

If the S50 register is set to 3, the modem operates in V.22 bis mode, and starts any search sequence at 2400 bps.

If the S50 register is set to 4, the modem operates in V.21 mode only, at 300 bps.

If the S50 register is set to 5, the modem operates in V.23 mode only, at 1200/75 bps.

If the S50 register is set to 6, the modem operates in V.32 mode, and starts any search sequence at 9600 bps.

When the S50 register is set to either 2 or 3, the modem checks the S91 register to determine what type of guard tone (if any) should be transmitted with the data in answer mode. The V.25 answer sequence is used while in V.22 or V.22 bis mode. Refer to the descriptions of the S90 and S91 registers for more information.

If the S50 register is set to 254, the modem will automatically search for the correct transmission speed starting with the speed of the last AT command. For example, if the last AT command was entered at 2400 bps, the modem would attempt to connect at 2400 bps followed by 1200 bps and finally 300 bps. A PEP connection would only be attempted if the last AT command was issued at 9600 or 19200 bps.

If the S50 register is set to 255, the modem uses the Packetized Ensemble Protocol (PEP) to establish a connection in PEP mode.

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S51 Interface Speed

Range: 0 - 5, 252, 254 or 255

Default: 255 - Enhanced, 252 - Conventional

The S51 register determines the data rate between the modem and the local DTE.

When the connection is made in V.32 or Low Speed Mode and flow control is not enabled (S66=0 or S66=2 and a non-MNP connection is established), the local DTE must be set to match the modem's transmission speed indicated by the CONNECT XXXX result code.

Failure to do so will result in erroneous data. When the connection is terminated, the speed reverts to that specified by S51, unless S51 is set to 252, 254 or 255 (auto speed select).

Possible contents for this register are:

- | | |
|-----|---|
| 0 | 300 bps |
| 1 | 1200 bps |
| 2 | 2400 bps |
| 3 | 4800 bps |
| 4 | 9600 bps |
| 5 | 19200 bps |
| 252 | Automatic speed select; type-ahead not permitted |
| 254 | Automatic speed select; type-ahead permitted;
default to 19200 bps |
| 255 | Automatic speed select; type-ahead permitted;
default to 9600 bps |

Note: One of the following data formats should be used:

- 8-bit data, no parity
- 7-bit data, even/odd parity
- 7-bit data, mark/space parity

When S51 is set to 252, the modem examines each AT prefix to derive the current interface speed, and a new command line may not be entered until the result code from the previous command is displayed. If no command lines have been entered after powering on, the speed at which the default profile was saved will be the speed used to send RING and CONNECT messages when an incoming call is received.

When S51 is set to 254 or 255, the modem only checks the interface speed on the first AT prefix after one of the following events occur:

The modem is powered on or reset.

S51 is set to 254 or 255 while in command mode.

A break is sent to the modem from the local DTE while the modem is not connected to another modem.

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A data call is disconnected and the modem is placed on-hook.

A NO CARRIER condition is detected due to: connect time has expired, dial command is aborted, or the carrier is lost.

Since the interface speed is not checked after each command line, multiple command lines can be entered without waiting for the results from the previous command. This may be useful for communications software scripting.

If no command lines have been entered after powering on, the modem will use 19200 bps (S51=254) or 9600 bps (S51=255) to send RING and CONNECT messages when a call is received.

S52 DTR Interpretation

Range: 0 - 4

Default: 0

The S52 register defines the interpretation of the Data Terminal Ready (DTR) signal.

Possible contents for this register are:

- 0 Modem assumes that DTR is always true.
- 1 Modem hangs up if DTR is turned off. Modem will not auto-answer if DTR is off.
- 2 Modem performs a hard reset and enters command mode when an on-to-off transition of DTR is detected. Note that a hard reset recalls the user profile designated as the default by the S255 register. Modem will not auto-answer if DTR is off.
- 3 Modem enters command mode when an on-to-off transition of DTR is detected.
- 4 Modem hangs up, enters command mode, and disables auto-answer when an on-to-off transition of DTR is detected. Auto-answer is enabled when DTR is turned on.

If S52 is set to 3 or 4, the modem will ignore DTR level changes with a duration of less than the time specified by the S25 register.

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S54 Break Signal Interpretation

Range: 0 - 4

Default: 0 - Enhanced, 3 - Conventional

The S54 register defines the modem's response when a break signal is transmitted by the local DTE. When the modem is operating in PEP mode, its response to a break signal is as follows:

- 0 If the modem is in data mode, it switches to command mode. If it is already in command mode, it remains in command mode.
- 1 Reserved.
- 2 The modem immediately sends a break signal to the remote DTE.
- 3 If the modem is in data mode, it sends a break signal to the remote DTE in sequence with the data stream. If it is in command mode, it immediately sends the break signal.
- 4 The modem discards the break signal.

If the modem is operating in V.32 or Low Speed Mode, and S54 is set to either 0 or 4, the modem responds the same as in PEP mode. Otherwise, when the local DTE sends a break signal, the modem sends a break to the remote DTE.

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Regardless of the setting of the S54 register, when the remote modem receives a break over the phone lines in PEP mode, it discards the data buffered to send to the local modem.

The length of the break signal sent to the remote DTE is controlled by the remote S62 register.

S55 Escape Character/Sequence - Interpretation

Range: 0 - 3

Default: 0

The S55 register defines the modem's response when you enter an escape sequence or the escape character (example: +) defined in the S2 register. An escape sequence is a series of three consecutive escape characters (example: +++) and is used only while in data mode to enter command mode. The following cases describe the action taken by the modem when the local DTE sends the escape character.

- 0 The modem enters command mode only after the escape sequence with the proper guard time (defined by the S12 register) has been entered. It also sends each of the escape characters to the remote DTE. If the Modem is already in command mode, it remains in command mode.
- 1 The modem discards data in its data buffers and sends the escape character to the remote DTE.
- 2 The modem immediately sends the escape character to the remote DTE.
- 3 The modem sends the escape character to the remote DTE in sequence with the data stream. If the modem is in command mode, it immediately sends the escape character to the remote DTE.

S56 XON Character

Range: ASCII Code 0 - 255

Default: ASCII Code 17 (CTRL-Q)

The S56 register defines the character to be used for resuming data flow when S58 or S68 is set to 3, 4 or 6. If S48=0, setting this register to a value greater than 127 disables the recognition of the XON character by the modem.

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S57 XOFF Character

Range: ASCII Code 0 - 255

Default: ASCII Code 19 (CTRL-S)

The S57 register defines the character to be used for suspending data flow when S58 or S68 is set to 3, 4, or 6. If S48=0, setting this register to a value greater than 127 disables the recognition of the XOFF character by the modem.

S58 Flow Control Used by DTE

(Data Terminal Equipment)

Range: 0 - 7

Default: 3 - Enhanced, 2 - Conventional

The S58 register determines the method of flow control used by the local DTE to control the flow of data coming from the modem when operating in PEP mode, or when S66=1 or S66=2 and an error-control connection (PEP or MNP) is established.

A similar register, S68, controls the flow of data in the opposite direction, i.e. from the local DTE to the modem.

Possible contents of this register are:

- 0 No flow control is used. (Not recommended.)
- 1 Use RTS/CTS flow control in half duplex mode. When the local DTE turns on RTS, the modem responds by turning on CTS. The modem will receive data from the local DTE. When the local DTE turns off RTS, the modem turns off CTS and will send buffered data to the local DTE.
- 2 Use full duplex RTS/CTS flow control. When RTS is off, the modem will not send data to the local DTE. When RTS is on, the modem will send data to the local DTE.
- 3 Use XON/XOFF flow control. If an XOFF is received by the modem, it will stop sending data to the local DTE until an XON is received.

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The XON and XOFF characters used for flow control are defined by the S56 and S57 registers, respectively. The S48 register defines how the modem determines if an XON or XOFF is received when a eight bit data format is used.

- 4 Use both XON/XOFF flow control and full duplex RTS/CTS flow control. If an XOFF is received or if RTS is off, the modem will stop sending data to the local DTE. Sending is resumed when RTS is turned on or an XON is received.
- 5 Use ENQ/ACK flow control. Note that this option is intended for use with some Hewlett Packard computers in PEP mode only. To operate correctly, the remote modem's S68 register must also be configured to use ENQ/ACK flow control. When an ENQ is received from the remote modem and sent to the local DTE, the modem will stop sending data to the local DTE until an ACK is received from the local DTE. The ACK from the local DTE is not passed to the remote modem.

In V.32 and Low Speed Modes, no flow control is used and ENQ/ACKs are passed to the remote modem.

- 6 Use ENQ/ACK and XON/XOFF. The modem will stop sending data to the local DTE if an ENQ is received from the remote modem and passed on to the local DTE, or if an XOFF is received from the local DTE. The modem will not resume sending data to the local DTE until an ACK has been received for any outstanding ENQ and an XON has been received for any previously received XOFF.

When connected in V.32 and Low Speed Modes, only XON/XOFF flow control is used. ENQ/ACKs are passed to the remote modem.

- 7 Use transparent XON/XOFF flow control. This method provides a way to send XON/XOFF characters as data rather than being interpreted as control characters when Hayes' Smartcom III software is used. Register S68 should be set to 255 when this option is selected.

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S59 Prompt Character
Range: ASCII Code 0 - 255
Default: 0

The S59 register contains the character which is used as a prompt character when in command mode. If no prompt is desired, a 0 should be entered.

S61 Speaker Volume
Range: 0 - 255
Default: 150

The index specified in this register will determine the speaker volume when it is enabled. When S61 is set to 0, the speaker is turned off.

The speaker volume is low at 1-99, medium at 100-199, and high at 200-255.

S62 Break Length Time
Range: 2 - 255
Default: 3 (150 msec.)

The contents of the S62 register determines the length of time a break signal will be placed on the Receive Data (RD) line when received from the remote modem. Each count represents 50 milliseconds.

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S63 Command Mode Selection

Range: 0 - 2

Default: 1 - Enhanced, 2 - Conventional

The S63 register is used to select either Conventional or Enhanced Command Mode, or to disable the requirement for the AT attention code.

This register can only be accessed in Enhanced Command Mode or by entering an `~S63=n` command in Conventional Command Mode.

Changes to this register take effect immediately. This means that an `~S63=0` or `1` command will cause the modem to process any subsequent commands contained in the same line in Enhanced Command Mode. Similarly, any commands contained in the same line following an `S63=2` will be processed in Conventional Command Mode.

Possible contents for this register are:

- 0 AT prefix not allowed and Enhanced Command Mode selected.
- 1 AT prefix required and Enhanced Command Mode selected.
- 2 AT prefix required and Conventional Command Mode selected.

If the content of the S63 register is a 0, the modem treats all characters as commands and operates on the "AT" as two separate commands. If the content of the register is a 1 or 2, the modem will require the "AT" or "at" to be entered at the beginning of each command line.

