be ON. If not check:
 - a. DC power is off or disconnected. Check for the presence of a nominal 12 volts DC on the power connector.
 - b. DC power is wired backwards. Check the source voltage with a voltmeter.
5. Reset the modem by pressing the Reset button on the front of the unit. This resets the modem and returns the AT command set to "last stored values" in NVRAM. The modem is ready to accept setup commands.
6. Connect the computer to the DLM4500 with a straight through 9 pin cable. DO NOT CONNECT THE PHONE LINE YET. Check that only the RED Power LED is On.
7. Press reset button, wait one second (in leased line mode the modems will only accept AT commands for the first 10 seconds, and after 30 seconds should have started their connection process) then type the command string '**AT**', then the **Enter** Key. The modem must reply with the characters 'OK'. If this does not happen, recheck step 6 above and try again.

8. The DLM4500 will be configured to your application if the information was supplied to Data-Linc Group during the order process. If not the Modem Mode (ie Master or Remote), Baud Rate and other parameter should be checked before connecting the modems (See Quick Configuration for help)
9. Connect a Master configured DLM4500 to a Remote configured DLM4500 using a phone RJ-11 cord. The modems will automatically connect after approximately 30 seconds. The carrier LED on both modems should light.
10. Leaving the PC computer connected to either of the modems, connect a wire jumper (bent paper clip) between pins 2 and 3 of the other (non-PC connected) DLM4500.
11. Type characters on the PC keyboard while running the terminal program. The characters must echo back on the display exactly as typed.
12. Remove the 2-3 pins jumper, and the phone cord connection. Connect the DLM4500 to the leased line. Connect the second modem to the RJ-11 at the other location. The modems will make a connection after approximately 30 seconds. If the connection is dropped the units will automatically reset and try to restore the connection.

■ **End Leased Line Quick Start and Testing**

Quick Configuration ***For Most Applications the DLM4500 Comes Preconfigured

Note: The Enter key produces the ASCII character 'cr' carriage return (decimal 13, hex 0d). Note also that there are no 'O's (ohs) in any of the following AT command string. All round characters are the number zero (0).

To verify the settings before and after changing parameters type the command string:

AT&V (Enter) then examine the settings and registers displayed on the screen.

A. Set to Chipset's default

AT&F0 (Enter)
Responds **OK**

B. Set Connection and Correction Modes

AT&D0&K0#P0%C0\K3\N4%E0\$LB=3&W0 (Enter)
Responds **OK**

C. Baud Rate

If this modem is to be forced to connect and communicate at a fixed baud rate, the following command will need to be entered. If an auto-connect baud rate sequence is used between modems then skip this section and go to step D.

Note: The most industrial equipment are operated at pre-selected fixed baud rates. These AT commands are used to force the modem to connect at only the specified baud rate. It will not hunt to find a matching baud rate.

AT\$SB9600\$MB9600&W0 (Enter) - Where 9600 in both places is the desired baud rate
Responds **OK**

D. Mode

Dial-Up

Type: AT&L0%DC0&W0 (Enter)
Responds **OK**

Leased Line mode enter:

Master

Type: AT&L1%DC1&W0 (Enter)
Responds **OK**

Remote

Type: AT&L2%DC1&W0 (Enter)
Responds **OK**

Note: Leased line operations require one modem to be a Master and other to be a Remote.

Short Description of AT Commands Used in Quick Configure Sections

&F0	Reset modem to chipset's defaults
&D0	Ignores DTR
&K0	Disables Flow Control
#P0	No Parity
%C0	Disables Compression
%DC1	Enables AT lockout mode (10 second delay)
\K3	Sets Break Control to send immediately
\N4	Non-Error Correct Mode
&L0	Set Dial-Up Mode
&L1	Leased Line Master
&L2	Leased Line Remote
%E0	Locks Baud Rate Set by the \$SB and \$MB Commands
\$LB=3	Sets the Length of Break to 30 ms
\$SB19200	Sets Baud Rate to 19200
\$MB19200	Sets Port Speed to 19200
&W0	Stores Settings in Working Memory

Reconfiguring a DLM4500 after setting it to Leased Line mode

Since there is no jumper or switch to change between Leased Line and Dial-Up/Command Mode on the DLM4500, a special AT command is used during a 10 second time window after powering up or pressing the reset switch to allow changing modem settings.

To get a Leased Line configured DLM4500 modem into Command Mode follow these steps:

- Remove power from DLM4500
- Connect PC to RS232 9-pin port. Start a Terminal program
- Apply Power to DLM4500
- Press Reset on front panel
- Wait 1 or 2 seconds
- Type the following String **AT%DC0&L0<enter>**
- Then follow the Quick Configuration Guide.

The DLM4500 has many commands and various operating modes. It can be configured to perform under almost all type of system designs. This manual does not try to cover each and every possible combination. If you are trying to use the DLM4500 in a particular mode and you can not decide what commands to use from Appendix A, then please contact Data-Linc Group Technical services for assistance. (Contact information is on page 14.)

