Chapter 6
Diagnostics and Service

This chapter describes the diagnostic tests performed by the modem when it is powered up and provides user assurance test procedures along with troubleshooting guidelines if you encounter a problem while setting up or using the modem.

Diagnostic Tests

When power is turned on, the modem automatically runs a series of self-diagnostic tests. The results of these tests can be obtained by using the ~I1 command. This command returns a decimal number which represents the sum of the failure codes triggered during testing. If no errors are detected during the diagnostic tests, 000 (zero) is returned.

You can run the diagnostic tests at any time by using the ~&T command. However, you should not run the diagnostic tests during a current communications session as this will disconnect the line and reset the modem. The ~&T command displays the results of the tests as a short message on the screen. If no errors are detected, the ~&T command returns a "Diagnostics Complete" message.

The diagnostic tests performed by the modem upon power up or when the ~&T command is issued are listed below:

> ROM Test
> RAM Addressing Test
> RAM Read/Write Test
> EEPROM Test
> Loopback Test
> 32010 Signal Processor Test

Successful completion of the first three tests means that the modem's firmware is intact and that the memory is functioning correctly.

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During the EEPROM test, a checksum is read which tests the integrity of the non-volatile memory. If the checksum is correct, Profile A or B register settings stored in the EEPROM are loaded into memory. If the checksum is incorrect, the factory default settings are loaded. The configuration loaded is dependent on the current setting of the S255 register.

The final two tests check the loopback capability of the Digital Analog Interface chip and verifies that the 32010 Signal Processor chip is operating correctly.

User Assurance Tests

The following tests are intended to check those components not tested at power-up. You should be familiar with the contents of this manual and understand how to operate the modem. It is assumed that you can communicate with the modem through the RS-232C serial interface port using a terminal or personal computer. If you are not able to communicate with the modem through the serial interface, read the *Troubleshooting* section at the end of this chapter.

Non-volatile Memory Test

To verify that the modem's non-volatile memory is working correctly:

1.   Enter one or two telephone numbers in the Number Directory.

2.   Turn the modem off then back on, and verify that the new numbers are still present.

Telephone Dialer Test

To check the integrity of the analog/digital circuitry and telephone line interface:

1.   Enter the following tone dialing command:

     AT DT 12345

2.   Listen to the tones from the speaker to verify that the modem is tone dialing.

3. Press the any key to hang up the line.

4. Enter the following pulse dialing command:

   AT DP 12345

5. Listen for the relay clicking sounds to verify that the modem is pulse dialing.

Telephone Line Relay Test

To check the operation of the line relay control signals:

1. Plug a telephone into the PHONE connector on the modem's rear panel, and verify that the modem is connected to the telephone line via the LINE connector.

2. Lift the receiver and listen for a dial tone.

3. Enter the following command to take the telephone line off-hook:

   AT H1

   The dial tone from the receiver should go away when the modem goes off-hook (OH indicator lit).

4. Enter the next command to hang up the telephone line:

   AT H0

   The dial tone from the telephone receiver should return.

Ring Detect Test

The easiest way to check the modem's ring detection circuit is to disable the auto-answer feature by setting the S0 register to 0, and call the number to which the modem is connected. When the modem detects a ring signal, the word RING is displayed on the screen. The word should appear every four to six seconds to indicate the end of each ring signal.

Remember to set the S0 register back to 1 if you plan on using the auto-answer feature.

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Troubleshooting

If you encounter problems while setting up and using your modem, you can simplify the troubleshooting process by progressing in stages. This approach makes it easier to isolate and resolve any problems which you might encounter as you progress through the various stages.

This section covers the following three stages of establishing a communications link:

- **Pre-Call Initialization** - focuses on ensuring that the modem and your equipment are properly configured for communications over the DTE-DCE interface.

  To confirm that the modem can in fact communicate with your equipment, refer to Table 6-1.

- **Call Establishment** - deals with problems which may occur while attempting to place or answer a call up to the point at which data can be exchanged across the communications link.

  If you have problems placing or answering a call, refer to Table 6-2 or 6-3, respectively.

- **Call In Progress** - addresses problems which may occur while actually transmitting information between two locations.

  Some of the problems which can occur while a call is in progress are: lost or garbled data, the modems unexpectedly stop communicating, or the connection is prematurely dropped. If you experience problems in any of these areas refer to Table 6-4 for recommended solutions.

Table 6-1. Modem Preconfiguration

Is the MR (Modem Ready) Indicator on the front panel lit?

The MR light indicates that the modem is operational. If the indicator is off, try issuing an AT ~I1 command to obtain the results of the diagnostic tests. If you get no response or the test result code returned is not 000, try running the self-diagnostics test again by turning the modem's power off and back on. If the MR indicator still does not light, contact your technical support representative for further assistance.

Issue an AT ~N? command to display the modem's current register settings.

Are double characters appearing on the screen?

Both the DTE and the modem are echoing characters to the screen. Disable local echo on your DTE. If this is not possible then disable echo from the modem by issuing an AT ~E0 command to the modem.

Are you getting garbled data or no response from the modem?

Verify that the modem is connected to a functioning RS-232C port on your DTE, and that the RS-232 cable is configured correctly.

Make sure that the modem and DTE are both using the same interface speed and data format.

If your modem has been used before, you may need to re-initialize it for either Enhanced or Conventional Command Mode as described in Chapter 3, *Using the Modem*.

Configure the modem to meet the specific requirements of your system and save the configuration parameters in non-volatile memory.

Refer to Chapter 4, *Conventional Command Mode*, or Chapter 5, *Enhanced Command Mode*, for configuration guidelines.

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Table 6-2. Placing a Call

Is the telephone line connected to the TO LINE connector on the modem's backpanel?

A common mistake is to connect the telephone line to the PHONE connector which is used for connecting a telephone to the modem for voice communications. Connect the telephone line to the LINE connector on the modem's backpanel. Optionally, connect a telephone set to the PHONE connector.

Is the modem ready to accept commands or data from the DTE? The MR (Modem Ready), DTR (Data Terminal Ready) and CTS (Clear to Send) indicators should be lit.

The modem must be operational and able to communicate with the DTE before placing a call. See Table 6-1 for information on verifying that the modem is able to communicate with your equipment.

Send a dialing command sequence to the modem from your terminal or computer.

Be sure to include any required access codes and wait for dial tone characters (W) in the dialing sequence. If your call requires operator assistance you can place a call manually using your telephone set, then press the T/D switch to cause the modem to go off-hook and listen for the called modem's answer tones.

Did the modem go off-hook and begin the dialing sequence? You should hear a brief dial tone followed by dialing sounds as the modem places the call. The OH (Off-Hook) indicator should be lit.

If the OH indicator did not light, the modem probably did not recognize the dial command. Try entering the command again. Be sure to precede the command with an AT prefix (unless register S63 is set to 0) and follow the command with a carriage return. Verify that the modem is properly configured to communicate with your equipment.

If you did not hear a dial tone before the modem started dialing, connect a telephone to the telephone line and listen for a dial tone. If you do not hear the dial tone, the telephone line is dead. Contact your telephone company service representative for assistance.

Table 6-2. Placing a Call (continued)

Did the telephone ring at the remote site? You should hear a ringing signal over the speaker.

Depending on how quickly the remote site answers the call, you may not hear a ringing signal. If you hear the answering modem's answer tones, you can assume that the remote site answered the call.

Make certain that you entered the correct dialing sequence. If you are going through a PBX (Private Branch Exchange), you may need to enter "9W" to access an outside line and wait for a second dial tone. The S6 register determines how long the modem will wait for a dial tone when a "W" is entered in a dialing sequence.

If your call is routed through key systems, security devices or similar equipment, additional access digits might be required, and it may take longer to set up the call. One or more commas can be used in the dialing sequence to cause the modem to pause when necessary. The length of the pause is determined by the S8 register.

You may need to extend the time that the modem will wait for a carrier by increasing the value of the S7 register.

It is possible that the touch tone speed is too fast for the phone switching equipment which occasionally happens with older phone equipment. Try lengthening the touch tone timing specified by the S11 register.

Did the remote modem answer the call? You should hear answer tones from the remote site over the speaker.

If the phone continues to ring with no answer, verify that you are dialing the correct number. Ask the operator at the remote site to confirm that their equipment will answer the phone.

If the ringing signal stops but you do not hear the answer tones from the answering modem, ask the operator at the remote site to check their equipment and connections.

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Table 6-2. Placing a Call (continued)

Did the modems at both ends synchronize? The FST(Fast) or SLW (Slow) indicator should be lit depending on if a connection was made in PEP or Slow Mode.

Verify that the modems at both ends agree on the transmission mode used. The S50 register determines the transmission mode used by the modem. If this register is not set for Automatic Speed Determination (S50=0), it must match the transmission speed of the remote modem.

If the modem goes on-hook (the OH indicator turns off) during synchronization, you may need to extend the time that it will wait for a carrier by increasing the value of the S7 register.

If you are calling a V.22 or V.22bis type modem, you should also check the setting of the S90 and S91 registers. The S90 register is used to select either 212A (S90=0) or V.22 (S90=1) emulation when operating at 1200 bps. Some V.22 or V.22bis modems use guard tones during synchronization. Try changing the setting of the S91 register to use either a 1800 Hz guard tone (S91=1) or a 550 Hz guard tone (S91=2).

If expected, did you receive a valid (ungarbled) sign-on message from the remote site?

Sign-on procedures vary from one system to another. You may need to press the space bar or take some other action to get the sign-on message. Refer to the system's operating instructions for the appropriate procedure.

If after taking the appropriate action you still do not receive a sign-on message, or the message is garbled, there may be some problem with the interface speed between the DTE and modem at either end, or a mismatch in the data format (usually parity) used between the DTEs at each site. Refer to Table 6-4 for information on resolving either of these two conditions.

Table 6-3. Answering a Call

Is the telephone line connected to the TO LINE connector on the modem's backpanel?

A common mistake is to connect the telephone line to the PHONE connect which is used for connecting a telephone to the modem for voice communications. Connect the telephone line to the LINE connector on the modem's backpanel. Optionally, connect a telephone set to the PHONE connector.

Is the MR (Modem Ready) indicator on the modem's front panel lit?

The MR light indicates that the modem is operational. If the indicator is off, the modem failed the power up diagnostic test. Contact your technical support representative for further assistance.

Did the modem answer an incoming call by going off-hook when a ringing signal was received? The OH (Off-Hook) indicator should be lit.

If register S0 is set to 0, the modem will not automatically answer an incoming call. To enable auto-answer mode, set this register to the ring number on which the modem should answer a call.

If S52 is non-zero, the modem will not answer an incoming call while DTR (Data Terminal Ready) is off. Your equipment should provide this signal when it is ready to transmit or receive data, or in response to a ringing signal on the RI (Ring Indicator) signal line of the RS-232 interface. If the DTR indicator on the front panel is not lit, verify that the RS-232 cable is configured correctly. If your equipment asserts DTR in response to a ringing signal, verify that it is receiving a signal on the RI line, and turning on DTR at the appropriate time.

Try placing the same call with a telephone set on each end of the connection. If the call cannot be placed with telephone sets, it will not work with modems.

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Table 6-3. Answering a Call (continued)

Did the modem answer the call and then hang-up before a connection was established? This can occur very rapidly so that the OH (Off-Hook) indicator is barely noticeable. The caller may hear a pair of clicks after the last ring.

Make certain that your equipment is not sending a sign-on message before DCD (Data Carrier Detected) is turned on. This could cause the modem to hang-up. Note that setting S64 to 1 causes the modem to ignore any characters sent by the local DTE while dialing or answering a call.

If the modem is configured to show status messages, your equipment may be echoing the status message back to the modem causing it to hang-up. To solve this problem, turn off echo and place the modem in quiet mode by issuing the E0 and Q1 commands.

When S52 is non-zero, the modem will disconnect a call if DTR is dropped. Make certain that your equipment is not turning off DTR during a call. Your equipment may be periodically switching DTR on and off while searching for an active device (looking for an active DSR or DCD signal from a modem). Try changing the S130 and S131 register settings to enable these signals. If you cannot configure your equipment to provide DTR, set the S52 register to 0 so that the modem will not hang up when DTR is not present.