When selecting a command mode for compatibility with your computer's data communications software, there are several other associated parameters that must also be changed. The best way to accomplish this is by following the procedure described under *Initializing the Modem* in Chapter 3. You can, however, initialize the modem using commands as described:

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To initialize the modem for Conventional Command Mode, enter the following command line:

AT ~&F &F1&W0 &W1 &Y0

To initialize the modem for Enhanced Command Mode, enter:

AT ~ &F &W1 &W2

S64 Dial/Answer Sequence Abort

Range: 0 or 1

Default: 0

The S64 register controls whether or not the modem will abort a dialing or answering sequence if characters are transmitted by the local DTE before a connection is established.

Possible contents for this register are:

- 0 Abort the dialing or answering sequence if characters transmitted by the local DTE before a connection is established.
- 1 Ignore any characters sent by the local DTE while dialing or answering a call.

S65 XON/XOFF Failsafe

Range: 0 or 1

Default: 0

The S65 register allows the modem to reissue one or more XOFF control characters over the serial interface if the local DTE continues to transmit data after an XOFF has been issued.

Possible contents for this register are:

- 0 Use normal XON/XOFF flow control.
- 1 Use failsafe XON/XOFF flow control. The modem will issue an XOFF when the flow control threshold is reached, and once again for every five characters subsequently sent by the local DTE.

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Note: This register is only valid when the modem is using XON/XOFF flow control. The S68 register must be set to 3, 4, 6, or 255 (when S58 is set to 3, 4, or 6).

S66 Lock Interface Speed

Range: 0 - 2

Default: 0 - Enhanced, 2 - Conventional

The S66 register controls whether or not the DTE interface speed is maintained and flow control is performed in V.32 and Low Speed Mode (103J, 212A, V.21, V.23, V.22 or V.22bis). This register should be configured before attempting to connect in any of these modes.

Possible contents for this register are:

- 0 Change interface speed to match connection and do not use flow control when a connection is made in a V.32 or Low Speed Modes.
- 1 Lock interface speed and use flow control in V.32 or Low Speed Modes.
- 2 Lock interface speed and use flow control in V.32 or Low Speed Modes if MNP connection is established. Do not use flow control in command mode. For non-MNP connections, the interface speed will change to match the speed of the connection and no flow control will be used.

If S66 is set to 0 and a connection is made in V.32 or Low Speed Mode, the modem forces the serial interface speed to match the speed of the connection and performs no flow control. The local DTE interface must also be changed to match the speed of the connection or data will be garbled. If S66 is set to 1 or 2, the local DTE must support the flow control method specified by the S58 and S68 registers, otherwise data will be lost.

5C

**S67 Clear to Send (CTS)
Signal Interpretation**
Range: 0 or 2
Default: 0

The S67 register defines how the modem uses Clear To Send (CTS) in relationship to Request To Send (RTS) and carrier detected. This register allows you to make the RTS-CTS signals behave like that of a conventional, non-intelligent modem. This register's effect on the CTS signaling depends on the setting of the S58 and S68 registers.

If S58 is set to 1, the content of the S67 register is ignored, and the modem operates in half duplex mode. Refer to the S58 register description for information on half duplex operation.

If S58 is set to some value other than 1, then the content of the S67 register determines how the modem generates the CTS control signal:

- 0 If full duplex RTS/CTS flow control is used, CTS is used to control the data flow as described for the S68 register. If full duplex RTS/CTS flow control is not used, CTS is always ON.
- 1 Cts is held OFF until a valid carrier is detected. When a carrier is detected, CTS is turned ON 200 milliseconds after RTS goes active. If RTS/CTS flow control is used, CTS is used to control the flow of data from the DTE.
- 2 CTS is turned ON in response to an OFF-to-ON transition of RTS after a delay specified by register S26. Recommended for use in transparent synchronous mode only.

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S68 Flow Control Used by DCE
(Data Communications Equipment)
Range: 0, 2 - 6, or 255
Default: 255

The S68 register determines the method of flow control used by the modem. This register, in conjunction with the S58 register, controls the flow of data from the local DTE to the modem when operating in PEP mode, or when S66=1 or S66=2 and an error-control connection (PEP or MNP) is established.

If S58 is set to 1, the content of the S68 register is ignored, and the modem operates in half duplex mode. Refer to the S58 register description for information on half duplex operation. If S58 is set to 7 (transparent ON/XOFF flow control), this register should be set to 255.

Possible contents of the S68 register are:

- 0 No flow control is used (not recommended).
- 2 Use RTS/CTS flow control. CTS is turned OFF by the modem when it wants to stop the flow of data to it. CTS is turned ON when the modem will accept data
- 3 Use XON/XOFF flow control. An XOFF is issued by the modem when it wants to stop the flow of data to it. An XON is issued to resume the flow of data.

The XON and XOFF characters used for flow control are defined by the S56 and S57 registers, respectively. The format of the XON and XOFF characters is defined by the S60 register.

- 4 Use both XON/XOFF and RTS/CTS flow control.
- 5 Use ENQ/ACK flow control. Note that this option is intended for use with some Hewlett Packard computers in PEP mode only. To operate correctly, the remote modem's S58 register must also be configured to use ENQ/ACK flow control. When an ENQ is issued by the local DTE, the modem will return an ACK to the local DTE when the modem can accept at least 2000 bytes of data. The ENQ is passed on to the remote modem.

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In V.32 and Low Speed Modes, no flow control is used and ENQ/ACKs are passed to the remote modem.

- 6 Use ENQ/ACK and XON/XOFF flow control. The modem always sends an ACK in response to an ENQ from the local DTE, and uses XON/XOFF to control the flow of data from the local DTE to the modem. The ENQ is passed on to the remote modem.

When connected in V.32 and Low Speed Modes, only XON/XOFF flow control is used. ENQ/ACKs are passed to the remote modem.

- 255 Use the flow control specified by S58.

S69 XON Signal Handling

Range: 0 - 2

Default: 0

The S69 register determines how the XON character is treated when XON/XOFF flow control is used by the local DTE. Possible contents for this register are:

- 0 XON character is processed and consumed by the modem and is not passed to the remote modem.
- 1 XON character is processed and consumed by the modem and is not passed to the remote modem.
- 2 If the modem has been previously XOFFed, the XON character is processed by the modem and is not passed on to the remote modem. If the modem has not been XOFFed, the XON character is not processed, but is passed on to the remote modem.

Registers S70 through S78 provide stastical information and cannot be set by the user. Registers S70 through S76 pertain only to Packetized Ensemble Protocol™ (PEP).

5C

S70 Instantaneous Transmit Rate

The S70 register indicates the instantaneous rate at which data is being transmitted to the remote modem in bits per second. It represents the present data transmission capacity of the dial-up lines. This register does not contain the actual data throughput. S70 is a read only register and contains either the current data if communication is currently active or the last sample made if the connection is broken. Any new connection attempt will reinitialize this register.

S71 Transmit Bits Per Channel

The S71 register contains the number of transmit bits assigned to each channel at 511 frequency points in the current telephone connection. All 511 values are displayed at the time this read only register is accessed.

S72 Instantaneous Receive Rate

The S72 register indicates the instantaneous rate at which data is being received from the remote modem in bits per second. It represents the present data transmission capacity of the dial-up lines.

This register does not contain actual data throughput. S72 is a read only register and contains either the current data rate if communication is currently active or the last sample made if the connection is broken. Any new connection attempt will reinitialize this register.

5C

S73 Receive Bits Per Channel

The S73 register contains the number of receive bits assigned to each channel at 511 frequency points in the current telephone connection. All 511 values are displayed at the time this read only register is accessed.

S74 Received Packets Retransmitted

The S74 register contains a count of the number of received packets requiring retransmission since the current connection was made. When the connection is broken, the register will retain the count until the next connection is attempted. S74 is a read only register.

S75 Packets Accepted

The S75 register contains a count of the number of acceptable packets received since the current connection was made. When the connection is broken, the register will retain the count until the next connection is attempted. S75 is a read only register.

5C S76 Equivalent Line Noise Profile

The S76 register contains the noise level in dBm to the nearest tenth observed at 511 frequency points in the current telephone connection. All 511 values are displayed at the time this read only register is accessed.

S77 Frequency Offset

The S77 register contains the observed frequency offset of the communication channel in Hertz to the nearest sixteenth for the current connection. Frequency offset is also reported in the 1200 bps and 2400 bps modes.

S78 Line Quality

The S78 register reports the modem's estimate of the quality of the current connection. This register is valid only when in 212A, V.22, V.22bis, or V.32 mode. The quality is represented in a scale from 0 to 100. The higher the number the better the quality of the line. Errors are less likely to occur on a higher quality line.

A line quality greater than 50 can be considered acceptable for good communications. You may want to redial to establish another connection if the line quality is less than 30, as the line error rate may increase transmission cost and reduce reliability.

Note: Register S78 does not return line quality information when PEP mode is being used.

S90 CCITT/Bell Mode Select

Range: 0 or 1

Default: 0

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The S90 register selects Bell 103 or V.21 mode when operating in 300 bps transmission mode, and Bell 212 or V.22 mode when operating in 1200 bps transmission mode..

Possible contents for this register are:

- 0 Bell Mode (103J at 300 bps, 212A at 1200 bps)
- 1 CCITT Mode (V.21 at 300 bps, V.22 at 1200 bps)

Refer to the descriptions of registers S50 and S91 for additional information.

S91 Guard Tone Selection

Range: 0 - 2

Default: 0

In V.22 or V.22 bis mode, the answer modem checks this register to determine if a guard tone is required, and what type of guard tone to transmit with the data.

Possible contents of this register are:

- 0 No guard tone (typical U.S. operation)
- 1 1800 Hz guard tone
- 2 550 Hz guard tone

Refer to the description of the S50 and S90 registers for more information.

S92 Answering Sequence Selection

Range: 0 - 2

Default: 0

5C

The S92 register is used to change the sequence of answering tones issued by the modem when answering a call in automatic speed determination mode (S50=0). This is required to accommodate slower speed modems which are adversely affected by PEP answer tones.

The following possible contents of the S92 register are only valid when the modem is answering a call in automatic speed determination mode:

- 0 Use the normal search sequence specified in the S50 register description.
- 1 Issue the PEP answer tones at the end of the search sequence rather than at the beginning to accommodate connecting with slower speed (non-PEP) modems. In order to establish a connection in PEP mode when the answering modem's S92 register is set to 1, the calling (originating) modem must have its S50 register set to 255.

In addition, the calling modem's S7 register should be set to 60 seconds or greater to allow enough time to detect a valid PEP answer sequence.
- 2 Use the normal search sequence specified in the S50 register description but preceded by a three second V.25 answer tone.

S93 V.32 AC Transmit Duration

Range: 3 - 255 (n = 100 milliseconds)

Default: 8

This register sets the amount of time the modem will wait for a V.32 answer sequence before abandoning this mode, assuming that the modem is in answer mode, and register S50 is set to any value other than 255. The default of 800 milliseconds will work well with most V.32 modems.

If you have some trouble connecting with some V.22bis modems, try a shorter duration. For manual or "late answer" V.32 modems a longer duration may be necessary.