Technical Specifications

RS232 Interface	DB-9 Female DCE
Serial Port Data Rates	300, 1,200, 2,400, 4,800, 9,600, 19,200, 38,400, 57,600, 115,200, and 230,400 bps
AE-485 Interface (Optional)	4 Position Barrier Strip - nc / - / + / nc
AE-422 Interface (Optional)	4 Position Barrier Strip - DO- / DO+ / DI- / DI+ Maximum of 6 DLM4500/AE-422 on a common RS-422 network
AE-485 and 422 Range	1000ft. maximum - Depends on Wire Size and Load
AE-485 and 422 Data Rate	Up to 115,200 bps
Data Format	Serial, binary, asynchronous 10 or 11 bits.
LED Indicators	Power (Red), Carrier Detect (Amber), Data IN (Yellow), and Data OUT (green)
Audio Indicator	Embedded Audio Circuit for Connection Monitoring
Input Voltage	9-18 VDC - Wider Range Available
Power Consumption	Max 3.0 watts
Telephone Interface	RJ-11
Ring Voltage Detect	38 to 150 RMS
Ring Frequency Detected	15.3 to 68 Hz
Data Transmit Level	-11dBm (varies by country settings)
AGC Dynamic Range	43 dB
Operating Temperature Range	-40° to 158° F (-40° to 70° C)
Humidity	Max 95% non-condensing humidity
Frequency Stability	± 0.01%
Receiver Sensitivity	-43 dBm under worst-case conditions
Ringer Equivalence	0.3B
DAA Isolation	1500 VAC
Command Buffer	60 Characters
Data Compression	V.42bis (4:1 throughput), MNP 5 (2:1 throughput)
Error Correction	V.42 (LAP-M or MNP 3-4)

Technical Specifications Cont.

Modes	V.34 enhanced, V.34, V.34, V.32bis, V.32, V.22vis, V.22; Bell 121A and 103/113
Client-to-Client Data Rates	33,600, 31,200, 28,800, 26,400, 24,000, 21,600, 19,200, 16,800, 14,400, 12,000, 9,600, 7,200, 4,800, 2,400, 1,200, 0-300 bps
Weight	1.68 lb. (.76 kg)
Enclosure Dimension	9.0" x 4.9" x 1.54" (22.86 x 12.45 x 3.94 cm) over mounting flanges
Enclosure Material	18 gauge steel
FCC Registration	FCC Reg AU7-USA-25814-M5-E

Technical Support

Data-Linc Group maintains a fully trained staff of service personnel who are capable of providing complete product assistance. They can provide you with technical, application, troubleshooting, and warranty assistance. Our technical staff is based in Bellevue, Washington USA and may be reached at (425) 882-2206 or e-mail support@data-linc.com

Product Warranty

Data-Linc Group warrants equipment of its own manufacture to be free from defects in material and workmanship for one year from date of shipment to original user. Data-Linc Group will replace or repair, at our option, any part found to be defective. Buyer must return any part claimed defective to Data-Linc Group, transportation prepaid.

Return Material Authorization

If a part needs to be sent to the factory for repair, contact Data-Linc Group's corporate office and request a Return Material Authorization (RMA) number. The RMA number identifies the part and the owner and must be included with the part when shipped to the factory.

Contact Information

Corporate Office

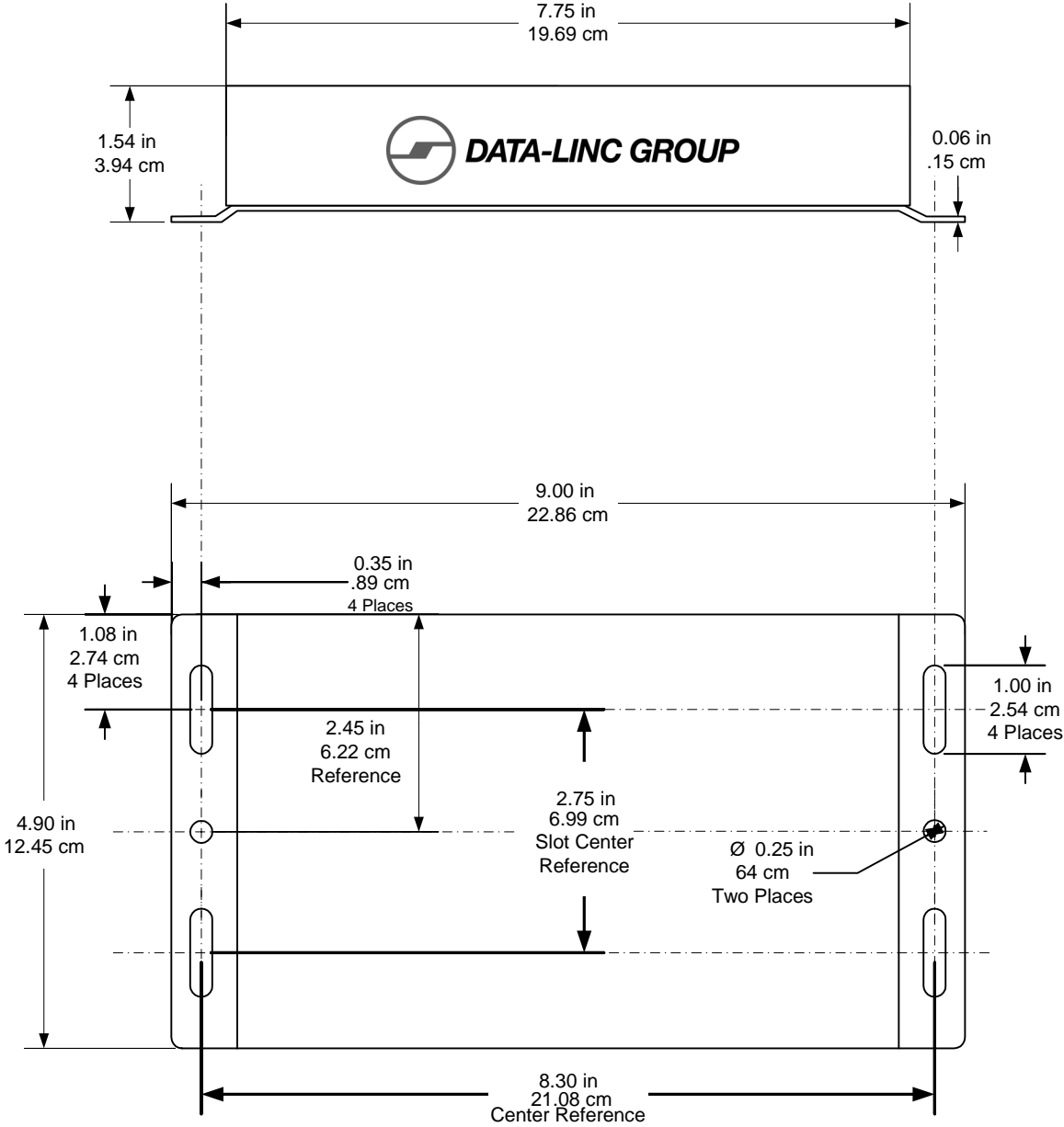
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Appendix A