Did the modems at both ends synchronize? The FST(Fast) or SLW (Slow) indicator should be lit depending on if a connection was made in PEP or Slow Mode.

Verify that the modems at both ends agree on the transmission mode used. The S50 register determines the transmission mode used by the modem. If this register is not set for Automatic Speed Determination (S50=0), it must match the transmission speed of the calling modem.

Table 6-3. Answering a Call (continued)

When the modem answers a call in Automatic Speed Determination mode, it steps through several different answer tones to allow the calling modem to synchronize on the appropriate tone. If the calling modem is not a PEP-compatible modem, it may be adversely affected by PEP answer tones. Try setting the S92 register to 1 to move the PEP answer tones to the end of the answering sequence.

The calling modem may need to extend the time that it waits for a carrier before disconnecting to allow time for the modem to arrive at the correct answer tone.

If the calling modem is a V.22 or V.22bis type modem, you should also check the setting of the S90 and S91 registers. The S90 register is used to select either 212A (S90=0) or V.22 (S90=1) emulation when operating at 1200 bps. Some V.22 or V.22bis modems use guard tones during synchronization. Try changing the setting of the S91 register to use either a 1800 Hz guard tone (S91=1) or a 550 Hz guard tone (S91=2).

If expected, did the calling modem receive a valid (ungarbled) sign-on message from the remote site?

Sign-on procedures vary from one system to another. The caller may need to press the space bar or take some other action to get the sign-on message. Ask the operator at the calling site to confirm that they are following the correct sign-on procedure.

If after taking the appropriate action the caller still does not receive a sign-on message, or the message is garbled, there may be some problem with the interface speed between the DTE and modem at either end, or a mismatch in the data format (usually parity) used between the DTEs at each site. Refer to Table 6-4 for information on resolving either of these two conditions.

At this point, the modem should be capable of communicating with the calling modem.

See Table 6-4 for information on solving problems which may occur during a communications session.

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Table 6-4. Call In Progress

Is data (or the sign-on message) being garbled during transmission?

If a connection has been made in non-packetized mode (SLW indicator is lit), the line quality of the connection may be inadequate for error free transmission. The modem only detects transmission errors when operating in packetized mode. Hang up and try placing the call again. The probability of getting the same connection is unlikely.

There may be some problem with the interface speed between the DTE and modem at either end, or a mismatch in the data format (usually parity) used between the DTEs at each site.

If the other modem is not a PEP-compatible modem, verify that your S66 register is set to 1. This prevents the modem from changing the interface speed when a connection is made. If S66 is set to 0 and a connection is made in non-packetized mode, the modem changes the interface speed to match the speed of the connection.

Ask the operator at the remote site to confirm that they do not have an interface speed mismatch at their end.

Check the setting of the S60 register. Except for a few rare cases, this register should be set to 0 which permits end-to-end parity checking between DTEs as well as providing a transparent data path for binary file transmissions.

Verify that the data format (data length, parity, and stop bits) used by your DTE matches the data format used by the DTE at the remote site. Refer to your equipment's manual for instructions on setting the data format.

Is data being lost during transmission?

Most problems with loss of data during transmission result from a mismatch in the flow control method used between the modem and the DTE at either end. Data in the DTE or modem's buffer is being overwritten.

The DTE may not be responding to the flow control signal soon enough to avoid a buffer overflow condition.

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Table 6-4. Call In Progress (continued)

The modem uses two registers to control the flow of data between the DTE and the modem. The S58 register controls data flow over the Received Data (RD) line to the DTE. A similar register, S68, controls data flow over the Transmitted Data (TD) line to the modem. The two most common flow control methods supported by the modem are: XON/XOFF or RTS/CTS. Check your equipment's manual to determine which type of flow control method it supports, and set the S58 and S68 registers to match that flow control method.

Did either modem unexpectedly stop transmitting or receiving data?

The calling modem , answering modem or both modems may have been inadvertently placed in Command Mode by a break signal or escape sequence. Registers S54 and S55 determine how the modem will respond to a break signal or escape sequence. You may need to change the setting of either or both of these registers to prevent the modem from entering Command Mode at an inappropriate time. Note that if the modem is installed in an unattended answer environment, these two registers should usually be set to not enter Command Mode under any condition.

If the answering site's modem is configured to ignore the DTR signal (S52=0), it will maintain the connection even if its DTE drops DTR due to inactivity or some other condition. If this happens, the calling site must terminate the connection, and if desired re-initiate the call.

Was the connection dropped prematurely?

If a connection has been made in non-packetized mode (SLW indicator is lit), the carrier signal may have been dropped due to a degradation in the line quality of the connection. Try placing the call again. The probability of getting the same connection is unlikely.

If the modem's S52 register is non-zero and its associated DTE drops DTR due to inactivity or some other condition, the modem will disconnect the call.

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Chapter 7
Technical Support Procedures

Telebit Corporation has made every effort to ensure that the product you have purchased is of excellent quality in all respects. Telebit products are rigorously tested and subjected to strict quality control procedures. However, if you experience difficulty in the use of this product, or it does not appear to operate correctly, we suggest doing the following:

o   Read this manual. It has been provided to help you configure and use your modem.

o   Contact your dealer. Telebit authorized dealers are familiar with Telebit's products and should be able to help you resolve any problems that you may encounter while setting up and using the modem.

o   Finally, call Telebit's Technical Support at (408) 734-5200. Before calling, please have all the following information about your unit available:

Product Name _____

Serial Number _____

Date of Purchase _____

Place of Purchase _____

If your product should require service, we will repair or replace it under the terms of our One Year Limited Warranty. Please read the warranty statement included in this chapter, and return the Warranty Registration Card at the back of this manual.

When the One Year Limited Warranty period expires, Telebit will continue to service your product for the current applicable service fee. If you wish, you may extend your warranty protection for an additional two years by purchasing our Extended Warranty any time before the first year warranty expires. However, there is a cost savings if you purchase this option within 10 days of the original equipment purchase date.

Return for Repair Procedure

The following procedure describes how to return the unit to Telebit for repair. This procedure is applicable to both in or out of warranty repairs.

1. Call Telebit's Technical Support Department at (408) 734-5200 and describe the problem. Tell the technical support representative if your unit is or is not covered by warranty. They will issue you a RMA number.

    If the unit is covered by a warranty but not registered, you must submit proof of purchase.

    If you do not have proof of purchase or your unit is not covered by the warranty, you must send the current repair fee with your unit.

    The technical support representative will provide you with that information and any further instructions if necessary.

2. Pack the unit in its original container or in a sturdy corrugated box using *non-static* material such as newspaper as a cushion. *Do not* use highly static prone material such plastic wrap or Styrofoam packing material (beads or peanuts) as they may further damage the unit in transit.

3. Ship the unit only. Do not ship manuals, power supply or phone cord unless your technical support representative instructs you to do so.

4. Include the following information with your unit:

> Name
> Address
> City, State, Zip Code
> Telephone Number
>
> RMA Number
> Description of the problem
> Current Repair Fee (if applicable)

5. Ship the unit (for repair) freight prepaid to:

> Telebit Corporation
> 1315 Chesapeake Terrace
> Sunnyvale, CA 94089
> Attention: Technical Support RMA #

We recommend that you insure the unit when shipped. ***Telebit will not accept units shipped C.O.D.***

6. Telebit will ship the repaired or replacement product at no cost to you to any destination in the U.S.A. Telebit will choose the carrier and method of shipment. If you desire some other specific form of conveyance or you are located outside the U.S.A., you must bear the cost of return shipment and other incidental costs.

One Year Limited Warranty

Telebit Corporation ("Telebit") warrants the hardware products and all components thereof against defects in materials and/or workmanship for one (1) year from the date of your original retail purchase.

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If you discover a malfunction or defect in materials or workmanship, Telebit, at its option, will repair or replace the product or component at no charge to you, provided you return it, as set forth below, during the warranty period. Telebit will furnish repair parts and replacement products on an exchange basis; all returned parts and products become Telebit's property. Repairs and replacements may be either reconditioned or new. Telebit will make the final determination as to the existence and cause of any alleged defect. If a returned product shows "no trouble found," Telebit may assess a repair charge.

Telebit does not warrant that any product will operate uninterrupted or without error. The warranty is contingent upon proper use of the product in the application for which it is intended. The warranty will be void on products which have been subjected to abuse, misuse, accident, alteration, neglect, unauthorized repair or installation; modified without Telebit's approval; subjected to unusual physical or electrical stress; or used with a power supply other than the one provided with the product. Expendable items (such as lamps and fuses) are not warranted. This limited warranty is extended only to the original purchaser and is not assignable.

THE WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHERS, ORAL OR WRITTEN, EXPRESS OR IMPLIED. TELEBIT MAKES NO EXPRESS OR IMPLIED WARRANTIES INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PAR-TICULAR PURPOSE, EXCEPT AS EXPRESSLY SET FORTH IN THIS LIMITED WARRANTY. SOFTWARE AND DOCUMENTATION IS PROVIDED ON AN 'AS IS' BASIS. IN NO EVENT SHALL TELEBIT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, COSTS OR EXPENSES ARISING OUT OF OR IN CONNECTION WITH THE USE OR PER-FORMANCE OF ANY PRODUCT DELIVERED HEREUNDER.

NOTE: Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages for consumer products, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Please see *Return for Repair Procedure* in this chapter for specific instructions on returning products for service.

You may extend the limited warranty period for an additional two (2) years by purchasing the Two Year Limited Warranty Extension. The limited warranty will then be for a total of three (3) years from the purchase date.

Two Year Limited Warranty Extension

You can extend your one year limited warranty for an additional two years by paying a reasonable one time fee. This fee guarantees repair or replacement of a faulty unit as often as required while it is under warranty subject to the same terms and conditions as the Telebit One Year Limited Warranty. The warranty period will then be for a total of three (3) years from the date of purchase. You may purchase this warranty extension at any time before the one year limited warranty expires.

If you purchase this warranty extension within 10 days of the date you purchase the modem, the price of the extended warranty is reduced. Contact your sales representative or Telebit's Technical Support Department for the current pricing options for your product. Be prepared to provide them with the product name, serial number, date and place of purchase.

You may also purchase this warranty extension by completing Part 2 of the Warranty Registration Card and returning it to Telebit.

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Appendix A
ASCII Code Chart

Code	Mnem	Dec	Hex	Code	Dec	Hex	Code	Dec	Hex	Code	Dec	Hex
	NUL	00	00	SP	32	20	@	64	40	`	96	60
CTRL A	SOH	01	01	!	33	21	A	65	41	a	97	61
CTRL B	STX	02	02	"	34	22	B	66	42	b	98	62
CTRL C	ETX	03	03	#	35	23	C	67	43	c	99	63
CTRL D	EOT	04	04	$	36	24	D	68	44	d	100	64
CTRL E	ENQ	05	05	%	37	25	E	69	45	e	101	65
CTRL F	ACK	06	06	&	38	26	F	70	46	f	102	66
CTRL G	BEL	07	07	'	39	27	G	71	47	g	103	67
CTRL H	BS	08	08	(	40	28	H	72	48	h	104	68
CTRL I	HT	09	09	)	41	29	I	73	49	i	105	69
CTRL J	LF	10	0A	*	42	2A	J	74	4A	j	106	6A
CTRL K	VT	11	0B	+	43	2B	K	75	4B	k	107	6B
CTRL L	FF	12	0C	,	44	2C	L	76	4C	l	108	6C
CTRL M	CR	13	0D	-	45	2D	M	77	4D	m	109	6D
CTRL N	S0	14	0E	.	46	2E	N	78	4E	n	110	6E
CTRL O	SI	15	0F	/	47	2F	O	79	4F	o	111	6F
CTRL P	DLE	16	10	0	48	30	P	80	50	p	112	70
CTRL Q	DC1	17	11	1	49	31	Q	81	51	q	113	71
CTRL R	DC2	18	12	2	50	32	R	82	52	r	114	72
CTRL S	DC3	19	13	3	51	33	S	83	53	s	115	73
CTRL T	DC4	20	14	4	52	34	T	84	54	t	116	74
CTRL U	NAK	21	15	5	53	35	U	85	55	u	117	75
CTRL V	SYN	22	16	6	54	36	V	86	56	v	118	76
CTRL W	ETB	23	17	7	55	37	W	87	57	w	119	77
CTRL X	CAN	24	18	8	56	38	X	88	58	x	120	78
CTRL Y	EM	25	19	9	57	39	Y	89	59	y	121	79
CTRL Z	SUB	26	1A	:	58	3A	Z	90	5A	z	122	7A
	ESC	27	1B	;	59	3B	[	91	5B	{	123	7B
	FS	28	1C	<	60	3C	\	92	5C			124	7C
	GS	29	1D	=	61	3D	]	93	5D	}	125	7D
	RS	30	1E	>	62	3E	^	94	5E	~	126	7E
	US	31	1F	?	63	3F	_	95	5F	DEL	127	7F

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Appendix B
Interface Description

Telephone Network Interface

The modem is connected to the telephone network through an RJ11C modular connector. A second connector allows you to connect a telephone to the network for voice communication. Table B-1 presents a definition of the pins in the line connector.