5C

S94 Transmission Speed Negotiation

Range: 0 - 3

Default: 1

The S94 register determines whether the modem will connect at any speed up to the maximum specified by the S50 register, or only at the speed specified by the S50 register. This register is ignored when the S50 register is set to 0 to 255.

- 0 Fallback disabled. The speed of the connection must be as specified by the S50 register. If S50 is set to 254, the connection speed must match the speed of the last AT command.
- 1 Allows a connection at any transmission speed supported by both modems up to the maximum specified by the S50 register. The modems arrive at the correct speed by selecting the highest speed which is supported by both modems.

Fallback can occur within a given modulation scheme, or, if necessary, can go to another scheme.
- 2 Fallback within a specified modulation scheme only. The modem cannot use another scheme if the connection fails. Note that the modem uses the DTE/DSRS signal in this setting only (see Appendix B).
- 3 Use appropriate fallback exclusively.

If the selected transmission speed is 300 or 1200 bps, the modem will reference the present setting of the S90 register (CCITT/Bell Mode Select) to determine whether Bell 103 or V.21 will be used for 300 bps, or whether Bell 212A or V.22 will be used for 1200 bps. If forced fallback is specified, and the specified modulation has no fallback, the primary speed will be used.

5C

S95 MNP Operating Mode

Range: 0 - 2

Default: 0 - Enhanced, 2 - Conventional

This register determines how the modem establishes an MNP connection while operating in V.32 and Low Speed Modes. MNP is a nearly-transparent, packetizing protocol which provides an error-free link to a remote asynchronous modem.

There are several classes of MNP which provide various levels of performance. This modem supports Classes 1 through 5. When an MNP connection is established, the modem will automatically operate at the highest MNP level supported by both modems. The negotiated setting of this register can be displayed by issuing an I4 command.

Possible contents for this register are:

- 0 Normal Mode - MNP is disabled. The modem does not attempt to establish an MNP connection.
- 1 Reliable Mode - When a carrier is established, the modem attempts to establish an MNP connection. If a connection cannot be made within 18 seconds of establishing carrier, the connection is dropped and NO CARRIER is reported. If an MNP connection is established, a CONNECT XXXX/REL message is reported.
- 2 Auto-reliable Mode - When a carrier is established, the modem attempts to establish an MNP connection. If a connection cannot be made within 4 seconds of establishing carrier, the modem falls back to a normal, non-reliable connection and a CONNECT XXXX message is reported.

Any characters sent to a non-MNP modem from its DTE during the 4 second interval in which the modem was unsuccessfully attempting to establish a connection will be lost. In addition, if the answer modem does not support MNP, it will receive a burst of characters from the originating modem during the first 4 seconds of the call as the originating modem attempts to make an MNP connection.

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Note: The Microcom modems use the "\N" command to set MNP capabilities. The corresponding Microcom and Telebit settings are:

Mode	Microcom	Telebit
Normal	\N0	S95=0 S66=1
Direct	\N1	S95=0 S66=0
Reliable	\N2	S95=1 S66=1 on 2*
Auto-Reliable	\N3	S95=2 S66=1 or 2

* **Note:** When register S95 is set to 1 or 2, you must also set the S66 register to 1 or 2 to enable flow control.

S96 MNP Data Compression Enable

Range: 0 or 1

Default: 1

This register determines if the modem will use data compression while operating in MNP Mode. Possible contents for this register are:

- 0 Data Compression is disable
- 1 Data Compression is enabled, provided the connection is made in MNP Mode and the modem at the remote end also has Data Compression enabled (S96=1).

5C

Data compression is negotiated between the two connecting modems during the MNP negotiation in V.32 and Low Speed Modes. If either modem does not support data compression, then it will not be used during the communications session. Changing this register after a connection is established will not change the data compression setting for the session in progress. The data compression negotiated by the connecting modems can be displayed by issuing an I4 command.

S97 V.42 LAP-M Enable

Range: 0 - 1

Default: 0

The S97 register enables or disables LAP-M, while the modem is operating in V.42 mode (S106=1). Possible contents for this register are:

- 0 Disable LAP-M
- 1 Enable LAP-M

S98 V.42bis Data Compression

Range: 0, 1, 2, or 3

Default: 3

The S98 register determines if the modem will use data compression while operating in LAP-M mode (S97=1). Possible contents for this register are:

- 0 No data compression.
- 1 Data compression in transmit direction only.
- 2 Data compression in receive direction only.
- 3 Data compression in both transmit and receive directions.

S100 Answer in Originate Mode

Range: 0 or 1

Default: 0

The S100 register controls whether the modem will answer as an originate modem or in a normal answer mode used to establish a connection. Possible contents for this register are:

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Enhanced Command Mode

- 0 Normal Mode. The modem will answer or originate a call in normal answer or originate mode.
- 1 Reverse mode. The modem will answer the ringing signal and attempt to connect as if it had originated the call.

S101 Continuous Answer/O Originate

Range: 0 - 4

Default: 0

This register can be set to have the modem continuously attempt to establish a connection in either answer or originate mode. Values 1 - 4 are intended for leased lines.

Possible contents for the register are:

- 0 Connect normally. That is, as if the modem was called on the Public Switched Telephone Network (PSTN) with S0 not equal to 0, or in response to a "D" or "A" command.
- 1 Attempt to connect as an answer modem every 20 seconds whenever a carrier is not present.
- 2 Attempt to connect as an originate modem every 20 seconds whenever a carrier is not present.
- 3 Immediately attempt to connect as an answer modem whenever a carrier is not present. The modem pauses for 20 seconds after carrier is lost before attempting a new connection.
- 4 Immediately attempt to connect as an originate modem whenever a carrier is not present. The modem pauses for 20 seconds after carrier is lost before attempting a new connection.

5C

S102 Auxiliary Telco Lead Setting

Range: 0 -2, 4- 6

Default: 0

This register controls A/A1, MI/MIC, and PR/PC lead utilization for the rear panel RJ-45 LINE jack. The following values can also be added together to yield mixed capabilities:

Value	Leads	Function
1	A/A1	Line in Uses signal for key systems
2	MI/MIC	Start Connection signal for data lines for (Automatic Calling Unit) ACU connection
4	PR/PC	Transmit Level Programming adjustment

This register must be set to match the A/A1 or MI/MIC jumper selection on the modem board (see Appendix F, *Leased Line Operation*, for jumper position information). These jumper connections are used to either signal the line switching equipment that the modem is using the telephone line (A/A1), or to cause the modem to initiate a connection (MI/MIC). Since A/A1 and MI/MIC use the same pair of wires for both functions, only one of the functions may be selected at a time.

Possible contents of this register are:

- 0 Ignore the auxiliary leads (RJ11C, RJ11W, RJ14C, RJ14W, RJ31X, RJ32X, RJ37X).
- 1 Interpret leads 3 & 6 as A/A1 leads (RJ12C, RJ12W, RJ13C, RJ13W, RJ33X, RJ34X, RJ35X).
- 2 Interpret leads 3 & 6 as MI/MIC leads. This value is used when the modem is operated in Key Telephone Systems.
- 4 Use leads 3 & 6 as PR/PC leads.
- 5 Use leads 3 & 6 as A/A1 and leads 7 & 8 as PR/PC (RJ42S, RJ43S, RJ46S, RJ47S).
- 6 Use leads 3 & 6 as MI/MIC and leads 7 & 8 as PR/PC (RJ41S, RJ45S).

Note: RJ3XX jacks are series rather than bridged configurations; if a unit is plugged into an RJ3XX jack, the units downstream of the jack will be disconnected.

Transmit levels for various resistor values across the PR/PC leads are specified in Appendix F, *Leased Line Operation*.

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S104 Automatic Dialing Options

Range: 0 - 4

Default: 0

The S104 register is used to enable automatic dialing via the DTR signal from the local DTE or from the front panel T/D switch.

Possible contents for this register are:

- 0 Disable automatic dialing.
- 1 Enable automatic dialing via an OFF to ON transition on the DTR control signal line. When DTR is ON, the modem will go off-hook and dial the first or second number in the Number Directory (the actual number is determined by the position of the A/B switch). The modem will attempt to connect in either originate or answer mode depending on the setting of the S100 register.
- 2 Reserved. An ERROR response code is sent if this register setting is attempted.
- 3 Enable automatic dialing from the front panel T/D switch. When the modem is idle (OH indicator is off), pressing the T/D switch causes the modem to go off-hook and automatically dial the first or second number in the Number Directory (the actual number is determined by the position of the A/B switch).
- 4 When the DTR signal is asserted, the modem will assume the originate mode if the setting of register S1 is less than that of register S0. If the setting of register S1 is greater than or equal to that of register S0, the modem will assume the answer mode.

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For values 0 - 3, the modem will attempt to connect in either originate or answer mode depending on the setting of the S100 register.

In originate mode, the number dialed is dependent on the setting of the A/B switch when the dialing function initiated. If the A/B switch is in the A position the first number (N0) in the Number Directory is dialed; if the switch is in the B position the second number (N1) is dialed.

S105 T/D Switch Enable

Range: 0 - 2

Default: 1

The S105 register enables or disables the T/D switch on the front panel. Possible contents for this register are:

- 0 Disable the T/D switch
- 1 Enable the T/D switch
- 2 Enable the T/D switch only when the modem is on-hook (OH indicator is off).

This register does not prohibit the use of the T/D switch when initializing the modem to its factory default settings.

S106 V.42 Detection Enable

Range: 0 or 1

Default: 0

This register determines if the answering modem will detect a data pattern, indicating an attempt to connect in V.42 mode.

Possible contents for this register are the following:

- 0 Modem will not perform detection.
- 1 The modem will perform detection of V.42 mode. LAP-M, MNP or non-error correcting mode, depending on the settings of the S95 and S97 registers.

V.42 detection is negotiated between the two connecting modems, when the originating modem sends a data pattern for a pre-determined period of time set by the S107 register (Detection Timer). During this time, the originating modem will attempt to detect a data pattern indicating if the answering modem should proceed in LAP-M mode, MNP, or non error correcting mode.

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If the particular pattern is detected, the answering modem will proceed in either LAP-M mode or non error correcting mode. However, if the answering modem fails to respond with the correct data pattern, the originating modem either falls back to non-error correcting mode or attempts to make a MNP connection, depending on the setting of S95 register, (MNP Operating Mode).

If the answering modem is responding, it will try to detect the data pattern, which will be the start of LAP-M mode or the start of MNP mode. If the start of LAP-M mode is detected, then the originating modem will respond with a data pattern indicating that it wants to connect in LAP-M mode, if the S97 register, (LAP-M Enable Register) is set to 1, or that it wants to connect in non error correcting mode, if the S97 register is set to 0.

If the start of MNP is detected from the originating modem, the setting of S95 register will determine whether it will respond in MNP mode or non error correcting mode. If there is not detection from the answering modem, for the LAP-M mode or the MNP mode, within a pre-determined amount of time, then the originating modem will drop back to non error correcting mode.

5C**S107 Detection Timer**

Range: 0 - 255

Default: 20 (2.8 sec)

The S107 register determines the amount of time the modem sets for the LAP-M mode or MNP mode start pattern.