Enclosure Dimensions



Appendix B

AT Commands, S-Registers and Result Codes

The AT commands are used to control the operation of your modem. They are called AT commands because the characters AT must precede each command to get the attention of the modem.

AT commands can be issued only when the modem is in command mode or on-line command mode. The modem is in command mode whenever it is not connected to another modem. The modem is in data mode whenever it is connected to another modem and ready to exchange data. On-line command mode is a temporary state in which you can issue commands to the modem while connected to another modem. To put the modem into on-line command mode from data mode, you must issue an escape sequence (+++). To return to data mode from on-line command mode, you must issue the command AT0.

To send AT commands to the modem you must use a communications program, such as the HyperTerminal, an application in Windows, or some other available terminal program. You can issue commands to the modem either directly, by typing them in the terminal window of the communications program, or indirectly, by configuring the operating system or communications program to send the commands automatically. Fortunately, communications programs make daily operation of modems effortless by hiding the commands from the user. Most users, therefore, need to use AT commands only when reconfiguring the modem, e.g., to turn auto-answer on or off.

The format for entering an AT command is ATXn, where X is the command and n is the specific value for the command, sometimes called the command parameter. The value is always a number. If the value is zero, you can omit it from the command; thus, AT&W is equivalent to AT&W0. Most commands have a default value, which is the value that is set at the factory.

You must press ENTER (depending on the terminal program it could be some other key) to send the command to the modem. Any time the modem receives a command it sends a response known as a result code. The most common result codes are OK, ERROR, and the CONNECT messages that the modem sends to the computer when it is connecting to another modem. For a table of valid result codes, see "Result Codes" at the end of this appendix.

You can issue several commands in one line, in what is called a command string. The command string begins with AT and ends when you press ENTER. Spaces to separate the commands are optional; the command interpreter ignores them. The most familiar command string is the initialization string, which is used to configure the modem when it is turned on or reset, or when your communications software calls another modem.

AT Commands

AT Attention Code

Values: n/a

Description: The attention code precedes all command lines except **A/**, **A:**, and escape sequences.

ENTER Key

Values: n/a

Description: Press the ENTER (RETURN) key to execute most commands.

A Answer

Values: n/a

Description: Answer call before final ring.

A/ Repeat Last Command

Values: n/a

Description: Repeat the last command string. Do not precede this command with **AT**. Do not press ENTER to execute.

Bn Communication Standard Setting

Values: $n = 0-3, 15, 16$

Default: 1 and 16

Description: B0 Select ITU-T V.22 mode when modem is at 1200 bps.

B1 Select Bell 212A when modem is at 1200 bps.

B2 Deselect V.23 reverse channel (same as **B3**).

B3 Deselect V.23 reverse channel (same as **B2**).

B15 Select V.21 when the modem is at 300 bps.

B16 Select Bell 103J when the modem is at 300 bps.

Ds Dial

Values: $s =$ dial string (phone number and dial modifiers)

Default: none

Description: Dial telephone number s , where s may up to 40 characters long and include the 0–9, *,#, [] (space), B, C, and D characters, and the **L**, **P**, **T**, **V**, **W**, **S**, [,](comma), [;](semicolon), !, @, ^and \$ dial string modifiers.

Dial string modifiers:

L Redial last number. (Must be placed immediately after **ATD**.)

P Pulse-dial following numbers in command.

T Tone-dial following numbers in command (default).

V Switch to speakerphone mode and dial the following number. Use **ATH** command to hang up.

W Wait for a new dial tone before continuing to dial. (**X2**, **X4**, **X5**, **X6**, or **X7** must be selected.)

, Pause during dialing for time set in register S8.