Table B-1. RJ11C Line Connector Pin Definitions

PIN	LINE	PHONE
1	Not Used	Not Used
2	Not Used	Not Used
3	Ring	Tip
4	Tip	Ring
5	Not Used	Not Used
6	Not Used	Not Used

RS-232C Interface

Communication between the modem and the local DTE is accomplished through a 25-pin RS-232C connector. Table B-2 lists the RS-232C interchange signals and their associated pins.

The modem is designed to operate as an asynchronous DCE device which only uses the primary interchange circuits defined in Figure B-1. This figure shows the cable configuration for connecting the modem to a standard DTE device.

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For systems which require the modem to act as a DTE connected to a DCE device, a specially modified RS-232C cable must be used. Figure B-2 shows a recommended cable arrangement for this case. Your system may require a different cable configuration. Consult your equipment manual for specific cabling requirements.

Table B-2. RS-232 Connector Pin Assignments

Pin	EIA Circuit	CCITT Circuit	Signal Description	From DCE	To DCE
1	AA	101	Protective Ground	X	X
2	BA	103	Transmitted Data (TD)		X
3	BB	104	Received Data (RD)	X	
4	CA	105	Request to Send (RTS)		X
5	CB	106	Clear to Send (CTS)	X	
6	CC	107	Data Set Ready (DSR)	X	
7	AB	102	Signal Ground	X	X
8	CF	109	Data Carrier Detected (DCD)	X	
9	-	-	Reserved for Test		
10	-	-	Reserved for Test		
11	-	-	Unassigned		
12	SCF	122	Reserved	X	
13	SCB	121	Reserved	X	
14	SBA	118	Reserved		X
15	DB	114	Reserved	X	
16	SBB	119	Reserved	X	
17	DD	115	Reserved	X	
18	-	-	Unassigned		
19	SCA	120	Reserved		X
20	CD	108.2	Data Terminal Ready (DTR)		X
21	CG	110	Reserved	X	
22	CE	125	Ring Indicator (RI)	X	
23	CH	111	Reserved		X
24	DA	113	Reserved		X
25	-	-	Unassigned		

A

Figure B-1. Standard Asynchronous RS-232C Cable Diagram

Figure B-2. Special Asynchronous RS-232C Cable Diagram

A

The primary interchange signals used by the modem are described below:

Protective and Signal Ground

Pin 1 (Protective Ground) should be electrically connected to the frame or chassis of the equipment. The equipment may be further connected to an external earth ground as required by local electrical codes. Pin 7 (Signal Ground) is the common reference signal ground for all of the other pins. This line should be connected at both ends to complete the signal circuits.

Transmitted Data (TD) and Received Data (RD)

These two signal lines are used for transferring data between the DTE (computer or terminal) and the DCE (modem). All signal names are as viewed from the DTE. Therefore, the DTE transmits data on the Transmitted Data line (pin 2) and receives data on the Received Data line (pin 3). On the other hand, the DCE receives data from the DTE on the Transmitted Data line (pin 2) and sends data to the DTE on the Received Data line (pin 3).

Request to Send (RTS) and Clear to Send (CTS)

According to the RS-232C standard, the DTE asserts Request to Send (RTS) on pin 4 when it has data to transmit. It then waits for the DCE to respond by asserting Clear to Send (CTS) on pin 5 before sending data to the DTE via the Transmitted Data (TD) line.

Depending on its register settings, the modem uses RTS and CTS to implement hardware flow control between the DTE and the modem.

Data Terminal Ready (DTR) and Data Set Ready (DSR)

Pin 20 (Data Terminal Ready) is used by the DTE to indicate its readiness to transmit or receive data. In automatic answer mode, DTR is activated in response to the ring indicator to tell the modem to answer the call. The DTR signal may be turned on whenever the DTE is ready to transfer data over the interface, or simply used to indicate that the DTE has been turned on.

The modem can be configured to interpret the DTR signal in a couple of different ways thus allowing it to interface with a variety of DTE devices which may use DTR differently.

Pin 6 (Data Set Ready) is used by the modem to indicate its readiness to transmit or receive data. Data Set is another term for modem typically used by the Bell Operating Companies.

Like the DTR signal, the modem can be configured to use the DSR signal in a variety of ways to meet the expectations of the DTE device.

Data Carrier Detected (DCD)

Although this signal line is actually named *Received Line Signal Detector* in the RS-232C standard, the term Data Carrier Detected is more commonly used. An active level on pin 8 (Data Carrier Detected) indicates to the DTE that the modem has received a signal over the telephone network which meets its criteria for an acceptable carrier signal.

Depending on the requirements of the DTE device, the modem can be configured to hold DCD active whether or not a carrier is detected, or to activate DCD only when an acceptable carrier signal is detected.

Ring Indicator (RI)

Pin 22 (Ring Indicator) is used by the modem to inform the DTE that the telephone is ringing. The Ring Indicator (RI) signal is asserted in cadence with the ringing signal on the telephone line. When the ringing voltage is present, RI is active. Between rings, RI is off.

The modem can be configured to automatically answer an incoming call, or to answer the call only when the DTE indicates that it is ready to accept the call by asserting the DTR signal.

A

Appendix C
Command Cross Reference

Command Mode		Description
Conventional	Enhanced	
A	A	Answer
B0	S90=1	Use V.22 for 1200 bps operation
B1	S90=0	Use 212A for 1200 bps operation
Dn	Dn	Dial
En	En	Echo On/Off
Fn	Fn	Echoplex On/Off
Hn	Hn	Hook On/Off
In	In	Information (each command mode provides different information)
L0	S61=50	Low speaker volume
L1	S61=50	Low speaker volume
L2	S61=150	Medium speaker volume
L3	S61=250	High speaker volume
Mn	Mn	Speaker On/Off
N0	S94=0	Limit transmission speed
N1	S94=1	Allow speed negotiation
O0	O	Go on-line
O1	&RO	Retrain and go on-line
Q0	Q0	Return result codes
Q1	Q3	Do not return result codes
Q2	Q9	Return result code when originating a call, but not when answering a call
Sn=x	Sn=x	Set Register
Sn?	Sn?	Read Register
Vn	Vn	Verbose
Wn	Wn	Negotiation Progress Reporting
X0	X10	Result codes 0 - 4
X1	X11	Result codes 0 - 5, 10 - 12 and 14
X2	X12	Result codes 0 - 6, 10 - 12 and 14
X3	X13	Result codes 0 - 5, 7, 10 - 12 and 14
X4	X14	Result codes 0 - 7, 10 - 12 and 14
Yn	Yn	Disconnect on Break
Z0	Z1	Reset and recall Profile A
Z1	Z2	Reset and recall Profile B

A

Command Mode		Description
Conventional	**Enhanced**	
&C0	S131=0	DCD is always on
&C1	S131=1	DCD on when carrier detected
&D0	S52=0	DTR is ignored
&D1	S52=3	Enter command mode when DTR is turned off for S25 time
&D2	S52=4	Disconnect, enter command mode and disable auto-answer when DTR is turned off for S25 time
&D3	S52=2	Reset and enter command mode when DTR is turned off
&F	&F	Recall factory defaults (see Note 1)
&G0	S91=0	No V.22 or V.22 bis guard tone
&G1	S91=2	Use 550 Hz guard tone
&G2	S91=1	Use 1800 Hz guard tone
&K0	S58=0 S68=255	No flow control
&K3	S58=2 S68=255	RTS/CTS flow control
&K4	S58=3 S68=255	XON/XOFF flow control
	S56=17 S57=19	
&K5	S58=7 S68=255	Transparent XON/XOFF flow control
	S56=17 S57=19	
&L0	S101=0	Dial up line operation
&L1A	S101=3	Leased line answer mode
&L1D	S101=4	Leased line originate mode
&M0	S95=0	Same as &Q0
&Pn	&Pn	Pulse Dialing Make/Break Ratio
&Q0	S95=0	Disable MNP error control
&Q5 S36=0	S95=1	Select MNP Reliable Mode
&Q5 S36=1	S95=2	Select MNP Autoreliable Mode
&R0	S67=0	CTS is always on except when used for flow control
&S0	S130=0	DSR is always on
&S1	S130=1	DSR is on when answer tone is detected or transmitted
&Tn	&Tn	Test Functions
&T0	&T2	Terminate test
&V	N? and &Nn	View active and stored profiles
&W0	&W1	Write to Profile A
&W1	&W2	Write to Profile B
&Y0	S255=1	Recall Profile A on power up
&Y1	S255=2	Recall Profile B on power up
&Zn=x	Nn=x	Store telephone number

A

Command Mode		Description
Conventional	Enhanced	
S0	S0	Answer on Ring Number
S1	S1	Count of Rings
S2	S2	Escape Character
S3	S3	Carriage Return Character
S4	S4	Line Feed Character
S5	S5	Backspace Character
S6	S6	Wait Time Before Dialing (see Note 2)
S7	S7	Wait For Carrier Time (see Note 2)
S8	S8	Pause Time for Comma
S9	S9	Carrier Detect Time
S10	S10	Carrier Loss to Disconnect Time
S11	S11	Touch Tone Timing
S12	S12	Escape Sequence Guard Time
S18	S18	Test Termination Timer
S25	S25	DTR Delay Timing
S36=0 &Q5	S95=1	Select MNP Reliable Mode
S36=1 &Q5	S95=2	Select MNP Autoreliable Mode
S37=0	S50=254	Connect at last AT speed
S37=1 - 3	S50=1	Connect at 300 bps maximum
S37=5	S50=2	Connect at 1200 bps maximum
S37=6	S50=3	Connect at 2400 bps maximum
S37=7 or 9	S50=0	Connect in PEP Mode maximum
S38	S38	Delay Before Disconnecting

1- When &F is entered in Conventional Command Mode (S63=2) or the modem is initialized to operate in Conventional Command Mode, the only Enhanced Command Mode parameters reset are those listed in this appendix and the following registers: S51, S54, S63 and S66.

When &F is entered in Enhanced Command Mode (S63=0 or 1) or the modem is initialized to operate in Enhanced Command Mode, all of the modem operating parameters are reset to the Enhanced Command Mode defaults.

See the Enhanced Command Mode Quick Reference Card for a summary of all default values.

2- In Conventional Command Mode, the dial tone wait time is specified by S7. In Enhanced Command Mode, the dial tone wait time is specified by S6.

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Appendix D
Result Codes

The modem provides you with the current status of a call by issuing result codes. Depending on the current setting of the Vn command, the modem's responses are displayed in either numeric (V0) or text (V1) mode.

The current setting of the Xn command and Wn command determines which set of result codes are used as described below:

Conventional Command Mode

X0   Only use the first five basic result codes (0 - 4) listed in Table D-1. The modem blindly dials and sends a CONNECT result code when the connection is made at any speed. Dial tone and busy signal are not recognized.