The length of time for the start pattern is determined by the following formula:

$$\text{Time} = 800 + 100 n \text{ MS.}$$

S108 V.42 Match Count

Range: 0 - 1

Default : 0

The S108 register determines the match count for V.42 detection. Possible contents for the register are:

- 0 Match count is 4
(V.42 standard, Current Microcom V.42)
- 1 Match count is 1
(Current Hayes V.42 Implementation)

S110 PEP Mode Data Compression Enable

Range: 0, 1 or 255

Default: 255

This register determines if the modem will use data compression while operating in PEP mode. Possible contents for this register are:

- 0 Data compression is disabled.
- 1 Data compression is enabled provided the connection is made in PEP Mode, and the modem at the remote end also has data compression enabled (S110=1 or 255).
- 255 Data compression is enabled only if the connection is made in PEP Mode and the remote modem has (S110 set to 1).

Data compression is negotiated between the two connecting modems during the PEP initialization sequence. If either modem does not support data compression, then it will not be used during the communications session. Changing this register after a connection is established will not change the data compression setting for the session in progress unless an &R1 command is issued to the modem. The data compression negotiated by the two connecting modems can be displayed by issuing an I4 command.

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S111 File Transfer Protocol Support

Range: 0, 10 - 14, 20, 30, 255

Default: 255

When file transfer protocol support is enabled, the modem interacts with the protocol to eliminate delays in the file transfer which normally occur with other high-speed modems. This significantly increases the data throughput rate without altering the protocol functionality.

The S111 register determines which file transfer protocol, if any, should be supported during a communications session. The content of this register is only valid when a connection is made in PEP mode.

Possible contents for this register are:

- | | |
|-----|--|
| 0 | No protocol is supported. |
| 10 | Kermit protocol with no parity supported. |
| 11 | Kermit protocol with odd parity supported. |
| 12 | Kermit protocol with even parity supported. |
| 13 | Kermit protocol with mark parity supported. |
| 14 | Kermit protocol with space parity supported. |
| 20 | XMODEM/YMODEM protocol supported. |
| 30 | UUCP "g" protocol supported. |
| 255 | Use protocol specified by remote modem. |

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Protocol support is negotiated between the two connecting modems during the PEP initialization sequence. Both modems must agree on the protocol supported, otherwise no protocol is supported. If one modem has its S111 register set to 255, it will support the protocol specified by the other modem. If both modems have the S111 register set to 255, no protocol is supported. Changing this register after a connection is established will not change the protocol supported for the session in progress unless an &R1 command is issued to the modem.

The protocol support negotiated by the two connecting modems can be displayed by issuing an I4 command.

Note to UUCP users:

For additional information when configuring the modem for UUCP protocol support, send an electronic mail request, which includes the type of system in which the modem will be used, to:

```
{ames,sun,uunet}!telebit!modems
```

or call your Telebit Technical Support representative. Also refer to the Nutshell handbook, entitled *Managing UUCP and Usenet*, by O'Reilly and Associates, Inc.

Note to Kermit users:

Kermit protocols that use sliding windows or large blocks may be used with protocol support. However, the modem modifies the "S" packet exchange forcing regular Kermit (no window, 94 byte maximum packet size) to be negotiated between both computers.

S112 Kermit Mark Character

Range: ASCII Code 0 - 255

Default: ASCII Code 1 (SOH)

The S112 register specifies the code used by Kermit as mark character to begin a packet. The default of 1 (ASCII SOH) is the standard mark character used by Kermit. This register is only used while operating in Kermit protocol support mode.

5C**S121 Echo Suppressor Compensation**

(PEP Mode only)

Range: 0 or 1

Default: 0

The S121 register is used to compensate for the effects of echo suppressors which may be interfering with data transmissions between modems.

This compensation reduces throughput by approximately five percent, and should only be used when data transmission problems occur over a connection involving echo suppressors.

The possible contents of this register are:

- 0 Do not compensate for echo suppression.
- 1 Enable echo suppressor compensation.

Note: If either modem has S121 set to 1, echo suppressor compensation is enabled. This is negotiated during the PEP initialization sequence. Changing this register setting after the connection is established will not change the echo suppressor compensation for that session unless an &R1 command is issued to the modem. The negotiated setting of this register can be displayed by issuing an I4 command.

S130 Data Set Ready Interpretation

Range: 0 - 6

Default: 2 - Enhanced, 0 - Conventional

The S130 register defines the Data Set Ready (DSR) signal interpretation.

Possible contents for this register are:

- 0 DSR is always ON.
- 1 DSR is turned ON when an answer tone is detected from the remote modem while originating a call, or when the modem begins transmitting an answer tone while answering a call.
- 2 DSR is ON when the modem is ready to accept commands or data.
- 3 DSR is ON when the modem is ready to accept commands or data. When carrier is lost, DSR is turned OFF for the amount of time specified by the S47 register, then is turned ON.
- 4 DSR is ON when the modem is off-hook.
- 5 DSR is ON only when a carrier is detected from the remote modem.

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- 6 The DSR signal will be raised if the DTR signal is raised while the modem is not online, or if a connection is made to another modem and the DTR signal was already asserted before the modem was reset.

The DSR signal will be lowered if the DTR signal drops or if the remote modem's carrier is dropped. Recommended for use in transparent synchronous mode only.

S131 Data Carrier Detected Interpretation

Range: 0 - 4

Default: 2 - Enhanced, 0 - Conventional

The S131 register defines the Data Carrier Detected (DCD) signal interpretation. Possible contents for this register are:

- 0 DCD is always ON.
- 1 DCD is ON only when a carrier is detected from the remote modem.
- 2 DCD is ON when the modem is ready to accept commands or data.
- 3 DCD is ON when the modem is ready to accept commands or data. When carrier is lost, DCD is turned OFF for the amount of time specified by the S47 register, then is turned ON.
- 4 DCD is the inverse of CTS in command and online modes. Recommended for use in transparent synchronous mode only.

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S150 Asynchronous/Synchronous Mode Selection

Range: 0 - 3

Default: 0

This register determines if the modem will operate in Asynchronous, SDLC, or Transparent Synchronous Mode when the modem is powered up or reset via a Z command, an &T command, or a change in the A/B switch position and S150 is in the non-volatile memory as 1 0r 2.

Possible contents for this register are:

- 0 Asynchronous Mode
- 1 PEP SDLC Mode
- 2 Transparent Synchronous Mode
- 3 Asynchronous/Synchronous Mode

When the S150 register is set to 0, the modem ignores the contents of the registers S151-S153, S154, S155, S164, and operates in Asynchronous Mode.

When the S150 register is set to 1, only PEP connections are allowed, and registers S151-S164 are used to configure the modem for SDLC operations. The following registers are ignored while operating in SDLC Mode: S12, S47, S50, S51, S54, S55, S58, S62, S65, S67, S111, S130, and S131.

Note: Changing the setting to or from 1 will have no effect until the next reset operation. To switch from SDLC Mode you must set the S150 register to the appropriate value, save the setting in non-volatile memory, and reset the modem.

While operating in SDLC Mode, and communicating using PEP modulation, the modem automatically determines if it is acting as an SDLC primary or secondary link station during the initial SDLC protocol sequence. If the modem is connected to a primary link station through the serial interface, it will act as a secondary link station. On the other hand, if the modem is connected to a secondary link station, it will act as a primary link station.

When the S150 register is set to 2, the modem ignores the contents of registers S151-S153, S154, S155-S164, and operates in the Transparent Synchronous Mode. While in this mode, the modem is capable of using V.22, V.22bis, Bell212A, and V.32 modulations. When the modem is not online, the primary data and clock lines are disabled.

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The modem will send the asynchronous "CONNECT", "RING", "RRING", "BUSY", and "NO CARRIER" messages through the secondary data line. The primary data and clock lines of the modem are enabled in synchronous mode when a connection to another modem is initiated.

Note: The S150=2 mode can only be set or reset by pushing the A/B switch, by issuing an "ATZ" command from the command port, or by reloading the factory default. To enter or exit Transparent Synchronous Mode you must set the S150 to 2, save the setting in non-volatile memory, and reset the modem. Refer to Table 5-3 Transparent Synchronous Cross Reference.

When the S150 register is set to 3, the modem operates in the Asynchronous/Synchronous Mode. When the modem is not online, the primary data and clock lines operate in asynchronous mode, but the modem switches to synchronous mode when a connection to another modem is established.

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Table 5-3. Transparent Synchronous Cross Reference

ACF/NCP/VSMacro	T2500 Register Setting
GROUP ,DIAL=YES or ,DIAL=NO ,LNCTL=BSC or SDLC	S130=6 S130=0 S150=2
LINE ,ANSTONE=NO ,AUTO=address (AUTO omitted) or ,CALL=IN or INOUT or ,CALL=OUT ,CLOCKNG=EXT or ,CLOCKNG=INT ,DUPLEX=HALF or ,DUPLEX=FULL ,LPDATS=NO ,NEWSYNC=NO ,RING=YES ,SPEED=9600 or ,SPEED=4800	S102=2 S102=0 S0=1 S0=0 S154=0 S154=1 S67=2 S131=4 S67=0 S131=1 S52=4 S50=6 S50=6 S94=3

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(Boldface values represent &F3 settings)

S151 SDLC Interface Speed

Range: 1 - 5

Default: 4

The S151 register specifies the data rate between the modem and local DTE while operating in SDLC Mode.

Possible contents for this register are:

- | | |
|---|-----------|
| 1 | 1200 bps |
| 2 | 2400 bps |
| 3 | 4800 bps |
| 4 | 9600 bps |
| 5 | 19200 bps |

S152 SDLC Switched/Nonswitched

Range: 0 - 2

Default: 1

The S152 register defines how the modem interprets the Data Set Ready (DSR) signal. *The S52 register defines how the modem interprets the DTR signal.*

Possible contents for this register are:

- | | |
|---|--|
| 0 | Modem operates in Non-switched Mode. DSR is active when the modem is ready to communicate with the local DTE. If the DTR signal is OFF, the modem will not communicate with the local DTE. |
| 1 | Modem operates in Switched Mode. DSR is held OFF until DTR is turned ON and a communications link is established with the remote modem in PEP mode. |
| 2 | Modem operates in a Special Switched Mode. DSR is active when the modem is ready to communicate with the local DTE. |

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S153 SDLC Full/Half Duplex Mode Selection

Range: 0 or 1

Default: 1

The S153 register determines the data transfer mode used between the modem and the local DTE.

Possible contents of this register are:

- 0 Modem operates in Full Duplex Mode. In this mode DCD and CTS are active when the modem is ready to communicate with the local DTE.
- 1 Modem operates in Half Duplex Mode. When the modem is transferring received data to the local DTE, DCD is ON and CTS is OFF. When the local DTE turns on RTS, the modem responds by turning CTS on. The local DTE cannot transmit until the modem turns on CTS, indicating that the modem is ready to accept data from the local DTE for transmission to the remote site. The SDLC protocol ensures that a conflict will not occur between the modem and the DTE.