; Return to command mode after dialing. (Place at end of dial string.)

! Hook flash. Causes the modem to go on-hook for one-half second, then off-hook again.

@ Wait for quiet answer. Causes modem to wait for a ringback, then 5 seconds of silence, before processing next part of command. If silence is not detected, the modem returns a NO ANSWER code.

^ Disable data calling tone transmission.

\$ Detect AT&T call card “bong” tone. The character should follow the phone number and precede the user’s call card number: ATDT1028806127853500\$123456789

DS=y Dial Stored Telephone Number

Values: n = 0–2

Default: none

Description: Dial a number previously stored in directory number y by the **&Zy=x** command.

Example: **ATDS=2**

En Echo Command Mode Characters

Values: n = 0 or 1

Default: 1

Description: E0 Do not echo keyboard input to the terminal.

E1 Do echo keyboard input to the terminal.

Fn Echo Online Data Characters

Values: n = 1

Default: 1

F0 Enable online data character echo. (Not supported.)

F1 Disable online data character echo (included for backward compatibility with some software).

Hn Hook Control

Values: n = 0 or 1

Default: 0

Description: H0 Go on-hook (hang up).

H1 Go off-hook (make the phone line busy).

In Information Request

Values: n = 0–5, 9, 11

Default: None

Description: I0 Display default speed and controller firmware version.

I1 Calculate and display ROM checksum (e.g., 12AB).

I2 Check ROM and verify the checksum, displaying OK or ERROR.

I3 Display default speed and controller firmware version.

I4 Display firmware version for data pump (e.g., 94).

I5 Display the board ID: software version, hardware version, and country ID

I9 Display the country code (e.g., *NA Ver. 1*).

I11 Display diagnostic information for the last modem connection, such as DSP and firmware version, link type, line speed, serial speed, type of error correction/data compression, number of past retrains, etc.

Mn Monitor Speaker Mode

Values: n = 0, 1, 2, or 3

Default: 1

Description: M0 Speaker always off.

M1 Speaker on until carrier signal detected.

M2 Speaker always on when modem is off-hook.

M3 Speaker on until carrier is detected, except while dialing.

Nn Modulation Handshake

Values: n = 0 or 1

Default: 1

Description: N0 Modem performs handshake only at communication standard specified by **S37** and the **B** command.

N1 Modem begins handshake at communication standard specified by **S37** and the **B** command. During handshake, fallback to a lower speed can occur.

On Return Online to Data Mode

Values: 0, 1, 3

Default: None

Description: O0 Exit online command mode and return to data mode.

O1 Issue a retrain and return to online data mode.

O3 Issue a rate renegotiation and return to data mode.

P Pulse Dialing

Values: P, T

Default: T

Description: Configures the modem for pulse (non-touch-tone) dialing. Dialed digits are pulsed until a **T** command or dial modifier is received.

Qn Result Codes Enable/Disable

Values: $n = 0$ or 1

Default: 0

Description: Q0 Enable result codes.

Q1 Disable result codes.

Q2 Returns an *OK* for backward compatibility with some software.

Sr=n Set Register Value

Values: $r =$ S-register number; n varies

Default: None

Description: Set value of register Sr to value of n , where n is entered in decimal format. E.g., S0=1.

Sr? Read Register Value

Values: $r =$ S-register number

Default: None

Description: Read value of register Sr and display it in 3-digit decimal form. E.g., S2? gives the response 043.

T Tone Dialing

Values: P, T

Default: T

Description: Configures the modem for DTMF (touch-tone) dialing. Dialed digits are tone dialed until a **P** command or dial modifier is received.

Vn Result Code Format

Values: $n = 0$ or 1

Default: 1

Description: V0 Displays result codes as digits (terse response).

V1 Displays result codes as words (verbose response).

Wn Result Code Options

Values: $n = 0, 1,$ or 2

Default: 2

Description: W0 CONNECT result code reports serial port speed, disables protocol result codes.

W1 CONNECT result code reports serial port speed, enables protocol result codes.

W2 CONNECT result code reports line speed, enables protocol result codes.

Xn Result Code Selection

Values: $n = 0-7$

Default: 4

Description: X0 Basic result codes (e.g., *CONNECT*); does not look for dial tone or busy signal.

X1 Extended result codes (e.g., *CONNECT 46000 V42bis*); does not look for dial tone or busy signal.

X2 Extended result codes with *NO DIALTONE*; does not look for busy signal.

X3 Extended result codes with *BUSY*; does not look for dial tone.

X4 Extended result codes with *NO DIALTONE* and *BUSY*.

X5 Extended result codes with *NO DIALTONE* and *BUSY*.

X6 Extended result codes with *NO DIALTONE* and *BUSY*.

X7 Basic result codes with *NO DIALTONE* and *BUSY*.

Zn Modem Reset

Values: $n = 0$ or 1

Default: None

Description: Z0 Reset modem to profile saved by the last **&W** command.

Z1 Same as **Z0**.

&Cn Data Carrier Detect (DCD) Control

Values: $n = 0$ or 1

Default: 1

Description: &C0 Forces the DCD circuit to be always high.

&C1 DCD goes high when the remote modem's carrier signal is detected, and goes low when the carrier signal is not detected.