X1   Use result codes 0 - 5, 10 - 12 and 14 listed in Table D-1. The modem blindly dials and sends the appropriate CONNECT XXXX result code when the connection is made. Dial tone and busy signal are not recognized.

X2   Use result codes 0 - 6, 10 - 12 and 14 listed in Table D-1. The modem waits for a dial tone before dialing and sends the appropriate CONNECT XXXX result code when the connection is made. The NO DIALTONE result code is sent if a dial tone is not detected within 5 seconds. The busy signal is not recognized.

X3   Use result codes 0 - 5, 7, 10 -12, and 14 listed in Table D-1. The modem blindly dials and sends the appropriate CONNECT XXXX result code when the connection is made. The BUSY result code is sent if a busy signal is detected. The dial tone is not detected.

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X4   Use result codes 0 - 7, 10 -12, and 14 listed Table D-1. The modem waits for a dial tone before dialing and sends the appropriate CONNECT XXXX result code when the connection is made. The NO DIALTONE result code is sent if a dial tone is not detected within 5 seconds. The BUSY result code is sent if a busy signal is detected.

W0   Do not report error control call progress result codes listed in Table D-2.

W1   Send the carrier speed and protocol messages listed in Table D-2 while establishing a connection in error control mode. If the X0 command setting is used, this option is ignored.

Table D-1. Conventional Command Mode Result Codes

Number	Message and Description
0	OK – The command was successfully completed.
1	CONNECT – Connection at 0 to 300 bps interface speed.
2	RING – An incoming ring has been detected.
3	NO CARRIER – Time to connect has expired, dial command aborted or carrier lost.
4	ERROR – A command error has been encountered.
5	CONNECT 1200 – Connection at 1200 bps interface speed.
6	NO DIALTONE – No dial tone was detected.
7	BUSY – Remote connection is busy.
8	NO ANSWER – Five seconds of silence was not detected within 30 seconds when an @ modifier was encountered in the dial string.
10	CONNECT 2400 – Connection at 2400 bps interface speed.
11	CONNECT 4800 – Connection at 4800 bps interface speed.
12	CONNECT 9600 – Connection at 9600 bps interface speed.
14	CONNECT 19200 – Connection at 19200 bps interface speed.

Table D-2. Error Control Call Progress Result Codes

Number	Message and Description
40	CARRIER 300 – Carrier detected at 300 bps (Bell 103 mode).
46	CARRIER 1200 – Carrier detected at 1200 bps (Bell 212A or V.22 mode).
47	CARRIER 2400 – Carrier detected at 2400 bps (V.22bis mode).
50	CARRIER 9600 – Modem is operating in PEP mode.
70	PROTOCOL: NONE – Error control is not being used.
71	PROTOCOL: ERROR-CONTROL/LAP-B – Either PEP or MNP error control is enforced.

Enhanced Command Mode

X0   Only use the first five basic result codes (0-4) listed in Table D-3. No speed is reported in the CONNECT message. BUSY, NO ANSWER and NO DIAL TONE are mapped to NO CARRIER. The RRING message is not reported.

X1   Use all of the extended result codes listed in Table D-3. This is the factory default setting of the Xn command.

X2   When an MNP connection is made, use the MNP extended result codes listed in Table D-4 in place of the CONNECT XXXX message.

X3   When an MNP connection is made, use the MNP extended result codes listed in Table D-4. When a connection is made in PEP mode in which an asynchronous protocol is supported or data compression is enabled, use the PEP extended result codes listed in Table D-5.

X10 Same as the X0 command listed in Conventional Command Mode.

X11 Same as the X1 command listed in Conventional Command Mode.

X12 Same as the X2 command listed in Conventional Command Mode.

X13 Same as the X3 command listed in Conventional Command Mode.

X14 Same as the X4 command listed in Conventional Command Mode.

W0 Same as the W0 command listed in Conventional Command Mode.

W1 Same as the W1 command listed in Conventional Command Mode. This option is only applicable for X11 through X14 command settings.

Table D-3. Enhanced Command Mode Result Codes

Number	Message and Description
0	OK – The command was successfully completed.
1	CONNECT 300 – Connected at 300 bps (Bell 103 mode).
2	RING – An incoming ring has been detected.
3	NO CARRIER – Time to connect has expired, dial command aborted or carrier lost.
4	ERROR – A command error has been encountered.
5	CONNECT 1200 – Connected at 1200 bps (Bell 212A or V.22 mode).
6	NO DIAL TONE – No dial tone was detected.
7	BUSY – Remote connection is busy.
8	NO ANSWER – Five seconds of silence was not detected within 30 seconds when an @ modifier was encountered in the dial string.
10	CONNECT 2400 – Connected at 2400 bps (V.22bis mode).
50	CONNECT FAST – Connected to a modem using the Packetized Ensemble Protocol (PEP).
52	RRING – Remote connection is ringing.

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Table D-4. MNP Extended Result Codes

Number	Message and Description
20	CONNECT 300/REL – MNP connection at 300 bps.
22	CONNECT 1200/REL – MNP connection at 1200 bps.
23	CONNECT 2400/REL – MNP connection at 2400 bps.

Table D-5. PEP Extended Result Codes

Number	Message and Description
61	CONNECT FAST/KERM – PEP connection with Kermit protocol supported.
62	CONNECT FAST/XMDM – PEP connection with Xmodem protocol supported.
63	CONNECT FAST/UUCP – PEP connection with UUCP protocol supported.

A

Appendix E
Leased Line Considerations

The modem is designed to connect to a two-wire circuit. If you need to connect to a four-wire leased line, you will need to obtain a four-wire to two-wire hybrid from your leased line representative.

For leased line applications, the modems should be configured as follows:

Originate Modem	Answer Modem
S7=255	S7=255
S50=255	S50=255
S101=2	S101=1

This configuration allows the modems to attempt to establish a connection in PEP Mode every 20 seconds whenever carrier is not present. For additional information read the descriptions for the above registers.

In Conventional Command Mode, the &L command sets the S101 register to an appropriate value when a subsequent Answer (A) or Dial (D) command is stored. See *Command Cross Reference* in Appendix C.

A

Appendix F
Technical Specifications

Environmental Limits

Operating Temperature	50 to 120° Fahrenheit
	10 to 50° Celsius
Storage Temperature	-40 to 150° Fahrenheit
	-40 to 65° Celsius
Relative Humidity	5 to 95% non-condensing
Altitude	10,000 feet maximum
Electrostatic Discharge	No data loss at 15 kV
	No damage at 20 kV

Power Requirements

AC Power	115 VAC (+10%, -15%) @ 60 Hz
	0.2 Amps maximum
DC Power	+5 VDC, 1.0 Amp
	+12 VDC, 0.2 Amps
	-12 VDC, 0.2 Amps

Physical Dimensions

Length	10 inches
Width	7 inches
Depth	1.4 inches

Interface

Serial Ports	25 pin RS-232C
Telephone	6 pin RJ11C

Operation

Asynchronous binary serial transmissions

A

Technical Specifications

Transmission Modes

Bell 103 (300 bps)
Bell 212A or V.22 (1200 bps)
V.22bis (2400 bps)
PEP (up to 9600 bps)

Standard Character Format

1 start bit, 8 data or 7data
plus 1 parity, and 1 stop bit

Modulation

FSK (Bell 103)
DPSK (Bell 212A, V.22)
QAM (V.22bis)
DAMQAM (PEP)

Transmit Level

-9 dBm maximum

Receiver Sensitivity

-45 dBm

Transmit/Receive Frequencies

Bell 103	Tx Frequency	Rx Frequency
Originate Mode	1070 Hz = space	2025 Hz = space
	1270 Hz = mark	2225 Hz = mark
Answer Mode	2025 Hz = space	1070 Hz = space
	2225 Hz = mark	1270 Hz = mark

Bell 212A/V.22/V.22bis	Tx Frequency	Rx Frequency
Originate Mode	1200 Hz (carrier)	2400 Hz (carrier)
Answer Mode	2400 Hz (carrier)	1200 Hz (carrier)

Packetized Ensemble Protocol

Up to 512 carriers spaced 7.8 Hz
apart in the 0 to 4000 Hz band

Frequency Offset

Can tolerate up to ± 7 Hz

Certifications

FCC Part 15J Class B, Part 68
DOC CS-03, Issue 05
UL and CSA

A

Glossary

ACK — Control character transmitted by a receiving device as an affirmation to a sending device.

alphanumeric — Letters (alphabetic) and numbers (numeric).

ANSI — American National Standards Institute, primary standards development body in the U.S.A.

ASCII — American Standard Code for Information Interchange, a seven bit code established by ANSI for representing alphanumeric and control characters.

asynchronous transmission — Digital transmission technique characterized by start and stop bits at the beginning and end of each character and not synchronized by a clock signal.

baud rate — Number of discrete signaling events per second; not necessarily the same as bits per second.

bit — An acronym for binary digit. A bit is the smallest unit of digital information represented by the choice of one of two possible states – one (mark) or zero (space).

block — Group of characters treated as a unit for the purpose of data transmission.

bps (bits per second) — The most common unit of measure for specifying the data transfer rate in a communication network.

break — Signal used by computer equipment to interrupt some process.

buffer — Temporary storage area used to compensate for a difference in the rate of data flow into and out of a device.

byte — A grouping of bits to specify a single character usually consisting of eight consecutive bits.

carrier — An analog signal which is modulated by another signal containing information to be transmitted.

G

Carrier Detected (CD) — RS-232C control signal used by the DCE to inform the DTE that it has detected a valid carrier signal.

CCITT — Consultive Committee for International Telephone and Telegraph sets standards for worldwide voice and data communications.

CCITT V.XX — International standards in communications concerned with modem interfaces, speeds, and transmission modes.

channel — An electronic communications path. A voice grade channel generally ranges from 300 to 4000 Hz.

character — A letter, number or other symbol contained in a message or used in a control function.

character set — The characters that can be coded or used by a particular machine.

Clear to Send (CTS) — An RS-232C control signal sent by the DCE to indicate that the DTE may begin a transmission.

clock — Source of timing signals used in synchronous transmission.

code — A predefined set of rules that specifies the way data is to be represented by the transmitting and receiving device.

common carrier — Telephone company that furnishes communications services to the general public.

conditioning — The addition of equipment to a leased voice grade line to improve the transmission characteristics of the line.

console — Part of a computer system, usually a video display terminal, used by the operator to communicate with the computer.

contention — Condition arising when two or more devices try to transmit at the same time using the same channel.

control character — Character that initiates some control function on the receiving device.

CPU — Central Processing Unit. The computer hardware which processes software instructions to control the computer system and its peripherals.

CRT — Cathode Ray Tube. This term is commonly used to stand for the video display terminal.

Cyclic Redundancy Check (CRC) — An error detection technique in which a data validation value is mathematically derived from a block of data and transmitted at the end of the block. The receiving end recomputes the value and if it matches the value sent, the data is assumed to be valid (error-free). If not, the receiver notifies the transmitter that an error has occurred and the block is retransmitted.

Data Communications Equipment (DCE) — The equipment which provides all the functions required to establish, maintain and terminate a connection, and provides the signal conversion required for communications between the Data Terminal Equipment and the Telephone Network.

data compression — An encoding technique which provides for the transmission of fewer data bits without the loss of information. The receiving end expands the data received to its original form.

Data Carrier Detected (CD) — RS-232C control signal used by the DCE to inform the DTE that it has detected a valid carrier signal.

data set — *See Modem.*

Data Set Ready (DSR) — An RS-232C control signal used to indicate the readiness of the DCE to accept data from the DTE.

Data Terminal Equipment (DTE) — The equipment which provides the data source and/or receiving end of a data transmission link. The DTE may be a CRT or teletype terminal, a personal computer, a printer, a front-end processor to a large mainframe computer, or any other device which can transmit or receive data.