S154 Synchronous Clock Mode

Range: 0 - 2

Default: 0

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The S154 register specifies which RS-232C timing signals are used for synchronization while operating in SDLC or Transparent Synchronous Mode.

Possible contents for this register area;

- 0 The DCE Transmitter Signal Element Timing (pin 15) and the Receiver Signal Element Timing (pin 17) signals from the modem are used to control the timing of the transmitted and received data stream.
- 1 The DTE Transmitter Signal Element Timing (pin 24) signal from the local DTE is used to control the timing of the transmitted and received data stream.
- 2 The DCE Transmitter Signal Element Timing (pin 15) is derived from the incoming data carrier signal (slave operation). This setting is valid only in Transparent Synchronous Mode.

S155 NRZ/NRZI Data Encoding

Range: 0 or 1

Default: 0

The S155 register specifies which data encoding method is used while operating in the SDLC Mode. Possible contents of this register are:

- 0 NRZ encoding is used. A "1" is represented by a high level and a "0" is represented by a low level.
- 1 NRZI encoding is used. A "1" is represented by no change in the level and a "0" is represented by a change in the level. This encoding method facilitates deriving the clock from the data itself.

Registers S160 through S164 are designed for fine-tuning SDLC protocol support. It is recommended that you use the defaults for these registers.

S157 SDLC Disconnection Delay Time

Range: 0 - 255

Default: 0

The S157 register specifies the amount of time in tenths of seconds that the modem will wait before disconnecting (dropping carrier and DSR) after one of the following events occur:

- DTR is dropped by the local DTE when S52 is set to 1.
- a SDLC DISC command is received from the local or remote DTE.
- the carrier from the remote DTE is lost.

The modem will wait until its transmit and receive buffers are empty, or until the time specified by this register expires, whichever occurs first.

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S158 SDLC DSR Delay Time

Range: 0 - 255

Default: 0

The S158 register specifies the amount of time in seconds that the modem will wait before asserting DSR after detecting a contact closure on the MI/MIC auxiliary telco leads when S102 is set to 2. The other RS-232C signals are asserted after the connection is established.

Registers S160 through S164 are designed for fine tuning SDLC protocol support. It is recommended that you use the defaults for these registers.

S160 SDLC Frame Retransmit Limit

Range: 0 - 255

Default: 10 (frames)

The S160 register specifies the maximum number of times any one frame can be retransmitted without receiving an SDLC acknowledgement from the DTE. It also limits the number of SDLC polls that can go unanswered by the DTE. If the limit is exceeded, the modem will terminate the connection.

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S161 SDLC Device Timeout

Range: 0 - 255

Default: 20 (seconds)

The S161 register specifies the number of seconds the modem will allow the SDLC link to be idle. If the limit is exceeded, the modem will terminate the connection. If this register is set to 0, no device timeout is enforced.

S162 SDLC Nonproductive Timeout

Range: 0 - 255

Default: 2 (seconds)

The S162 register specifies the maximum number of seconds the modem will wait before generating an SDLC frame to keep the link alive.

When the modem is acting as an SDLC primary link station, it will regenerate the poll/final bit if the DTE allows more than 1-1/2 times this length of time to elapse.

The modem automatically determines if it is a primary or secondary link station as described in the S150 register description.

If this register is set to 0, the nonproductive timeout function is not used.

S163 SDLC Retransmit Timeout

Range: 0 - 255

Default: 3 (seconds)

The S163 register specifies the number of seconds the modem will wait for the DTE to acknowledge an SDLC frame. If the timeout is exceeded, the modem will retransmit the I-frames. If this register is set to 0, no retransmit timeout is in effect.

S164 SDLC Primary Poll Rate

Range: 1 - 32

Default: 7 (polls)

The S164 register specifies the number of SDLC polls per second which will be generated by the modem while operating as primary link station in Normal Response Mode when an idle condition exists.

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The modem automatically determines if it is a primary or secondary link station as described in the S150 register description.

**S222 Enhanced Command Mode
Access Character**

Range: ASCII Code 0 - 127

Default: ASCII Code 126

This register contains the ASCII code for the character which is interpreted as the Enhanced Mode Access character used in Conventional Command Mode.

The default character is "~". If your keyboard does not have a "~" character, the modem should be powered up in the Enhanced Command Mode (refer to Chapter 3, *Initializing the Modem*), and the S222 register changed to the ASCII code of the character to be used as the access character.

The T2500 modem uses only one set of active operating parameters regardless of the command mode being used. Every Conventional Command Mode function has an equivalent in Enhanced Command Mode. Changing an operating parameter in either command mode will alter its equivalent in the other command mode. For example, entering ~S95-2 is identical to entering &Q5 S36=1. Appendix C summarizes the command and register equivalents.

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S255 Default User Profile Selection

Range: 0 - 2

The S255 register designates which user profile to recall when the modem is powered up or reset. The possible contents of this register are:

- 0 Recall user profile specified by A/B switch after power up or reset.
- 1 Recall User Profile A after power up or reset. Disable A/B switch.
- 2 Recall User Profile B after power up or reset. Disable A/B switch.

This register also determines the profile used when none is specified for any of the following commands:

Reset (Z)
Recall EEPROM Operating Parameters (&E)
Display EEPROM Operating Parameters (&N)
Write Configuration Parameters (&W)

Note: An &F command will not change the setting of this register.

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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 `!1` 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.

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. The configuration loaded is dependent on the current setting of the S255 register. If the checksum is incorrect, the factory default settings are loaded.

The final two tests check the loopback capability of the Digital/ Analog Interface chip and verify 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.

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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 RETURN 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 in to the TO PHONE connector on the modem's rear panel, and verify that the modem is connected to the telephone line via the TO LINE connector.
2. Lift the receiver and listen for a dial tone.
3. Press the T/D switch on the modem's front panel. The dial tone from the receiver should go away when the modem goes off-hook (OH indicator lit).
4. Press the T/D switch again to put the modem back on-hook (OH indicator off). 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.

Common Problems

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 modem configured to operate in Asynchronous Mode and connected to an asynchronous DTE?

The modem and DTE must be operating in Asynchronous Mode while preconfiguring the modem. *Refer to Chapter 3, Using the Modem.*

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, by setting it for full duplex. 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 operating in Asynchronous Mode and are 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 4A, *Command Mode*, for configuration guidelines.

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

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Table 6-2. Placing a Call (continued)

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.

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.

Table 6-2. Placing a Call (continued)

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.

Did the modems at both ends synchronize?

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).

Table 6-2. Placing a Call (continued)**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 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.

Table 6-3. Answering a Call (continued)

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.

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 setting the S53 register to 0 to enable both of 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.

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Did the modems at both ends synchronize?

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.

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.

Table 6-4. Call in Progress

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

If a connection has been made (CD indicator is lit), the line quality of the connection may be inadequate for error free transmission. 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.

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 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.

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

Table 6-4. Call in Progress (continued)

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 (CD 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.



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:

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

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 PARTICULAR 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 PERFORMANCE OF ANY PRODUCT DELIVERED HEREUNDER.

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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.



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 RJ45S modular connector. A second connector (RJ11C) 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. Phone Line Connector Pin Definitions

PIN	LINE	PHONE
1	Not Used	Not Used
2	Not Used	A1 or MIC
3	A or MI	Tip
4	Ring	Ring
5	Tip	A or MI
6	A1 or MIC	Not Used
7	PR	-----
8	PC	-----

RS-232C Interface

Communication between the modem and the local DTE is accomplished through a 25-pin RS-232C connector.

The RS-232C standard is a set of specifications developed by the Electronic Industries Association (EIA) that applies to the transfer of data between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE). It is the most common DTE-DCE interface in use in the United States, and is compatible with the International Telegraph and Telephone Consultative Committee Recommendation V.24.

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Interface Description

The RS-232C standard covers three specific areas:

1. The electrical and mechanical characteristics of the interface.
2. The function of each interchange circuit.
3. Standard subsets of interchange circuits for specific communication system applications.

A specific connector is not defined. However, the DB-25 connector is almost universally associated with the RS-232C interface. Table B-2 lists the RS-232C interchange signals and their associated pins.

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	CI	122	DCE Signal Rate Select	X	
13	SCB	121	Secondary Clear to Send	X	
14	SBA	118	Secondary Transmitted Data		X
15	DB	114	DCE Transmitter Signal Element Timing	X	
16	SBB	119	Secondary Received Data	X	
17	DD	115	Receiver Signal Element Timing	X	
18	-	141	Local Loopback		X
19	SCA	120	Secondary Request to Send		X
20	CD	108.2	Data Terminal Ready (DTR)		X
21	-	-	Remote Digital Loopback		X
22	CE	125	Ring Indicator (RI)	X	
23	CH	111	DTE Signal Rate Selector		X
24	DA	113	DTE Transmitter Signal Element Timing		X
25	-	142	Test Mode	X	

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Test Signals

Remote Digital Loopback

Pin 21 (Remote Digital Loopback) is used by the local DTE to place the modem into remote digital loopback. The modem must have a connection established with a remote modem, and must be in the data mode. When Pin 21 is turned ON, the modem will loopback all data received from the remote modem. When Pin 21 is turned OFF, the modem will return to the data mode.

Local Digital Loopback

Pin 18 (Local Digital Loopback) is used by the local DTE to put the modem into local digital loopback. The modem should be off-line and in the command mode. When Pin 18 is turned ON, the modem will enter local digital loopback. All data received on the primary transmit data pin (Pin 2) will be looped back on the primary receive data pin (Pin 3). When Pin 18 is turned OFF the modem will return to the off-line condition.

Test Mode

Pin 25 (Test Mode) is a signal from the modem to the local DTE signifying that the modem is in a test mode. The test mode may be initiated either through the &T commands, or the Remote Digital or Local Digital Loopback RS-232 pins.

Rate Select Signals

DTE Signal Rate Select

Pin 23 (DTE Signal Rate Select) is used by the local DTE to select between a primary signalling rate and the fallback rate. The only modulation modes where Pin 23 may be used are V.32 (9600 bps and 4800 bps fallback) and V.22bis (2400 bps and 1200 bps fallback). Use of Pin 23 is enabled by setting S94=2 (if in V.22bis, register S90 must be set to 1). In this setting the only connection speeds available are the selected modulation mode's primary and fallback rates. If Pin 23 is ON prior to the completion of a connection, the T2500 will attempt to connect

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If Pin 23 is OFF, then only the fallback rate will be attempted. If this pin is not driven by the local DTE, it will assume the ON condition.

DCE Signal Rate Select

Pin 12 (DCE Signal Rate Select) is generated by the modem to inform the local DTE of the current connection rate. The only modulation modes where Pin 12 is valid are V.32 (9600 bps and 4800 bps fallback) and V.22bis (2400 bps and 1200 bps fallback). When Pin 12 is ON, the connection was made at the primary rate. When Pin 12 is OFF, the connection was made at the fallback rate.

RS-232C Primary Interchange Signals

The modem hardware supports all data, control and timing signals defined by the RS-232C standard. However, when operating in Asynchronous Mode, the modem 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.

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.