&Dn Data Terminal Ready (DTR) Control

Values: $n = 0, 1, 2,$ or 3

Default: 2

Description: &D0 Modem ignores the true status of the DTR signal and responds as if it is always on.

&D1 If DTR drops while in online data mode, the modem enters command mode, issues an *OK*, and remains connected.

&D2 If DTR drops while in online data mode, the modem hangs up. If the signal is not present, the modem will not answer or dial.

&D3 If DTR drops, the modem hangs up and resets as if an **ATZ** command were issued.

Vn Result Code Format

Values: $n = 0$ or 1

Default: 1

Description: V0 Displays result codes as digits (terse response).

V1 Displays result codes as words (verbose response).

Wn Result Code Options

Values: $n = 0, 1,$ or 2

Default: 2

Description: W0 *CONNECT* result code reports serial port speed, disables protocol result codes.

W1 *CONNECT* result code reports serial port speed, enables protocol result codes.

W2 *CONNECT* result code reports line speed, enables protocol result codes.

Xn Result Code Selection

Values: $n = 0-7$

Default: 4

Description: X0 Basic result codes (e.g., *CONNECT*); does not look for dial tone or busy signal.

X1 Extended result codes (e.g., *CONNECT 46000 V42bis*); does not look for dial tone or busy signal.

X2 Extended result codes with *NO DIALTONE*; does not look for busy signal.

X3 Extended result codes with *BUSY*; does not look for dial tone.

X4 Extended result codes with *NO DIALTONE* and *BUSY*.

X5 Extended result codes with *NO DIALTONE* and *BUSY*.

X6 Extended result codes with *NO DIALTONE* and *BUSY*.

X7 Basic result codes with *NO DIALTONE* and *BUSY*.

Zn Modem Reset

Values: $n = 0$ or 1

Default: None

Description: Z0 Reset modem to profile saved by the last **&W** command.

Z1 Same as **Z0**.

&Cn Data Carrier Detect (DCD) Control

Values: $n = 0$ or 1

Default: 1

Description: &C0 Forces the DCD circuit to be always high.

&C1 DCD goes high when the remote modem's carrier signal is detected, and goes low when the carrier signal is not detected.

&Dn Data Terminal Ready (DTR) Control

Values: $n = 0, 1, 2,$ or 3

Default: 2

Description: &D0 Modem ignores the true status of the DTR signal and responds as if it is always on.

&D1 If DTR drops while in online data mode, the modem enters command mode, issues an *OK*, and remains connected.

&D2 If DTR drops while in online data mode, the modem hangs up. If the signal is not present, the modem will not answer or dial.

&D3 If DTR drops, the modem hangs up and resets as if an **ATZ** command were issued.

&En XON/XOFF Pass-Through

Values: 6, 7

Default: 6

Description: &E6 Modem responds to XON/XOFF characters, but does not allow XON/XOFF characters to pass through to remote sites.

&E7 Modem responds to XON/XOFF characters and allows them to pass through to remote site.

&Fn Load Factory Settings

Values: $n = 0$

Default: None

Description: &F0 Load factory settings as active configuration.

Note: See also the **Z** command.

&Gn V.22bis Guard Tone Control

Values: $n = 0, 1, \text{ or } 2$

Default: 0

Description: &G0 Disable guard tone.

&G1 Set guard tone to 550 Hz.

&G2 Set guard tone to 1800 Hz.

Note: The **&G** command is not used in North America.

&Kn Flow Control Selection

Values: $n = 0, 3, \text{ or } 4$

Defaults: 3

Description: &K0 Disable flow control.

&K3 Enable CTS/RTS hardware flow control.

&K4 Enable XON/XOFF software flow control.

&Pn Pulse Dial Make-to-Break Ratio Selection

Values: $n = 0, 1, \text{ or } 2$

Default: 0

Description: &P0 60/40 make-to-break ratio

&P1 67/33 make-to-break ratio

&P2 20 pulses per second

Note: The **&P2** command is available only if the country code is set to Japan.

&Qn Asynchronous Communications Mode

Values: $n = 0, 5, 6, 8, \text{ or } 9$

Default: 5

Description: &Q0 Asynchronous with data buffering. Same as **\N0**.

&Q5 Error control with data buffering. Same as **\N3**.

&Q6 Asynchronous with data buffering. Same as **\N0**.

&Q8 MNP error control mode. If MNP error control is not established, the modem falls back according to the setting in **S36**.

&Q9 V.42 or MNP error control mode. If neither error control is established, the modem falls back according to the setting in **S36**.

&Sn Data Set Ready (DSR) Control

Values: $n = 0 \text{ or } 1$

Default: 0

Description: &S0 DSR is always high (on).

&S1 DSR goes high only during a connection.

&Tn Loopback Test (V.54 Test) CommandsValues: $n = 0, 1, 3, 6$

Default: None

Description: The modem can perform selected test and diagnostic functions. A test can be run only when the modem is operating in non-error-correction mode (normal or direct mode). For tests 3 and 6, a connection between the two modems must be established. To terminate a test in progress, the escape sequence (**+++**) must be entered.

&T0 Stops any test in progress.

&T1 Starts a local analog loopback, V.54 Loop 3, test. If a connection exists when this command is issued, the modem hangs up. When the test starts, a *CONNECT* message is displayed.