Data Terminal Ready (DTR) — An RS-232C control signal used to indicate the readiness of the DTE for data transmission.

decibel (dB) — Unit of measure indicating the logrithmic ratio of output signal power to input signal power.

dedicated line — A communications line which is not dialed. Also known as leased line or private line.

demodulation — The process of recovering digital information from a modulated analog carrier waveform.

dial-up line — A communication circuit which is established by a switched circuit connection using the telephone dial network.

dibit — A grouping of two bits.

digital signal — A signal composed of discrete signal levels as opposed to the continuous signal levels of an analog signal.

distortion — Undesired change in a signal's original waveform resulting from the characteristics of the transmission circuits or other external influences.

dumb terminal — Terminals that do not contain an intelligent microprocessor and usually send data one character at a time.

EBCDIC — Extended Binary Coded Decimal Interchange Code. An eight bit code used primarily by IBM equipment.

echoplex — Method of verification of transmitted data by echoing the characters transmitted back to the source device for verification.

EIA — Electronic Industries Association. Standards organization in the U.S. that sets standards for the functional characteristics of electronic interfaces.

ENQ — Control character used to enquire as to the identification or status of a remote device.

EPROM — Erasable Programmable Read Only Memory.

ETX — Control character which indicates the "End of Text" in a transmitted message.

FCC — Federal Communications Commission.

firmware — Computer program stored permanently in Read Only Memory.

Forward Error Correction (FEC) — Technique of transmitting additional information with the original data such that the if small errors are detected the correct information can be recreated by the receiving end without requiring a retransmission.

frame — *see Block.*

front-end processor — Computer equipment designed primarily for communications control associated with a large mainframe.

full duplex — Method of transmission in which transmissions can occur in both directions at the same time.

guard band — Narrow frequency bands left unused between adjacent channels to minimize interference.

half duplex — Method of transmission in which communications can occur in both directions but not at the same time.

hardware — The electronic or electromechnical devices in a computer system as opposed to the programs or software.

HDLC — High Level Data Link Control. Communications protocol developed by the International Standards Organization.

header — In communications protocols, this is the control information that precedes the message or text portion of a block of data.

Hertz (Hz) — Unit of frequency, one cycle per second.

Horizontal Redundancy Checking (HRC) — Technique in which redundant information is included with a block of data for validating the transmitted data at the receiving end.

host computer — The main computer system in a data communications system.

Interface — A shared boundary defined by common physical interconnection characteristics, signal characteristics, and meaning of interchanged signals.

G

Interference — Undesirable disturbances or distortions in a data transmission signal.

ISO — International Standards Organization.

leased line — Telephone line reserved for the exclusive use of a single customer.

link — A circuit or transmission path, including all equipment, between a sender and a receiver.

Longitudinal Redundancy Check (LRC) — Error detection technique that consists of a byte where each bit is calculated on the basis of the parity of all bits in the block in the same position.

loopback — Directing signals sent back toward the source at some point in the communications path.

mainframe — Large scale computer system composed of large number of peripherals and comprehensive software.

mark — One of the two possible states of a binary data element. The closed circuit and idle condition in a teleprinter circuit. *Also see Space.*

modem — MOdulator/DEModulator. A type of DCE that converts digital data to an analog signal for transmission on telephone circuits. A modem at the receiving end converts the analog signal to digital form.

modulation — The process of varying some characteristic of the carrier wave in accordance with the data to be transmitted.

multidrop Line — Single communications circuit interconnecting many stations (nodes) each containing terminal devices.

NAK — Negative Acknowledgement. This control character indicates that the last block transmitted was in error and that the receiver is expecting a retransmission.

node — A point of interconnection on a circuit.

noise — Random electrical signals introduced by components of the circuit or natural disturbances which can produce errors in transmission.

packet — Group of bits including data and control elements that are transmitted as a whole.

Packetized Ensemble Protocol (PEP) — A patented data transmission technique used by the T1000 to transmit data at up 9600 bps on the switched telephone network.

parity — A bit that is derived from a character's data bits and transmitted along with the character. The receiving end recalculates the parity and if it matches the transmitted parity that character is assumed to have been transmitted correctly. If the parity does not match the character is deemed invalid.

PBX — Private Branch Exchange. Telephone switching equipment dedicated to one customer and connected to the the public switched network.

point-to-point — A connection between two points as opposed to a multipoint or multidrop line.

private line — *See leased line.*

PROM — Programmable Read Only Memory.

propagation delay — The time required for a signal to travel from one end of a circuit to another.

protocol — The rules governing the orderly exchange of information between devices on a data link.

protocol convertor — Device that converts from one protocol to another.

public switched network — Telephone system providing circuit switching to many customers.

RAM — Random Access Memory

Received Line Signal Detector — *See Carrier Detected.*

redundancy check — Technique of error detection involving the transmission of additional data related to the message so that the receiving device can determine if the data transmitted is valid (error-free).

G

Request to Send (RTS) — RS-232C control signal used by the DTE to inform the DCE that it is ready to transmit data. When used for flow control between the DTE and modem, this signal indicates to modem that the DTE is ready to accept data.

Ring Indicator (RI) — RS-232C control signal used by the DCE to inform the DTE that it is receiving a ringing signal.

ROM — Read Only Memory.

RS-232C — Recommended standard of the Electronics Industires Association for the interface between data terminal equipment and data communications equipment.

SDLC — The standard Synchronous Data Link Control protocol used by IBM for products which conform to their System Network Architecture.

serial transmission — Method of transmission in which each data bit is transmitted sequentially.

software — Computer program or set of computer programs held in storage, and loaded into RAM for execution.

SOH — Start Of Header used in synchronous transmissions indicating the start of a header block.

space — One of the two possible states of a binary data element. The open circuit condition in a teleprinter circuit. *Also see Mark.*

start bit — The first bit or element transmitted in asynchronous transmission of a character to synchronize the receiver.

stop bit — The last bit or element transmitted in asynchronous transmission of a character to return the circuit to an idle state.

STX — Start Of Text control character used in synchronous transmission which precedes the text portion of the data block.

SYN — Synchronous Idle control characters transmitted when the line is idle in synchronous transmissions.

synchronous transmission — Transmission method in which the transmitter and receiver are continuously operating at a fixed rate. The clock signal is typically derived from the data stream in order to maintain synchronization.

terminal — Any device capable of sending and/or receiving data over a communications channel.

text — The message portion of a data block in synchronous data transmissions.

turnaround time — The time required to reverse the direction of transmission when operating in half duplex mode.

UART — Universal Asynchronous Receiver Transmitter. An integrated circuit that performs the functions required for asynchronous communications.

USART — Universal Synchronous Asynchronous Receiver Transmitter. An integrated circuit that performs the functions required for both synchronous and asynchronous communications.

Vertical Redundancy Check (VRC) — A method of character parity checking.

voice grade line — Channel with a frequency range of 300 to 3400 Hz suitable for the transmission of speech or data in analog form.

XOFF/ XON — The control characters used to stop or resume transmissions.

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I

I

I

I

You may enter a command line of up to 80 characters in upper or lower case with the first command in the line preceded by an "AT" or "at" and the last command followed by a carriage return. Note that if the S63 register is set to 0, you should not enter the "AT" at the beginning of the command line.

The notation "(n)" in the descriptions represents a decimal numeric option, and "(x)" represents an assigned value. The parentheses should not be typed. If a command is typed without a value when one is expected, the modem will assume a value of 0. The option should immediately follow the command. For example, to turn off the result codes, type Q1 not Q=1. The use of the "=" is explained under the S command in your Reference Manual.

You can repeat the last command line issued by entering "A/" or "a/". Do not enter the "AT" prefix when using this command.

Result Codes

The following result codes are returned when the X command setting is X0 through X3. If the X command setting is X10 through X14, Conventional Command Mode result codes are returned. Refer to Appendix D of your Reference Manual for more information.

Number	Message and Description
0	OK — The command was successfully completed.
1	CONNECT 300 — Connected at 300 bps (Bell 103 Compatible).
2	RING — An incoming ring has been detected.
3	NO CARRIER — Time to connect has expired or carrier lost.
4	ERROR — A command error has been encountered.
5	CONNECT 1200 — Connected at 1200 bps (Bell 212A or V.22 Compatible).
6	NO DIAL TONE — No dial tone was detected.
7	BUSY — Remote connection is busy.
8	NO ANSWER — Five seconds of silence was not detected within 30 seconds when an @ modifier was encountered in the dial string.
10	CONNECT 2400 — Connected at 2400 bps (V.22 bis Compatible).
50	CONNECT FAST — Connected to a modem using the Packetized Ensemble Protocol (PEP).
52	RRING — Remote connection is ringing.
20	CONNECT 300/REL — MNP connection at 300 bps.
22	CONNECT 1200/REL — MNP connection at 1200 bps.
23	CONNECT 2400/REL — MNP connection at 2400 bps.
61	CONNECT FAST/KERM — PEP connection with Kermit support.
62	CONNECT FAST/XMDM — PEP connection with Xmodem support.
63	CONNECT FAST/UUCP — PEP connection with UUCP support.

Command Summary (continued)

Command	Parameter	Description	Default
&J(n)	0	Jack Type Selection 0 RJ-11 jack 1 Not supported	&J0
&K(n)	0, 3 - 5	Flow Control 0 No flow control 3 RTS/CTS 4 XON/XOFF 5 Transparent XON/XOFF	&K3
&L(n)	0 or 1	Line Type Selection 0 Dial-up line 1 Leased line	&L0
&M(n)	0	Communications Mode Selection 0 Same as &Q0 1-3 Not supported	&M0
&P(n)	0 or 1	Pulse Dialing Make/Break Ratio 0 39% make, 61% break 1 33% make, 67% break	&P0
&Q(n)	0 or 5	Communications Mode Selection 0 Normal mode 5 Error control mode	&Q5
&R(n)	0 or 1	CTS Interpretation This command is reserved for synchronous operation which is not supported in Conventional Command Mode. CTS is always on except when RTS/CTS flow control is used.	&R0
&S(n)	0 or 1	Data Set Ready Interpretation 0 DSR is always on 1 DSR is turned on when answer tone is detected	&S0
&T(n)	0 - 8	Initiate Test Function *See Reference Manual*	&T4
&V		View Active Configuration and User Profiles	
&W(n)	0 or 1	Write Configuration Parameters 0 Save to profile A 1 Save to profile B	
&X(n)		Transmit Clock Source This command is reserved for synchronous operation which is not supported by the T1000.	&X0
&Y(n)	0 or 1	Default User Profile Selection 0 Recall profile A after power up 1 Recall profile B after power up	&Y0
&Z(n)=(x)	0 - 3	Set Number Directory	

Quick Reference Card
Enhanced Command Mode

You may enter a command line of up to 80 characters in upper or lower case with the first command in the line preceded by an "AT" or "at" and the last command followed by a carriage return. Note that if the S63 register is set to 0, you should not enter the "AT" at the beginning of the command line.

The notation "(n)" in the descriptions represents a decimal numeric option, and "(x)" represents an assigned value. The parentheses should not be typed. If a command is typed without a value when one is expected, the modem will assume a value of 0. The option should immediately follow the command. For example, to turn off the result codes, type Q1 not Q=1. The use of the "=" is explained under the S command in your Reference Manual.