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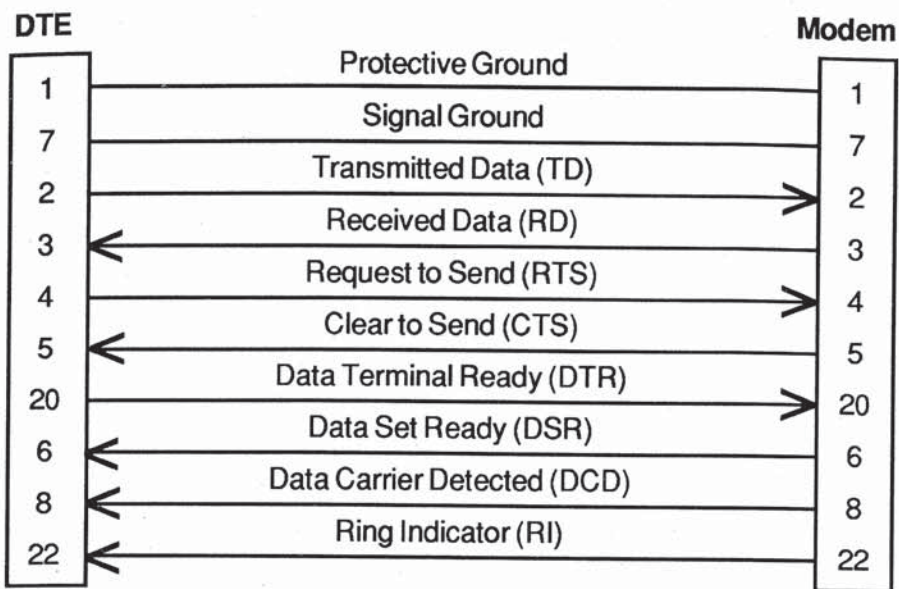


Figure B-1. Asynchronous RS-232C Cable Diagram

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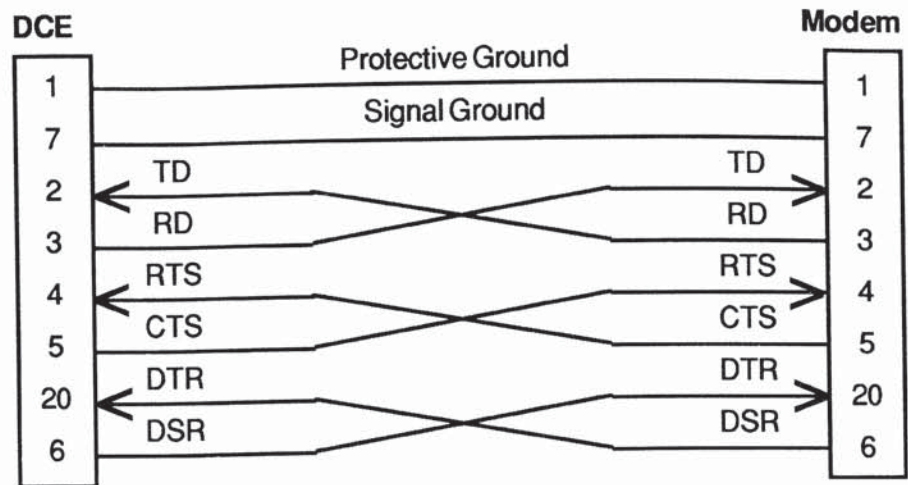


Figure B-2. Special Asynchronous RS-232C Cable Diagram

The primary interchange signals used by the modem in Asynchronous Mode 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).

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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 while operating in Asynchronous Mode, 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.

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Interface Description

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.

RS-232C Timing Interchange Signals

When operating in SDLC or Transparent Synchronous Mode, the modem uses the RS-232C timing signals in addition to the primary interchange signals described above. Figure B-3 shows the recommended cable configuration for connecting the modem to a synchronous device.

The timing interchange signals used by the modem in SDLC or Transparent Synchronous Mode are described below:

Receiver Signal Element Timing (RxC)

Pin 17 (Receiver Signal Element Timing) is used by the modem to provide the local DTE with received signal element timing information. The transition from an on to off condition indicates the center of each signal element on the Received Data (RD) signal line.

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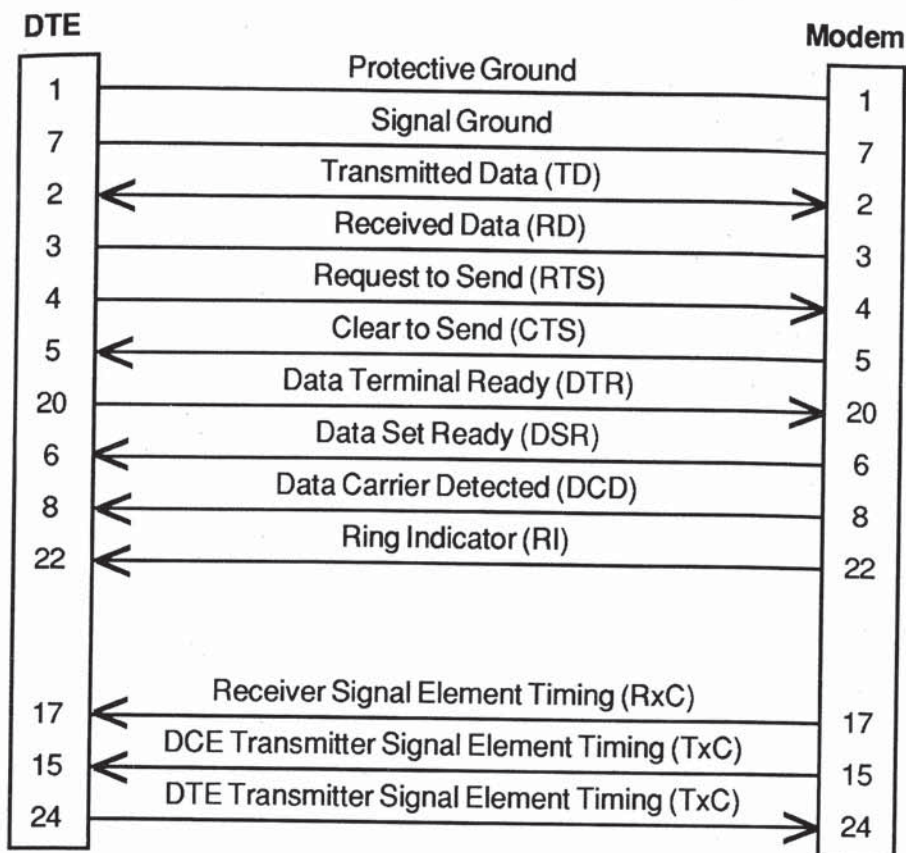


Figure B-3. SDLC & Transparent Synchronous RS-232C Cable Diagram

Transmitter Signal Element Timing (TxC)

The modem can be configured to either provide the Transmitter Signal Element Timing signal to the DTE via pin 15, or accept the Transmitter Signal Element Timing signal from the DTE via pin 24. The S154 register determines which Transmit Clock is used. The default setting for this register is to use the DCE Transmit Clock (pin 15) to control the timing of the DTE's transmissions.

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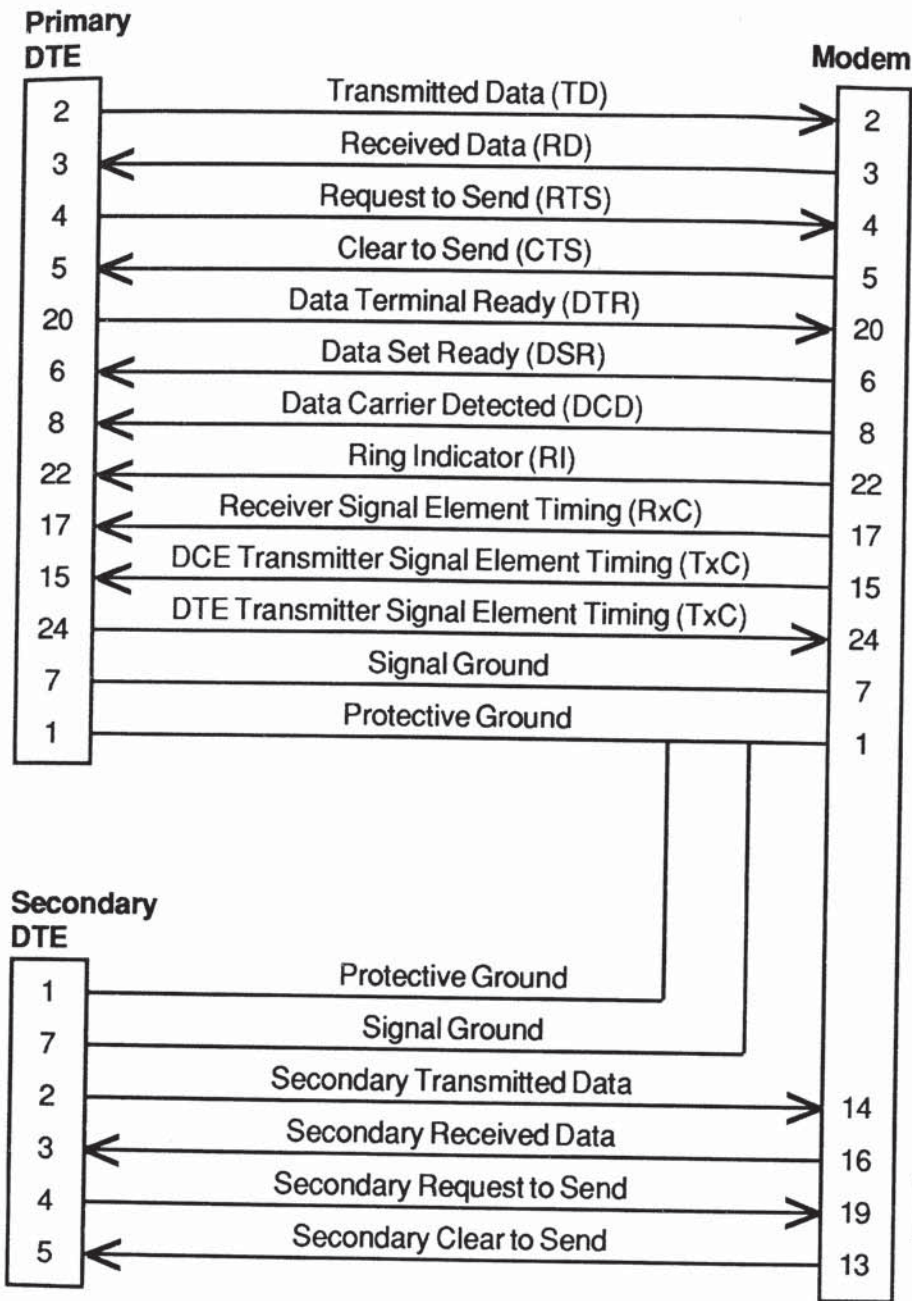
An on to off transition on pin 15 (DCE Transmitter Signal Element Timing) indicates that a transition between signal elements on the Transmitted Data (TD) signal line should occur.