&T3 Starts local digital loopback, V.54 Loop 2, test. If no connection exists, *ERROR* is returned.

&T6 Initiates a remote digital loopback, V.54 Loop 2, test without self-test. If no connection exists, *ERROR* is returned.

&V Display Current Settings

Values: n/a

Description: Displays the active modem settings.

&Wn Store Current ConfigurationValues: $n = 0$

Default: 0

Description: &W0 Stores current modem settings in non-volatile memory and causes them to be loaded at power-on or following the **ATZ** command instead of the factory defaults. See also the **&F** command.

&W1 Clears user default settings from non-volatile memory and causes the factory defaults to be loaded at power-on or following the **ATZ** command.

&Zy=x Store Dialing CommandValues: $y = 0-2$ $x =$ Dialing command

Default: None

Description: Stores dialing command x in memory location y . Dial the stored number using the command **ATDS=y**.

\An Select Maximum MNP Block SizeValues: $n = 0, 1, 2, \text{ or } 3$

Default: 3

Description: \A0 64-character maximum.

\A1 128-character maximum.

\A2 192-character maximum.

\A3 256-character maximum.

\Bn Transmit BreakValues: $n = 0-9$ in 100 ms units

Default: 3

Description: Works in error-correction mode only. Error correction must be set on. Sends a break signal of the specified length to a remote modem. Works in conjunction with the **IK** command. Usable for GE SNP protocol.

\Kn Break Control

Values: $n = 0-5$

Default: 5

Description: Controls the response of the modem to a break received from the computer, the remote modem, or the \B command. The response is different for each of three different states.

Data mode. The modem receives the break from the computer:

\K0 Enter online command mode, no break sent to the remote modem.

\K1 Clear data buffers and send break to the remote modem.

\K2 Same as \K0.

\K3 Send break immediately to the remote modem .

\K4 Same as \K0.

\K5 Send break to the remote modem in sequence with the transmitted data.

Data mode. The modem receives the break from the remote modem:

\K0 Clear data buffers and send break to the computer.

\K1 Same as \K0.

\K2 Send break immediately to the computer.

\K3 Same as \K2.

\K4 Send break to the computer in sequence with the received data.

\K5 Same as \K4.

Online command mode. The modem receives a \Bn command from the computer:

\K0 Clear data buffers and send break to the remote modem.

\K1 Same as \K0.

\K2 Send break immediately to the remote modem.

\K3 Same as \K2.

\K4 Send break to the remote modem in sequence with the transmitted data.

\K5 Same as \K4.

\Nn Error Correction Mode Selection

Values: $n = 0-5$, or 7

Default: 3

Description: \N0 Non-error correction mode with data buffering (buffer mode; same as &Q6).

\N1 Direct mode.

\N2 MNP reliable mode. If the modem cannot make an MNP connection, it disconnects.

\N3 V.42/MNP auto-reliable mode. The modem attempts first to connect in V.42 error correction mode, then in MNP mode, and finally in non-error correction (buffer) mode with continued operation.

\N4 V.42 reliable mode. If the modem cannot make a V.42 connection, it disconnects.

\N5 V.42, MNP, or non-error correction (same as \N3).

\N7 V.42, MNP, or non-error correction (same as \N3).

\Qn Flow Control Selection

Values: $n = 0, 1$, or 3

Default: 3

Description: \Q0 Disable flow control (same as &K0).

\Q1 XON/XOFF software flow control (same as &K4).

\Q2 CTS-only flow control. Not supported.

\Q3 RTS/CTS hardware flow control (same as &K3).

C*n* Inactivity TimerValues: $n = 0, 1-255$

Default: 0

Description: Sets the time (in minutes) after the last character is sent or received that the modem waits before disconnecting. A value of zero disables the timer. Applies only in buffer mode.

Note: You can also set the inactivity timer by changing the value of **S30**.

\V*n* Protocol Result CodeValues: $n = 0, 1, \text{ or } 2$

Default: 1

Description: \V0 Disables the appending of the protocol result code to the DCE speed.

\V1 Enables the appending of the protocol result code to the DCE speed.

\V2 Same as \V1.

-C*n* Data Calling ToneValues: $n = 0 \text{ or } 1$

Defaults: 0

Description: -C0 Disable V.25 data calling tone to deny remote data/fax/voice discrimination.

-C1 Enable V.25 data calling tone to allow remote data/fax/voice discrimination.

%B View Numbers in Blacklist

Values: n/a

Description: If blacklisting is in effect, **AT%B** displays the numbers for which the last call attempted in the previous two hours failed. In countries that do not require blacklisting, the *ERROR* result code appears.

%C*n* Data Compression ControlValues: $n = 0 \text{ or } 1$

Default: 1

Description: %C0 Disable V.42bis/MNP 5 data compression.

%C1 Enable V.42bis/MNP 5 data compression.

%DC*n* AT Command ControlValues: $n = 0 \text{ or } 1$

Default: 0

Description: %DC0 The modem responds to AT commands.

%DC1 The modem ignores AT commands.

Note: The modem will respond to **AT%DC** for 10 seconds after power-up.

%E*n* Fallback and Fall Forward ControlValues: $n = 0, 1, \text{ or } 2$

Default: 2

Description: %E0 Disable fallback and fall forward.

%E1 Enable fallback, disable fall forward.