You can repeat the last command line issued by entering "A/" or "a/". Do not enter the "AT" prefix when using this command.
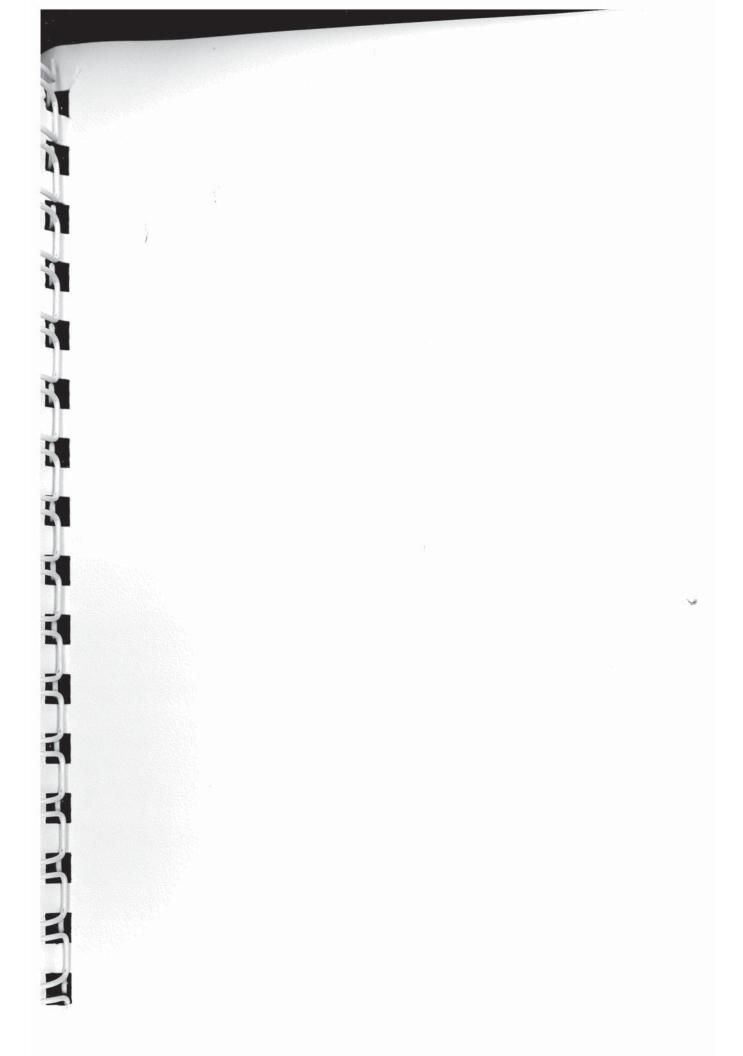
Result Codes

The following result codes are returned when the X command setting is X0 through X3. If the X command setting is X10 through X14, Conventional Command Mode result codes are returned. Refer to Appendix D of your Reference Manual for more information.

Number	Message and Description
0	OK — The command was successfully completed.
1	CONNECT 300 — Connected at 300 bps (Bell 103 Compatible).
2	RING — An incoming ring has been detected.
3	NO CARRIER — Time to connect has expired or carrier lost.
4	ERROR — A command error has been encountered.
5	CONNECT 1200 — Connected at 1200 bps (Bell 212A or V.22 Compatible).
6	NO DIAL TONE — No dial tone was detected.
7	BUSY — Remote connection is busy.
8	NO ANSWER — Five seconds of silence was not detected within 30 seconds when an @ modifier was encountered in the dial string.
10	CONNECT 2400 — Connected at 2400 bps (V.22 bis Compatible).
50	CONNECT FAST — Connected to a modem using the Packetized Ensemble Protocol (PEP).
52	RRING — Remote connection is ringing.
20	CONNECT 300/REL — MNP connection at 300 bps.
22	CONNECT 1200/REL — MNP connection at 1200 bps.
23	CONNECT 2400/REL — MNP connection at 2400 bps.
61	CONNECT FAST/KERM — PEP connection with Kermit support.
62	CONNECT FAST/XDM — PEP connection with Xmodem support.
63	CONNECT FAST/UUCP — PEP connection with UUCP support.

Command Summary

Command	Parameter	Description	Default
A		Answer	
A/		Repeat previous command	
C(n)	0 or 1	Turn Carrier ON/OFF / 0 Off / 1 On	
D(n)	0-9, A-D, *, # Modifiers:	Dial number / W Wait for dial tone / N Reference number in number directory / P Pulse dialing / T Tone dialing / , Timed wait / ! Initiate momentary on-hook flash / @ Wait for quiet answer / R Switch to answer mode when remote modem answers / ; Remain in command mode after dialing / \ Reference a number in number directory	Pulse dialing
E(n)	0 or 1	Echo Command ON/OFF / 0 Off / 1 On	E1
F(n)	0-2	Echoplex ON/OFF / 0 Off / 1 On / 2 On plus linefeed after carriage return	F1
G		Go to Voice	
H(n)	0 or 1	Hook ON/OFF / 0 Hang up (on-hook) / 1 Pick up phone line (off-hook)	
I(n)	0-4	Information / 0 Return product ID code / 1 Return diagnostic status / 2 Return current transmission mode / 3 Return firmware version level / 4 Return negotiated register values	
M(n)	0-3	Speaker ON/OFF / 0 Speaker off / 1 Speaker on while connecting / 2 Speaker always on / 3 Speaker on after dialing until carrier detected	M1
N(n)=(x)	0-9	Set Number Directory	
N(n)?	0-9	Display Number	
N?	0-9	Display Number Directory and S-registers	
O		On-Line / Place modem in data mode	

Command Summary (continued)

Command	Parameter	Description	Default
Q(n)	0-9	Quiet Enable / 0 Return result code for both local and remote modems / 1 Return result code for remote modem only / 2 Return result code for local modem only / 3 Do not return result code for either local or remote modem / 4-9 Partial quiet modes (see your Reference Manual)	Q0
S(n)=(x)		Set register n to value x	
S(n)?		Read contents of register n	
V(n)	0 or 1	Verbose ON/OFF / 0 Return numeric response / 1 Return English response	V1
W(n)	0 or 1	Negotiation Progress Reporting / 0 Progress not reported / 1 Progress reported	W0
X(n)	0 - 3, 10-14	Result Code Basic/Extended / 0 Basic result codes / 1 Extended result codes / 2 MNP result codes / 3 MNP and PEP result codes / 10-14 Conventional result codes	X1 - ECM / X14 - CCM
Y(n)	0 or 1	Disconnect on Break / 0 Modem ignores break / 1 Modem disconnects on break	Y0
Z(n)	0 - 2	Reset / 0 Reset and recall default profile / 1 Reset and recall profile A / 2 Reset and recall profile B	
&B		Blind Command	
&E(n)	0 - 2	Use EEPROM Parameters / 0 Recall default profile / 1 Recall profile A / 2 Recall profile B	
&F(n)	0 - 4	Recall Factory Parameters / See Reference Manual	
&N(n)	0 - 2	Display EEPROM Parameters / 0 Display default profile / 1 Display profile A / 2 Display profile B	
&P(n)	0 or 1	Pulse Dialing Make/Break Ratio	P0
&R(n)	0 or 1	Force Retrain or Renegotiate / 0 Retrain / 1 Renegotiate	
&T(n)	0 - 8	Initiate Test Function	
&W(n)	0 - 2	Write Configuration Parameters / 0 Save to default profile / 1 Save to profile A / 2 Save to profile B	
%		Remote Modem Access	

Register Summary

Register	Range	Description	Default
S0	0 - 255	Answer on Ring Number	1 - ECM 0 - CCM
S1	0 - 255	Count of Rings	43
S2	0 - 255	Escape Character (ASCII)	13
S3	0 - 96, 123-127	Carriage Return Character (ASCII)	13
S4	0 - 255	Line Feed Character (ASCII)	10
S5	0 - 96, 123-127	Backspace Character (ASCII)	8
S6	2 - 255	Dial Tone Wait Time (seconds)	2
S7	1 - 255	Wait for Carrier Time (seconds)	40 - ECM 30 - CCM
S8	0 - 255	Pause Time for Comma (seconds)	2
S9	1 - 255	Carrier Detect Time (100 ms units)	6
S10	1 - 255	Carrier Loss to Disconnect Time (100 ms units)	7 - ECM 14 - CCM
S11	50 - 255	Touch Tone Timing (milliseconds)	70 - ECM 95 - CCM
S12	0 - 255	Escape Sequence Guard Time (1/50 second units)	50
S18	0 - 255	Test Termination Timer	0
S25	0 - 255	DTR Delay Timing (10 ms units)	5
S38	0 - 255	Delay Before Disconnecting	0 - ECM 20 - CCM
S41	0 - 255	Inactivity Timer (tenths of hours)	0
S45	0 or 255	Remote Access Enable 0 Disable Remote Access 255 Enable Remote Access	0
S47	0 - 255	DSR/DCD Delay Time (50 ms units)	4

S48	0 or 1	Eight Bit Comparison
		  0 Compare lower seven bits only
		  1 Compare all eight bits
			0

S49	0 or 1	Product Identification String
		  0 I0 returns 96X ID code
		  1 I0 returns 123 ID code
			0

S50	0 - 3,
	254, 255
		Transmission Mode
		  0 Auto Speed Determination
		  1 300 bps (Bell 103)
		  2 1200 bps (Bell 212 A or V.22)
		  3 2400 bps (V.22bis)
		254 Use last AT command speed
		255 PEP mode
			0 - ECM
			254-CCM

S51	0 - 5, 252
	254, 255
		Interface Speed
		  0 300 bps
		  1 1200 bps
		  2 2400 bps
		  3 4800 bps
		  4 9600 bps
		  5 19200 bps
		252 Autbaud (no type-ahead)
		254 Autbaud (19200 bps default)
		255 Autbaud (9600 bps default)
			255-ECM
			252-CCM

Command Summary (continued)

Command	Parameter	Description	Default

Q(n)	0 - 9	Quiet Enable
		  0 Return result code for both local and remote modems
		  1 Return result code for remote modem only
		  2 Return result code for local modem only
		  3 Do not return result code for either local or remote modem
		  4-9 Partial quiet modes (see your Reference Manual)
			Q0

S(n)=(x)		Set register n to value x	
S(n)?		Read contents of register n	

V(n)	0 or 1	Verbose ON/OFF
		  0 Return numeric response
		  1 Return English response
			V1

W(n)	0 or 1	Negotiation Progress Reporting
		  0 Progress not reported
		  1 Progress reported
			W0

X(n)	0 - 3, 10-14	Result Code Basic/Extended
		  0 Basic result codes
		  1 Extended result codes
		  2 MNP result codes
		  3 MNP and PEP result codes
		  10-14 Conventional result codes
			X1 - ECM
			X14 - CCM

Y(n)	0 or 1	Disconnect on Break
		  0 Modem ignores break
		  1 Modem disconnects on break
			Y0

Z(n)	0 - 2	Reset
		  0 Reset and recall default profile
		  1 Reset and recall profile A
		  2 Reset and recall profile B	

&B		Bind Command	

&E(n)	0 - 2	Use EEPROM Parameters
		  0 Recall default profile
		  1 Recall profile A
		  2 Recall profile B	

&F(n)	0 - 4	Recall Factory Parameters *See Reference Manual*	

&N(n)	0 - 2	Display EEPROM Parameters
		  0 Display default profile
		  1 Display profile A
		  2 Display profile B	

&P(n)	0 or 1	Pulse Dialing Make/Break Ratio	P0

&R(n)	0 or 1	Force Retrain or Renegotiate
		  0 Retrain
		  1 Renegotiate	

&T(n)	0 - 8	Initiate Test Function	

&W(n)	0 - 2	Write Configuration Parameters
		  0 Save to default profile
		  1 Save to profile A
		  2 Save to profile B	

%		Remote Modem Access	

Command Summary

Command	Parameter	Description	Default
A		Answer	
A/		Repeat previous command	

C(n)	0 or 1	Turn Carrier ON/OFF
		  0 Off
		  1 On	

D(n)	0-9, A-D, *, #
	Modifiers:
		Dial number
		  W Wait for dial tone
		  N Reference number in number directory
		  P Pulse dialing
		  T Tone dialing
		  , Timed wait
		  ! Initiate momentary on-hook flash
		  @ Wait for quiet answer
		  R Switch to answer mode when remote modem answers
		  ; Remain in command mode after dialing
		  \ Reference a number in number directory
			Pulse dialing

E(n)	0 or 1	Echo Command ON/OFF
		  0 Off
		  1 On
			E1

F(n)	0 - 2	Echoplex ON/OFF
		  0 Off
		  1 On
		  2 On plus linefeed after carriage return
			F1

G		Go to Voice	

H(n)	0 or 1	Hook ON/OFF
		  0 Hang up (on-hook)
		  1 Pick up phone line (off-hook)	