An on to off transition on pin 24 (DTE Transmitter Signal Element Timing) indicates the center of each signal element that is sent over the Transmitted Data (TD) signal line.

Secondary Interchange Signals

The secondary RS-232C data and control signals can be used to connect an asynchronous terminal to the modem for issuing modem commands without disturbing the primary connection. This is particularly useful when the default settings for the SDLC registers need to be changed. A special cable assembly is required which splits the modem's RS-232C signals between two DTEs (the primary DTE and the secondary DTE). As shown in Figure B-4, the cable should be configured to route the primary RS-232C signals from the secondary DTE to the corresponding secondary RS-232C signal pins on the modem. The primary RS-232C signals from the primary DTE are routed straight-through to the modem's primary signal pins.

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Figure B-4. Secondary SDLC RS-232C Cable Diagram



Appendix C

Command Cross Reference

(Boldface commands are default values)

Command Mode		Description
Conventional	Enhanced	
A	A	Answer
B	S90=1	Use V.21 for 300 bps operation
BO	S90=1	Same as B
B1	S90=0	Use Bell 103 for 300 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=15	Low speaker volume
L2	S61=150	Medium speaker volume
L3	S61=250	High speaker volume
Mn	Mn	Speaker On/Off
No	S94=0	Limit transmission speed
N1	S94=1	Allow speed negotiation
Oo	O	Go on-line
O1	&RO	Retrain and go on-line
Q0	Qo	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
Xo	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
Zo	Z1	Reset and recall Profile A
Z1	Z2	Reset and recall Profile B

A

Command Cross Reference

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 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.22bis guard tone
&G1	S91=2	Use 550 Hz guard tone
&G2	S91=1	Use 1800 Hz guard tone
&J and	S102=0	No A/A1 lead control
&J0	S102=0	Same as &f
&J1	S102=1	A/A1 lead control
&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
&K5	S58=7 S68=255 S56=17 S57=19	Transparent XON/XOFF flow control
&L0	S101=0	Dial up line operation
&L1A	S101=3	Leased Line Answer Mode
&L1D	S101=4	Leased line originate mode
&M0	S95=0 S150=0	Asynchronous Mode (factory default)
&M1	S95=0 S150=2	Synchronous Mode 1
&M2	S95=0 S150=2	Synchronous Mode 2
&M3	S95=0 S150=2 S52=4 S104=4	Synchronous Mode 3
&Pn	&Pn	Pulse Dialing Make/Break Ratio
&Q0	S95=0	Same as &M0
&Q1	S95=0 S150=2	Same as &M1
&Q2	S95=0 S150=2 S52=4 S104=1	Same as &M2
&Q3	S95=0 S150=2 S52=4 S104=4	Same as &M3
&Q5 S36=0	S95=1 S150=0	Select MNP Reliable Mode
&Q5 S36=1	S95=2 S150=0	Select MNP Autoreliable Mode

A

Command Mode		Description
Conventional	Enhanced	
&R0	S67=2	CTS is always on except when used for flow control
&R1	S67=0	CTS always on, RTS ignored
&S0	S130=0	DSR is always on
&S1	S130	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
&X0	S154=0	DCE Transmitter Timing
&X1	S154=1	DTE Transmitter Timing
&X2	S154=2	RX Source Timing
&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 Cross Reference

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 XCarrier Time (see Note 2)
S8	S8	Pause Time for Comma
S9	S9	Carrier Detect Time
S10	S109	Carrier Loss to Disconnect Time
S11	S11	Touch Tone Timing
S12	S12	Escape Sequence Guard Time
S25	S25	DTR Delay Timing
S26	S26	RTS/CTS Delay Timing
S36=0 & Q5	S95=1	Select MNP Reliable Mode
S36=1 & Q5	S95=2	Select MNP Autoreliable Mode
S37=0	S50=25	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	Automatic speed determination
S38	S38	Delay Before Disconnecting

Notes:

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.

A

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.

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.

A

Result Codes

- 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.

A

Table D-2. Error Control Call Progress Result Codes

Number	Message and Description
40	CARRIER 300 – Carrier detected at 300 bps (Bell 103 compatible).
46	CARRIER 1200 – Carrier detected at 1200 bps (Bell 212A or V.22 compatible).
47	CARRIER 2400 – Carrier detected at 2400 bps (V.22 bis compatible).
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.

A

Result Codes

- 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 and V.21 compatible).
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 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.22bis Compatible).
11	CONNECT 4800 -- Connected at 4800 bps (V.32 fallback).
12	CONNECT 9600 -- (V.32 mode).
50	CONNECT FAST – Connected to a modem using the Packetized Ensemble Protocol (PEP).
52	RRING – Remote connection is ringing.

A

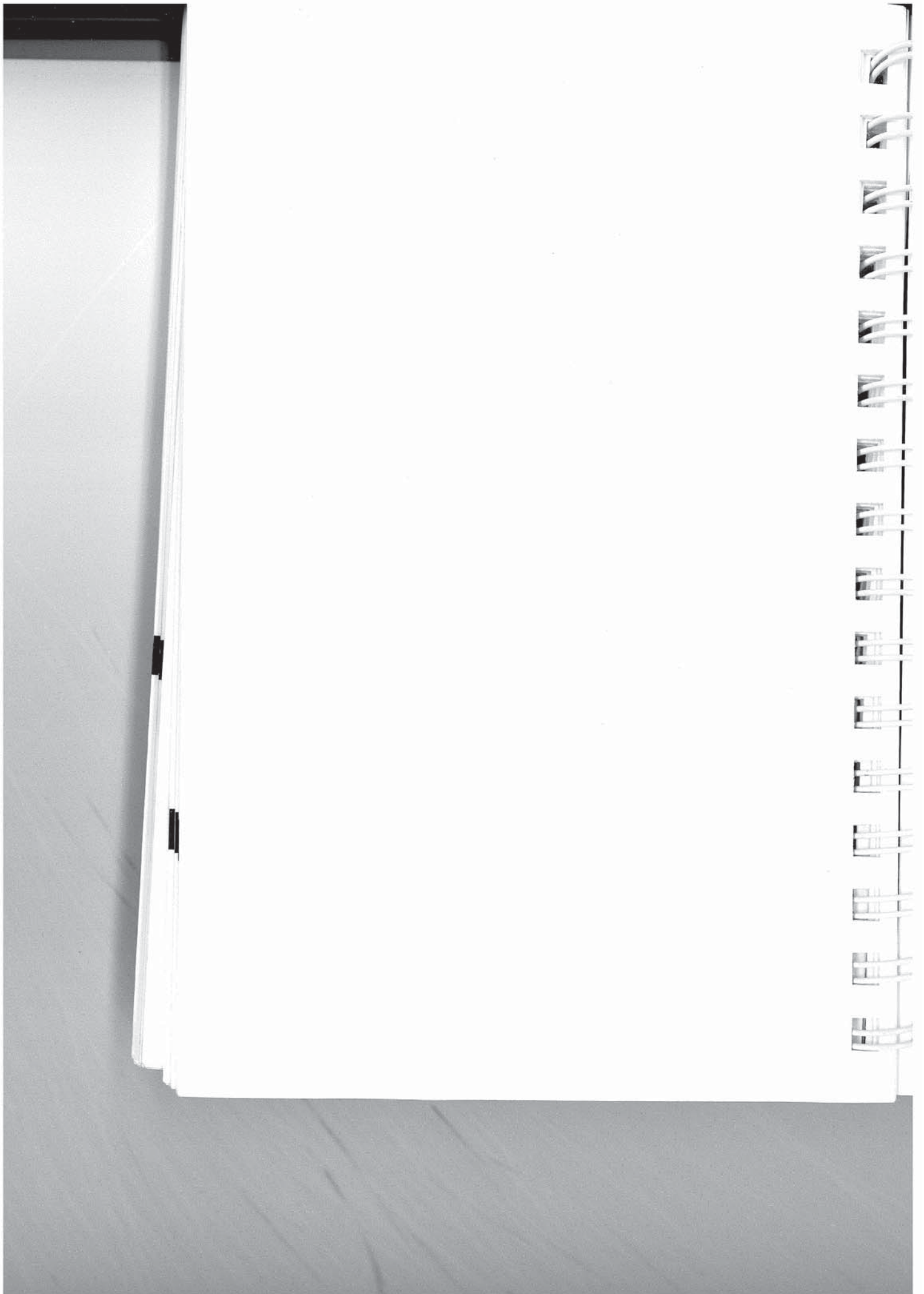
Table D-4. MNP Extended Result Codes

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.
24	CONNECT 4800/REL - MNP connection at 4800 bps.
25	CONNECT 9600/REL - MNP connection at 9600 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.
70	CONNECT FAST/COMP – PEP connection with data compression enabled.
71	CONNECT FAST/KERM/COMP – PEP connection with Kermit protocol supported and data compression enabled.
72	CONNECT FAST/XMDM/COMP – PEP connection with Xmodem protocol supported and data compression enabled.
73	CONNECT FAST/UUCP/COMP – PEP connection with UUCP protocol supported and data compression enabled.

A



Appendix E

T2500 to T2500 Interconnection

The following chart illustrates how two T2500 modems would interact given S90=0 or 2, for a normal answer sequence, and S90=1, CCITT Mode selected. Other registers are assumed to be set to factory default settings.

		Originate Modem																
		S94=0								S94=1								
		S50=	0	1	2	3	4	5	6	255	0	1	2	3	4	5	6	255
Answer Modem	S94=0	0	F	A	B	D	A	C	E	F	F	A	B	D	A	C	E	F
		1	A	A	-	-	-	-	-	-	A	A	A	A	A	-	A	-
		2	B	-	B	-	-	-	-	-	B	-	B	B	-	-	B	-
		3	D	-	-	D	-	-	-	-	D	-	-	D	-	-	D	-
		4	A	-	-	-	A	-	-	-	A	A	A	A	A	-	A	-
		5	C	-	-	-	-	C	-	-	C	C	C	C	C	C	C	-
		6	E	-	-	-	-	-	E	-	E	-	-	-	-	-	E	-
		255	F	-	-	-	-	-	-	F	F	-	-	-	-	-	-	F
	S94=1	0	F	A	B	D	A	C	E	F	F	A	B	D	A	C	E	F
		1	A	A	-	-	A	C	-	-	A	A	A	A	A	C	A	-
		2	B	A	B	-	A	C	-	-	B	A	B	B	A	C	B	-
		3	D	A	B	D	A	C	-	-	D	A	B	D	A	C	D	-
		4	A	A	-	-	A	C	-	-	A	A	A	A	A	C	A	-
		5	C	-	-	-	-	C	-	-	C	C	C	C	C	C	C	-
6		E	A	B	D	A	C	E	-	E	A	B	D	A	C	E	-	
255		F	-	-	-	-	-	-	F	F	-	-	-	-	-	-	F	

- KEY: A = 300 bps
 B = 1200 bps
 C = 1200/75 bps
 D = 2400 bps
 E = V.32
 F = PEP
 - = No Connection Made

A



Appendix F

Leased Line Considerations

When connecting the modem to private or leased lines, the modem output power level can be adjusted in two different ways.