%E2 Enable fallback and fall forward.

\$D*n* DTR DialingValues: $n = 0 \text{ or } 1$

Default: 0

Description: \$D0 Disables DTR dialing.

\$D1 Dials the number in memory location 0 when DTR goes high.

\$LB=*n* Lenth of Break

Values: *n*= 0-255 (1 = 10ms)

Default: 003 (30 ms)

\$MB*n* Online BPS Speed

Values: *n* = speed in bits per second

Default: 28,800

Description: \$MB75 Selects CCITT V.23 mode

\$MB300 Selects 300 bps on-line

\$MB1200 Selects 1200 bps on-line

\$MB2400 Selects 2400 bps on-line

\$MB4800 Selects 4800 bps on-line

\$MB9600 Selects 9600 bps on-line

\$MB14400 Selects 14,400 bps on-line

\$MB19200 Selects 19,200 bps on-line

\$MB28800 Selects 28,800 bps on-line

\$MB33600 Selects 33,600 bps on-line

\$SB*n* Serial Port Baud Rate

Values: *n*= speed in bits per second

Default: 115200

Description: \$SB300 Selects 300 bps at serial port

\$SB1200 Selects 1200 bps at serial port

\$SB2400 Selects 2400 bps at serial port

\$SB4800 Selects 4800 bps at serial port

\$SB9600 Selects 9600 bps at serial port

\$SB19200 Selects 19,200 bps at serial port

\$SB38400 Selects 38,400 bps at serial port

\$SB57600 Selects 57,600 bps at serial port

\$SB115200 Selects 115,200 bps at serial port

\$SB230400 Selects 230,400 bps at serial port

#S*x* Enter Setup Password

Values: *x*= password (1–8 characters, case sensitive)

Default: MTSMODEM

Description: Enters the remote configuration setup password.

#S=*x* Store Setup Password

Values: *x*= password (1–8 characters, case sensitive)

Default: MTSMODEM

Description: Stores a new remote configuration setup password.

+++ Escape Sequence

Values: n/a

Description: Puts the modem in command mode (and optionally issues a command) while remaining online. Used mostly to issue the hang-up command: [pause] +++ [pause] **ATH<CR>**.

S-Registers

Certain modem values, or parameters, are stored in memory locations called S-registers. Use the **S** command to read or to alter the contents of S-registers (see previous section).

Register Unit Range Default Description

S0 1 ring 0, 1–255 1 Sets the number of rings until the modem answers. **ATS0=0** disables auto-answer completely.

S1 1 ring 0–255 0 Counts the rings that have occurred.

S2 decimal 0–127 43 (+) Sets ASCII code for the escape sequence character. 128–255 Values greater than 127 disable escape.

S3 decimal 0–127 13 (^M) Sets the ASCII code for the carriage return character.

S4 decimal 0–127 10 (^J) Sets the ASCII code for the line feed character.

S5 decimal 0–32 8 (^H) Sets the ASCII code for the backspace character. 33–127 Values greater than 32 disable backspace.

S6 seconds 2–65* 2* Sets the time the modem waits after it goes off-hook before it begins to dial the telephone number.

S7 seconds 1–255* 50* Sets the time the modem waits for a carrier signal before aborting a call. Also sets the wait for silence time for the @ dial modifier.

S8 seconds 0–65 2 Sets the length of a pause caused by a comma character in a dialing command.

S9 decimal 0, 1–127 37 (%) Sets ASCII code for remote configuration escape character.

S9=0 disables remote configuration.

S10 100 ms 1–254 20 Sets how long a carrier signal must be lost before the modem disconnects.

S11 1 ms 50–150* 95* Sets spacing and duration of dialing tones.

S28 decimal 0, 1–255 1 0 disables, 1–255 enables V.34 modulation.

S30 1 minute 0, 1–255 0 Sets the length of time that the modem waits before disconnecting when no data is sent or received. A value of zero disables the timer. See also the **IT** command

S35 decimal 0–1 0 0 disables, 1 enables the V.25 calling tone, which allows remote data/fax/voice discrimination.

S36 decimal 0–7 7 Specifies the action to take in the event of a negotiation failure when error control is selected. (See **S48**.)

S37 decimal 0–19 0 Sets the maximum V.34 “upstream” speed at which the modem attempts to connect.

- 0 = maximum speed
- 1 = reserved
- 2 = 1200/75 bps
- 3 = 300 bps
- 4 = reserved
- 5 = 1200 bps
- 6 = 2400 bps
- 7 = 4800 bps
- 8 = 7200 bps
- 9 = 9600 bps
- 10 = 12000 bps
- 11 = 14400 bps
- 12 = 16800 bps
- 13 = 19200 bps
- 14 = 21600 bps
- 15 = 24000 bps
- 16 = 26400 bps
- 17 = 28800 bps
- 18 = 31200 bps
- 19 = 33600 bps

S38 decimal 0–23 1 Sets “downstream” data rate where V.90 provides rates of 28,000 to 56,000 bps in increments of 1,333 bps.