I(n)	0 - 4	Information
		  0 Return product ID code
		  1 Return diagnostic status
		  2 Return current transmission mode
		  3 Return firmware version level
		  4 Return negotiated register values	

M(n)	0 - 3	Speaker ON/OFF
		  0 Speaker off
		  1 Speaker on while connecting
		  2 Speaker always on
		  3 Speaker on after dialing until carrier detected
			M1

N(n)=(x)	0 - 9	Set Number Directory	
N(n)?	0 - 9	Display Number	
N?	0 - 9	Display Number Directory and S-registers	
O		On-Line Place modem in data mode	

Mnem	Dec	Hex	Code
NUL	00	00	
SOH	01	01	
STX	02	02	
ETX	03	03	
EOT	04	04	
ENQ	05	05	
ACK	06	06	
BEL	07	07	
BS	08	08	
HT	09	09	
LF	10	0A	
VT	11	0B	
FF	12	0C	
CR	13	0D	
SO	14	0E	
SI	15	0F	
DLE	16	10	
DC1	17	11	
DC2	18	12	
DC3	19	13	
DC4	20	14	
NAK	21	15	
SYN	22	16	
ETB	23	17	
CAN	24	18	
EM	25	19	
SUB	26	1A	
ESC	27	1B	
FS	28	1C	
GS	29	1D	
RS	30	1E	
US	31	1F	

Register Summary (continued)

Register	Range	Description	Default
S96	0 or 1	MNP Data Compression Enable 0 Disable data compression 1 Enable data compression	0
S100	0 or 1	Answer in Originate Mode 0 Normal mode 1 Reverse mode	0
S101	0 - 4	Continuous Answer/Originate 0 Connect normally 1 Attempt to connect as answer modem every 20 seconds 2 Attempt to connect as originate modem every 20 seconds 3 Immediately attempt to connect as answer modem 4 Immediately attempt to connect as originate modem	0
S104	0 or 1	Automatic Dialing Options 0 Disable automatic dialing 1 Auto dial when DTR goes active	0
S111	0, 10 - 14, 20, 30, 255	File Transfer Protocol Support See Reference Manual	255
S112	0 - 255	Kermit Mark Character (ASCII)	1
S121	0 or 1	Echo Suppressor Compensation 0 Disable echo suppressor compensation 1 Enable echo suppressor compensation	0
S130	0 - 5	Data Set Ready Interpretation 0 DSR is always on 1 DSR is turned on when answer tone is detected 2 DSR on when modem ready 3 DSR on when modem ready. If carrier is lost, DSR turns off for time specified by S47 4 DSR on when modem off-hook 5 DSR is turned on when carrier is detected	2
S131	0 - 3	Data Carrier Detected Interpretation 0 DCD is always on 1 DCD is turned on when carrier is detected 2 DCD is on when modem ready 3 DCD on when modem ready. If carrier is lost, DSR turns off for time specified by S47	0
S222	0 - 255	Enhanced Command Mode Access Character (ASCII)	126
S255	0 - 2	Default User Profile Selection 0 Recall profile A after power on or reset 1 Recall profile A after power on or reset 2 Recall profile B after power on or reset	0

Register Summary (continued)

Register	Range	Description	Default
S66	0 - 2	Lock Interface Speed 0 Change speed to match connection, no flow control 1 Lock speed, use flow control 2 Lock speed, use flow control if MNP connection established	0 - ECM 2 - CCM
S67	0 or 1	CTS Interpretation 0 CTS is on when modem is ready to accept data 1 CTS turns on 200 ms after RTS goes active	0
S68	0, 2-6, 255	Flow Control Used by DCE 0 No flow control 2 Use CTS flow control in full duplex mode 3 Use XON/XOFF protocol 4 Use both XON/XOFF and CTS flow control 5 Use ENQ/ACK protocol 6 Use both ENQ/ACK and XON/XOFF protocol 255 Use flow control specified by S58	255
S69	0 - 2	XON Signal Handling 0 XON processed, not passed on 1 XON processed, passed on 2 See Reference Manual	0
S70		Instantaneous Transmit Rate	
S71		Transmit Bits Per Channel	
S72		Instantaneous Receive Rate	
S73		Receive Bits Per Channel	
S74		Received Packets Retransmitted	
S75		Packets Accepted	
S76		Equivalent Line Noise Profile	
S77		Frequency Offset	
S78		Slow Mode Line Quality	
S90	0 or 1	V.22 Mode Enable 0 212A Emulation 1 V.22 Emulation	0
S91	0 - 2	Guard Tone Selection 0 No guard tone 1 1800 Hz guard tone 2 550 Hz guard tone	0
S92	0 - 2	Answering Sequence Selection 0 Normal search sequence 1 PEP answer tones last 2 Normal search sequence but preceded by V.25 answer tone	0
S94	0 or 1	Transmission Speed Negotiation 0 Use speed specified by S50 register only 1 Negotiate speed to maximum specified by S50 register	1
S95	0 - 2	MNP Operating Mode 0 Normal mode - MNP disabled 1 MNP reliable mode 2 MNP autoreliable mode	0 - ECM 2 - CCM

Register Summary (continued)

Register	Range	Description	Default
S52	0 - 4	DTR Interpretation 0 DTR is ignored 1 The modem disconnects and disables auto-answer if DTR is not present 2 The modem disconnects and reloads operating parameters if DTR is dropped, and will not auto-answer if DTR is not present 3 Modem enters command mode when DTR is dropped 4 Modem hangs up and enters command mode when DTR is dropped	0
S54	0 - 4	Break Signal Interpretation See Reference Manual	0 - ECM 3 - CCM
S55	0 - 3	Escape Character/Sequence Interpretation See Reference Manual	0
S56	0 - 255	XON Character (ASCII)	17
S57	0 - 255	XOFF Character (ASCII)	19
S58	0 - 7	Flow Control Used by DTE 0 No flow control 1 Use RTS/CTS flow control in half duplex mode 2 Use RTS flow control in full duplex mode 3 Use XON/XOFF protocol 4 Use both XON/XOFF and RTS flow control 5 Use ENQ/ACK protocol 6 Use both ENQ/ACK and XON/XOFF protocol 7 Use transparent XON/XOFF	3 - ECM 2 - CCM
S59	0 - 255	Prompt Character (ASCII)	0
S61	0 - 255	Speaker Volume 0 Speaker is off 1-99 Low volume 100-199 Medium volume 200-255 High volume	150
S62	2 - 255	Break Length Time (50 ms units)	3
S63	0 - 2	Command Mode Selection 0 Enhanced Command Mode AT prefix not allowed 1 Enhanced Command Mode AT prefix required 2 Conventional Command Mode	1 - ECM 2 - CCM
S64	0 or 1	Dial/Answer Sequence Abort 0 Abort dial/answer sequence if character sent by DTE before connection is established 1 Ignore characters sent by DTE while dialing or answering a call	0
S65	0 or 1	XON/XOFF Failsafe 0 Normal XON/XOFF flow control 1 Reissue XOFF if DTE does not suspend data transmissions	0

Register Summary (continued)

Register	Range	Description	Default
S66	0 - 2	Lock Interface Speed — 0 Change speed to match connection, no flow control; 1 Lock speed, use flow control; 2 Lock speed, use flow control if MNP connection established	0 - ECM / 2 - CCM
S67	0 or 1	CTS Interpretation — 0 CTS is on when modem is ready to accept data; 1 CTS turns on 200 ms after RTS goes active	0
S68	0, 2-6, 255	Flow Control Used by DCE — 0 No flow control; 2 Use CTS flow control in full duplex mode; 3 Use XON/XOFF protocol; 4 Use both XON/XOFF and CTS flow control; 5 Use ENQ/ACK protocol; 6 Use both ENQ/ACK and XON/XOFF protocol; 255 Use flow control specified by S58	255
S69	0 - 2	XON Signal Handling — 0 XON processed, not passed on; 1 XON processed, passed on; 2 See Reference Manual	0
S70		Instantaneous Transmit Rate	
S71		Transmit Bits Per Channel	
S72		Instantaneous Receive Rate	
S73		Receive Bits Per Channel	
S74		Received Packets Retransmitted	
S75		Packets Accepted	
S76		Equivalent Line Noise Profile	
S77		Frequency Offset	
S78		Slow Mode Line Quality	
S90	0 or 1	V.22 Mode Enable — 0 212A Emulation; 1 V.22 Emulation	0
S91	0 - 2	Guard Tone Selection — 0 No guard tone; 1 1800 Hz guard tone; 2 550 Hz guard tone	0
S92	0 - 2	Answering Sequence Selection — 0 Normal search sequence; 1 PEP answer tones last; 2 Normal search sequence but preceded by V.25 answer tone	0
S94	0 or 1	Transmission Speed Negotiation — 0 Use speed specified by S50 register only; 1 Negotiate speed to maximum specified by S50 register	1
S95	0 - 2	MNP Operating Mode — 0 Normal mode - MNP disabled; 1 MNP reliable mode; 2 MNP autoreliable mode	0 - ECM / 2 - CCM

Register Summary (continued)

Register	Range	Description	Default
S96	0 or 1	MNP Data Compression Enable — 0 Disable data compression; 1 Enable data compression	0
S100	0 or 1	Answer in Originate Mode — 0 Normal mode; 1 Reverse mode	0
S101	0 - 4	Continuous Answer/Originate — 0 Connect normally; 1 Attempt to connect as answer modem every 20 seconds; 2 Attempt to connect as originate modem every 20 seconds; 3 Immediately attempt to connect as answer modem; 4 Immediately attempt to connect as originate modem	0
S104	0 or 1	Automatic Dialing Options — 0 Disable automatic dialing; 1 Auto dial when DTR goes active	0
S111	0, 10 - 14, 20, 30, 255	File Transfer Protocol Support — See Reference Manual	255
S112	0 - 255	Kermit Mark Character (ASCII)	1
S121	0 or 1	Echo Suppressor Compensation — 0 Disable echo suppressor compensation; 1 Enable echo suppressor compensation	0
S130	0 - 5	Data Set Ready Interpretation — 0 DSR is always on; 1 DSR is turned on when answer tone is detected; 2 DSR is on when modem ready; 3 DSR on when modem ready If carrier is lost, DSR turns off for time specified by S47; 4 DSR on when modem off-hook; 5 DSR is turned on when carrier is detected	2
S131	0 - 3	Data Carrier Detected Interpretation — 0 DCD is always on; 1 DCD is turned on when carrier is detected; 2 DCD is on when modem ready; 3 DCD on when modem ready If carrier is lost, DSR turns off for time specified by S47	See Manual
S222	0 - 255	Enhanced Command Mode Access Character (ASCII)	126
S255	0 - 2	Default User Profile Selection — 0 Recall profile A after power on or reset.; 1 Recall profile A after power on or reset.; 2 Recall profile B after power on or reset.	0