- 0 = V.90 disabled
- 1 = V.90 autorate
- 2 = 28,000 bps
- 3 = 29,333 bps
- 4 = 30,666 bps
- 5 = 32,000 bps
- 6 = 33,333 bps
- 7 = 34,666 bps
- 8 = 36,000 bps
- 9 = 37,333 bps
- 10 = 38,666 bps
- 11 = 40,000 bps
- 12 = 41,333 bps
- 13 = 42,666 bps
- 14 = 44,000 bps
- 15 = 45,333 bps
- 16 = 46,666 bps
- 17 = 48,000 bps
- 18 = 49,333 bps
- 19 = 50,666 bps
- 20 = 52,000 bps
- 21 = 53,333 bps
- 22 = 54,666 bps
- 23 = 56,000 bps

Upstream data rates: Upstream V.90 data rates are 4800 to 33,600 bps in 2400 bps increments.

S43 decimal 0–1 1 *For testing and debugging only.* Enables/disables V.32bis startup auto mode operation. 0 = disable; 1 = enable.

S48 decimal 7 or 128 7 Enables (7) or disables (128) LAPM negotiation. The following table lists the **S36** and **S48** configuration settings for certain types of connections.

S48=7 S48=128

S36=0, 2 LAPM or hang up Do not use

S36=1, 3 LAPM or async Async

S36=4, 6 LAPM, MNP, or hang up MNP or hang up

S36=5, 7 LAPM, MNP, or async MNP or async

S89 seconds 0, 5–255 10 Sets the length of time in the off-line command mode before the modem goes into standby mode. A value of zero prevents standby mode; a value of 1–4 sets the value to 5. Standby mode (sleep mode or low power mode) is controlled by **S89**. It programs the number of seconds of inactivity before the modem will go to sleep. The default value is 60. A value of 0 disables standby mode. The modem will wake on an incoming ring or an AT command.

S108 decimal 0–3, 6, 7 6 Selects the 56K digital loss if using the modem through a PBX line. The default value is -6 dB loss, the value used when calling from a typical POTS line long distance.

0 = -0 dB digital loss, no robbed-bit signaling

1 = -3 dB PBX digital loss

2 = -2 dB digital loss

3 = -3 dB digital loss

6 = -6 dB digital loss

7 = -0 dB digital loss with robbed-bit signaling

In command mode your modem can send responses called *result codes* to your computer. Result codes are used by communications programs and can also appear on your monitor.

Terse and Verbose Result Codes

- 0 OK Command executed
- 1 CONNECT Modem connected to line
- 2 RING Ring signal detected
- 3 NO CARRIER Carrier signal lost or not detected
- 4 ERROR Invalid command
- 5 * CONNECT 1200 Connected at 1200 bps
- 6 NO DIALTONE No dial tone detected
- 7 BUSY Busy signal detected
- 8 NO ANSWER No answer at remote end
- 10* CONNECT 2400 Connected at 2400 bps
- 11* CONNECT 4800 Connected at 4800 bps
- 12* CONNECT 9600 Connected at 9600 bps
- 13* CONNECT 14400 Connected at 14400 bps
- 14* CONNECT 19200 Connected at 19200 bps
- 24* CONNECT 7200 Connected at 7200 bps
- 25* CONNECT 12000 Connected at 12000 bps
- 26* CONNECT 16800 Connected at 16800 bps
- 40* CONNECT 300 Connected at 300 bps
- 55* CONNECT 21600 Connected at 21600 bps
- 56* CONNECT 24000 Connected at 24000 bps
- 57* CONNECT 26400 Connected at 26400 bps
- 58* CONNECT 28800 Connected at 28800 bps
- 59* CONNECT 31200 Connected at 31200 bps
- 60* CONNECT 33600 Connected at 33600 bps
- 88 DELAYED Delay is in effect for the dialed number
- 89 BLACKLISTED Dialed number is blacklisted
- 90 BLACKLIST FULL Blacklist is full
- 100 CONNECT 28000 Connected at 28000 bps, V.90 rate X
- 101 CONNECT 29333 Connected at 29333 bps, V.90 rate X
- 102 CONNECT 30666 Connected at 30666 bps, V.90 rate X
- 103 CONNECT 33333 Connected at 33333 bps, V.90 rate X
- 104 CONNECT 34666 Connected at 34666 bps, V.90 rate X
- 105 CONNECT 37333 Connected at 37333 bps, V.90 rate X
- 106 CONNECT 38666 Connected at 38666 bps, V.90 rate X
- 107 CONNECT 41333 Connected at 41333 bps, V.90 rate X
- 108 CONNECT 42666 Connected at 42666 bps, V.90 rate X
- 109 CONNECT 45333 Connected at 45333 bps, V.90 rate X
- 110 CONNECT 46666 Connected at 46666 bps, V.90 rate X
- 111 CONNECT 49333 Connected at 49333 bps, V.90 rate X
- 112 CONNECT 50666 Connected at 50666 bps, V.90 rate X
- 113 CONNECT 53333 Connected at 53333 bps, V.90 rate X
- 114 CONNECT 54666 Connected at 54666 bps, V.90 rate X

* EC is added to these result codes when the extended result codes configuration option is enabled. EC is replaced by one of the following codes, depending on the type of error control connection:

- V42bis – V.42 error control (LAP-M) and V.42bis data compression
- V42 – V.42 error control (LAP-M) only
- MNP5 – MNP 4 error control and MNP 5 data compression
- MNP4 – MNP 4 error control only
- NoEC – No error control protocol.