ASCII Code Chart

Mnem	Dec	Hex	Code	Dec	Hex	Code	Dec	Hex	Code	Dec	Hex
NUL	00	00	SP	32	20	@	64	40	`	96	60
SOH	01	01	!	33	21	A	65	41	a	97	61
STX	02	02	"	34	22	B	66	42	b	98	62
ETX	03	03	#	35	23	C	67	43	c	99	63
EOT	04	04	$	36	24	D	68	44	d	100	64
ENQ	05	05	%	37	25	E	69	45	e	101	65
ACK	06	06	&	38	26	F	70	46	f	102	66
BEL	07	07	'	39	27	G	71	47	g	103	67
BS	08	08	(	40	28	H	72	48	h	104	68
HT	09	09	)	41	29	I	73	49	i	105	69
LF	10	0A	*	42	2A	J	74	4A	j	106	6A
VT	11	0B	+	43	2B	K	75	4B	k	107	6B
FF	12	0C	,	44	2C	L	76	4C	l	108	6C
CR	13	0D	-	45	2D	M	77	4D	m	109	6D
SO	14	0E	.	46	2E	N	78	4E	n	110	6E
S1	15	0F	/	47	2F	O	79	4F	o	111	6F
DLE	16	10	0	48	30	P	80	50	p	112	70
DC1	17	11	1	49	31	Q	81	51	q	113	71
DC2	18	12	2	50	32	R	82	52	r	114	72
DC3	19	13	3	51	33	S	83	53	s	115	73
DC4	20	14	4	52	34	T	84	54	t	116	74
NAK	21	15	5	53	35	U	85	55	u	117	75
SYN	22	16	6	54	36	V	86	56	v	118	76
ETB	23	17	7	55	37	W	87	57	w	119	77
CAN	24	18	8	56	38	X	88	58	x	120	78
EM	25	19	9	57	39	Y	89	59	y	121	79
SUB	26	1A	:	58	3A	Z	90	5A	z	122	7A
ESC	27	1B	;	59	3B	[	91	5B	{	123	7B
FS	28	1C	<	60	3C	\	92	5C	|	124	7C
GS	29	1D	=	61	3D	]	93	5D	}	125	7D
RS	30	1E	>	62	3E	^	94	5E	~	126	7E
US	31	1F	?	63	3F	_	95	5F	DEL	127	7F

Command Summary (continued)

Command	Parameter	Description	Default
N(n)	0 or 1	Transmission Speed Negotiation 0 Connection speed must match value specified by S37 1 Allow speed negotiation to maximum specified by S37	N1
O(n)	0 or 1	On-Line 0 Place modem in data mode 1 Place modem in data mode and initiate retrain	
Q(n)	0 - 2	Quiet Enable 0 Modem returns result codes 1 Result codes disabled 2 Result codes returned when originating a call but not when answering a call	Q0
S(n)=(x) S(n)?		Set register n to value x Read contents of register n	
V(n)	0 or 1	Verbose ON/OFF 0 Return numeric response 1 Return English response	V1
W(n)	0 or 1	Negotiation Progress Reporting 0 Progress not reported 1 Progress reported	W0
X(n)	0 - 4	Result Code and Dialing Capabilities *See Reference Manual*	X4
Y(n)	0 or 1	Disconnect on Break 0 Modem ignores break 1 Modem disconnects on break	Y0
Z(n)	0 - 1	Reset 0 Reset and recall profile A 1 Reset and recall profile B	
&C(n)	0 or 1	Data Carrier Detect Control 0 DCD always on 1 DCD on when carrier detected	C0
&D(n)	0 - 3	DTR Interpretation 0 Modem ignores DTR 1 Modem enters command mode when DTR is dropped 2 Modem disconnects and enters command mode when DTR is dropped 3 Modem resets and enters command mode when DTR is dropped	D0
&F		Recall Factory Parameters	
&G(n)	0 - 2	Guard Tone Selection 0 No guard tone 1 550 Hz guard tone 2 1800 Hz guard tone	&G0

Command Summary

Command	Parameter	Description	Default
,		Enhanced Command Mode Access Character Used to enter commands which are not normally available in Conventional Command Mode. All commands following a "," character to the end of the command line are interpreted in Enhanced Command Mode.	
A		Answer	
A/		Repeat previous command	
B(n)	0 or 1	1200 bps Mode Selection 0 CCITT V.22 1 Bell 212A	B1
D(n)	0-9, A-D, *, # Modifiers:	Dial number W Wait for dial tone P Pulse dialing T Tone dialing , Timed wait ! Initiate momentary on-hook flash @ Wait for quiet answer R Switch to answer mode when remote modem answers ; Remain in command mode after dialing S=n Reference a number in number directory	Pulse dialing
E(n)	0 or 1	Echo Command ON/OFF 0 Off 1 On	E1
F(n)	1	Echoplex ON/OFF 0 Not supported 1 No echo	F1
H(n)	0 or 1	Hook ON/OFF 0 Hang up (on-hook) 1 Pick up phone line (off-hook)	
I(n)	0 - 2	Information 0 Return product ID code 1 Return 3 digit number 2 Return OK result code	
L(n)	0 - 3	Speaker Volume 0 Low 1 Low 2 Medium 3 High	L2
M(n)	0 - 3	Speaker ON/OFF 0 Speaker off 1 Speaker on while connecting 2 Speaker always on 3 Speaker on after dialing until carrier detected	M1

Quick Reference Card
Conventional Command Mode

You may enter a command line of up to 80 characters in upper or lower case with the first command in the line preceded by an "AT" or "at" and the last command followed by a carriage return.

The notation "(n)" in the descriptions represents a decimal numeric option, and "(x)" represents an assigned value. The parentheses should not be typed. If a command is typed without a value when one is expected, the modem will assume a value of 0. The option should immediately follow the command. For example, to turn off the result codes, type Q1 not Q=1. The use of the "=" is explained under the S command in your Reference Manual.

You can repeat the last command line issued by entering "A/" or "a/". Do not enter the "AT" prefix when using this command.

Result Codes

Number	Message and Description
0	OK — The command was successfully completed.
1	CONNECT — Connected at 300 bps interface speed.
2	RING — An incoming ring has been detected.
3	NO CARRIER — Time to connect has expired or carrier lost.
4	ERROR — A command error has been encountered.
5	CONNECT 1200 — Connected at 1200 bps interface speed.
6	NO DIALTONE — No dial tone was detected.
7	BUSY — Remote connection is busy.
8	NO ANSWER — Five seconds of silence was not detected within 30 seconds when an @ modifier was encountered in the dial string.
10	CONNECT 2400 — Connected at 2400 bps interface speed.
11	CONNECT 4800 — Connected at 4800 bps interface speed.
12	CONNECT 9600 — Connected at 9600 bps interface speed.
14	CONNECT 19200 — Connected at 19200 bps interface speed.
40	CARRIER 300 — Carrier detected at 300 bps (Bell 103 model).
46	CARRIER 1200 — Carrier detected at 1200 bps (Bell 212A or V.22 model).
47	CARRIER 2400 — Carrier detected at 2400 bps (V.22bis model).
50	CARRIER 9600 — Modem is operating in PEP mode.
70	PROTOCOL:NONE — Error control is not being used.
71	PROTOCOL:ERROR-CONTROL/LAP-B — PEP or MNP error control is being used.

ASCII Code Chart

Mnem	Dec	Hex	Code	Dec	Hex	Code	Dec	Hex	Code	Dec	Hex
NUL	00	00	SP	32	20	@	64	40	`	96	60
SOH	01	01	!	33	21	A	65	41	a	97	61
STX	02	02	"	34	22	B	66	42	b	98	62
ETX	03	03	#	35	23	C	67	43	c	99	63
EOT	04	04	$	36	24	D	68	44	d	100	64
ENQ	05	05	%	37	25	E	69	45	e	101	65
ACK	06	06	&	38	26	F	70	46	f	102	66
BEL	07	07	'	39	27	G	71	47	g	103	67
BS	08	08	(	40	28	H	72	48	h	104	68
HT	09	09	)	41	29	I	73	49	i	105	69
LF	10	0A	*	42	2A	J	74	4A	j	106	6A
VT	11	0B	+	43	2B	K	75	4B	k	107	6B
FF	12	0C	,	44	2C	L	76	4C	l	108	6C
CR	13	0D	-	45	2D	M	77	4D	m	109	6D
SO	14	0E	.	46	2E	N	78	4E	n	110	6E
S1	15	0F	/	47	2F	O	79	4F	o	111	6F
DLE	16	10	0	48	30	P	80	50	p	112	70
DC1	17	11	1	49	31	Q	81	51	q	113	71
DC2	18	12	2	50	32	R	82	52	r	114	72
DC3	19	13	3	51	33	S	83	53	s	115	73
DC4	20	14	4	52	34	T	84	54	t	116	74
NAK	21	15	5	53	35	U	85	55	u	117	75
SYN	22	16	6	54	36	V	86	56	v	118	76
ETB	23	17	7	55	37	W	87	57	w	119	77
CAN	24	18	8	56	38	X	88	58	x	120	78
EM	25	19	9	57	39	Y	89	59	y	121	79
SUB	26	1A	:	58	3A	Z	90	5A	z	122	7A
ESC	27	1B	;	59	3B	[	91	5B	{	123	7B
FS	28	1C	<	60	3C	\	92	5C	|	124	7C
GS	29	1D	=	61	3D	]	93	5D	}	125	7D
RS	30	1E	>	62	3E	^	94	5E	~	126	7E
US	31	1F	?	63	3F	_	95	5F	DEL	127	7F

Register Summary

Register	Range	Description	Default
S0	0 - 255	Answer on Ring Number	0
S1	0 - 255	Count of Rings	
S2	0 - 255	Escape Character (ASCII)	43
S3	0 - 97, 123 - 127	Carriage Return Character (ASCII)	13
S4	0 - 255	Line Feed Character (ASCII)	10
S5	0 - 97, 123 - 127	Backspace Character (ASCII)	8
S6	2 - 255	Dial Tone Wait Time (seconds)	2
S7	1 - 255	Wait for Carrier Time (seconds)	30
S8	0 - 255	Pause Time for Comma (seconds)	2
S9	1 - 255	Carrier Detect Time (100 ms units)	6
S10	1 - 255	Carrier Loss to Disconnect Time (100 ms units)	14
S11	50 - 255	Touch Tone Timing (milliseconds)	95
S12	0 - 255	Escape Sequence Guard Time (1/50 second units)	50
S18	0 - 255	Test Termination Timer	0
S25	0 - 255	DTR Delay Timing (10 ms units)	5
S36	0 or 1	Negotiation Failure Treatment 0 If error control connection cannot be made disconnect 1 If error control connection cannot be made fall back to non-error-control mode	1
S37	0 - 9	Transmission Mode 0 Connect at last AT speed 1-3 300 bps (Bell 103) 5 1200 bps (Bell 212A or V.22) 6 2400 bps (V.22bis) 7 PEP mode 9 PEP mode	0
S38	0 - 255	Delay Before Disconnecting	20

Command Summary (continued)

Command	Parameter	Description	Default
&J(n)	0	Jack Type Selection 0 RJ-11 jack 1 Not supported	&J0
&K(n)	0, 3 - 5	Flow Control 0 No flow control 3 RTS/CTS 4 XON/XOFF 5 Transparent XON/XOFF	&K3
&L(n)	0 or 1	Line Type Selection 0 Dial-up line 1 Leased line	&L0
&M(n)	0	Communications Mode Selection 0 Same as &Q0 1-3 Not supported	&M0
&P(n)	0 or 1	Pulse Dialing Make/Break Ratio 0 39% make, 61% break 1 33% make, 67% break	&P0
&Q(n)	0 or 5	Communications Mode Selection 0 Normal mode 5 Error control mode	&Q5
&R(n)	0 or 1	CTS Interpretation This command is reserved for synchronous operation which is not supported in Conventional Command Mode. CTS is always on except when RTS/CTS flow control is used.	&R0
&S(n)	0 or 1	Data Set Ready Interpretation 0 DSR is always on 1 DSR is turned on when answer tone is detected	&S0
&T(n)	0 - 8	Initiate Test Function See Reference Manual	&T4
&V		View Active Configuration and User Profiles	
&W(n)	0 or 1	Write Configuration Parameters 0 Save to profile A 1 Save to profile B	
&X(n)	0 or 1	Transmit Clock Source This command is reserved for synchronous operation which is not supported by the T1000.	&X0
&Y(n)	0 or 1	Default User Profile Selection 0 Recall profile A after power up 1 Recall profile B after power up	&Y0
&Z(n)=(x)	0 - 3	Set Number Directory	

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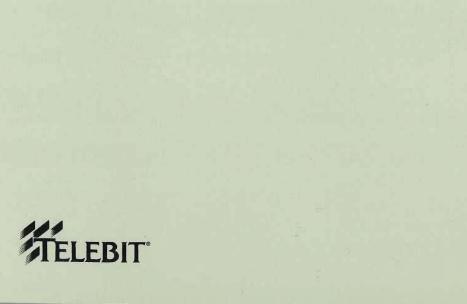
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