Internal Resistor

If register S102 (Auxillary Telco Lead Setting) is set to a value of 0-2, the modem will furnish an output level determined by the on-board resistor R51 (see figure F-1). The modem is shipped with a 56.2 K resistor installed, which will supply an output level of -9dBm. For use *outside the United States*, other output levels can be selected by changing R51 to one of the values shown below:

Table F-1. Internal Resistor (R51) Values

Power Limit (dBm)	Resistor (1%)
0 dBm	20.0 K
-1 dBm	22.6 K
-2 dBm	24.9 K
-3 dBm	28.0 K
-4 dBm	31.6 K
-5 dBm	35.7 K
-6 dBm	40.2 K
-7 dBm	44.2 K
-8 dBm	49.9 K
-9 dBm	56.2 K
-10 dBm	63.4 K
-11 dBm	71.5 K
-12 dBm	78.7 K
-13 dBm	88.7 K
-14 dBm	100 K
-15 dBm	113 K

A

External Resistor

If register S102 is set to a value of 4-6, the modem will ignore the on-board resistor, and will furnish an output level determined by an external resistor, placed *by a telco installer* between pins PR & PC (pins 7 & 8) of the RJ-45S connector. The value of the external resistor should be selected from the table below:

Table F-2. External Resistor Values

Power Limit (dBm)	Resistor (1%)
0 dBm	short
-1 dBm	150
-2 dBm	336
-3 dBm	569
-4 dBm	866
-5 dBm	1.24 K
-6 dBm	1.78 K
-7 dBm	2.52 K
-8 dBm	3.61 K
-9 dBm	5.49 K
-10 dBm	9.20 K
-11 dBm	19.8 K
-12 dBm	open

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:

A

Originate Modem

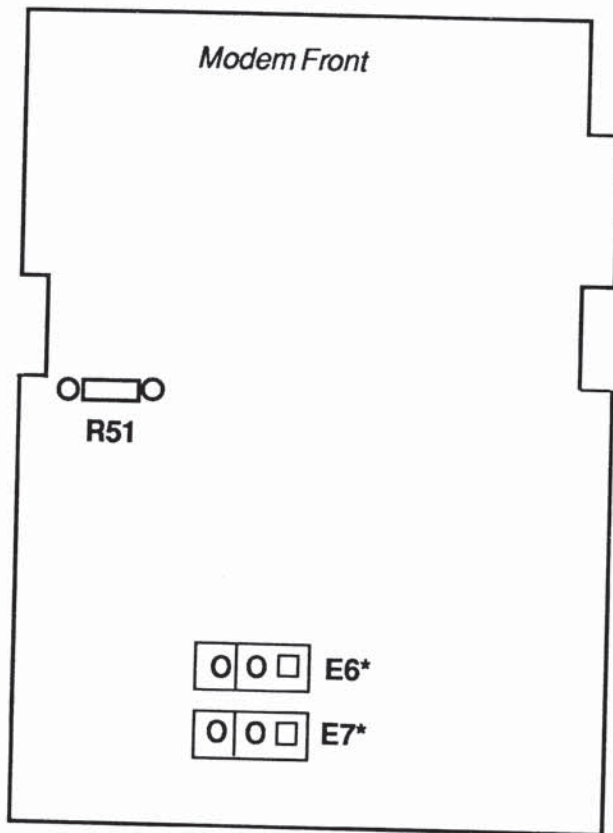
S7=255
S50=255
S101=2

Answer Modem

S7=255
S50=255
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 refer to Sections 4C and 5C Register Descriptions.

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.



*Jumpers shown for MI/MIC operation.
For A/A1 operation, move jumpers
to opposite position.

A

Figure F-2. Resistor R51 & Jumper Placement



Appendix G

Technical Specifications

Environmental Limits

Operating Temperature	50 to 120° Fahrenheit 10 to 50° Celsius
Storage Temperature	-40 to 149° Fahrenheit -40 to 65° Celsius
Relative Humidity	5 to 95% non-condensing
Altitude (maximum)	20,000 feet (6,096 meters)

Power Requirements

60 Hz Operation	115 VAC (+10%/-15%) @ 0.55 Amps maximum
50 Hz Operation	230 VAC (+10%/-15%) @ 0.28 Amps maximum

Physical Dimensions

Height	2.4 inches (6.1 cm)
Width	8.5 inches (21.6 cm)
Depth	13.0 inches (33.0 cm)
Weight	2.8 pounds (1.27 Kg)

Interface

Serial Port	25 pin RS-232C
Telephone Line	8 pin RJ45S
Phone	4 pin RJ11C

Operation

Asynchronous binary, SDLC, or
Transparent synchronous
transmissions

A

Technical Specifications

Transmission Modes
Bell 103 or V.21 (300 bps)
Bell 212A or V.22 (1200 bps)
V.23 (1200/75 bps)
V.22bis (2400 bps)
V.32 (9600, 4800 bps)
PEP (up to 18,000 bps)

Standard Character Format
1 start bit, 7 or 8 data bits,
plus 1 parity bit, and 1 stop bit

Modulation
FSK (Bell 103, V.21, V.23)
DPSK (Bell 212A, V.22)
QAM (V.22bis, V.32)
DAMQAM (PEP)

Receiver Sensitivity
-45 dBm

Frequencies

Bell 103	<u>Tx Frequency</u>	<u>Rx Frequency</u>
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

V.21	<u>Tx Frequency</u>	<u>Rx Frequency</u>
Originate Mode	1180Hz = space	1850Hz = space
	980Hz = mark	1650Hz = mark
Answer Mode	1850Hz = space	1180Hz = space
	1650Hz = mark	980Hz = mark

V.23	<u>Tx Frequency</u>	<u>Rx Frequency</u>
Originate Mode	450Hz = space	2100Hz = space
	390Hz = mark	1300Hz = mark
Answer Mode	2100Hz = space	450Hz = space
	1300Hz = mark	390Hz = mark

A

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

V.32

Originate Mode
Answer Mode

Tx Frequency Rx Frequency
1800Hz (carrier) 1800Hz (carrier)
1800Hz (carrier) 1800Hz (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

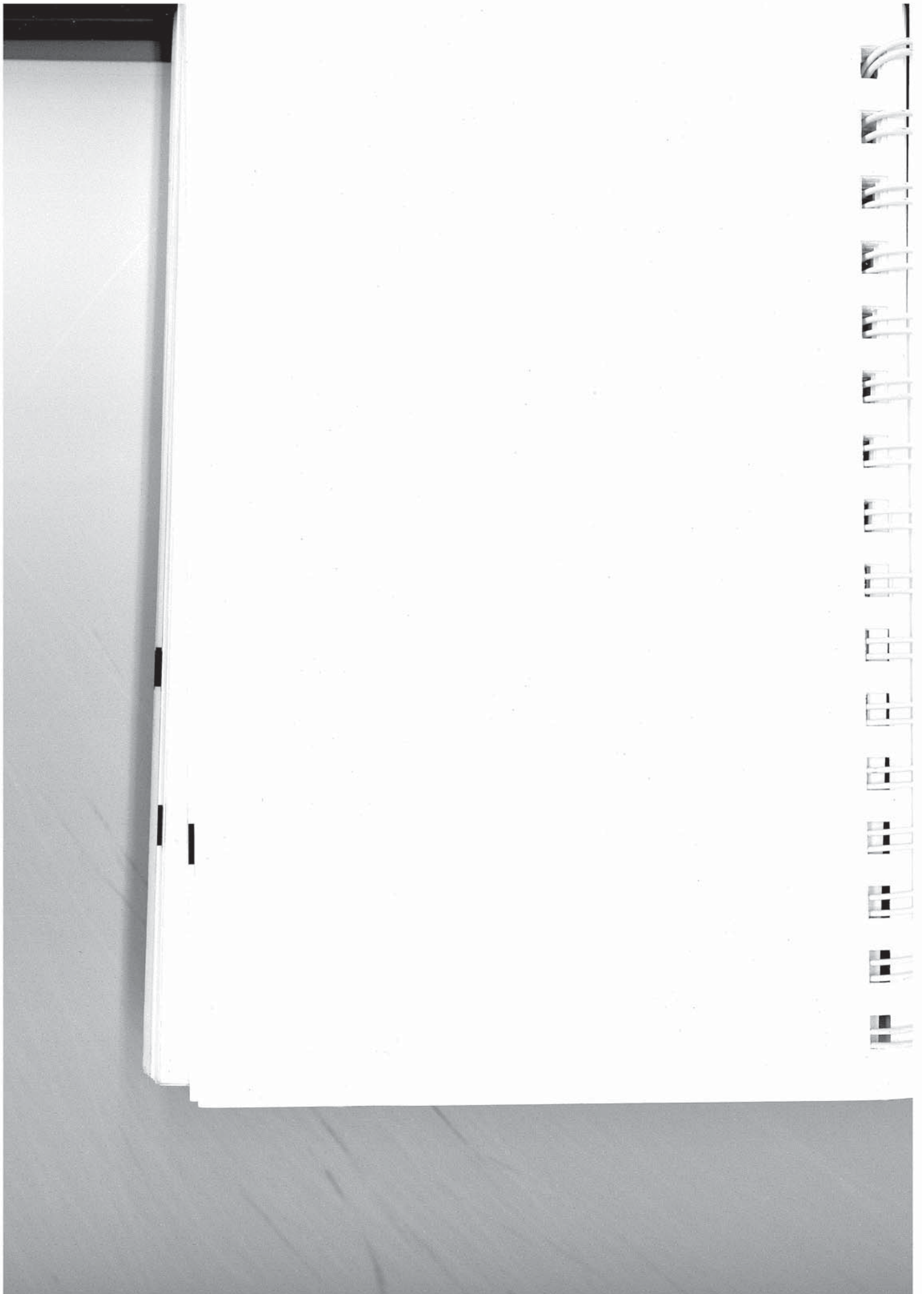
Certifications

FCC Part 15J Class A, part 68
15-ER95W5T1SA

FCC Part 68
ER95W5-17716-MD-E T25SA

DOC CS-03, Issue 05
CSA #LR66104-7
UL #E104318 (S)

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.

G

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.

G

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 logarithmic 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.

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EEPROM — Electronically 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 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.

guard tone — A tone used to signal the presence of a carrier.

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

hardware — The electronic or electromechanical 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.

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

ISO — International Standards Organization.

Kermit — a data communications protocol. *Also see Protocol.*

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.

LAP-M — Link Access Protocol for Modems

MNP — Microcom Networking Protocol. *Also see Protocol.*

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.

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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.

non-volatile memory — Memory which retains its contents even when no power is applied.

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 T2500 to transmit data at up to 18000 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 public switched network.

PEP — (see Packetized Ensemble Protocol)

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.

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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).

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 Industries 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.

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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.

Trellis Code Modulation — a method of modulating a carrier to reduce errors.

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.

UUCP — Unix to Unix Copy Program.

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.

XMODEM — A file transfer protocol. *Also see Protocol.*

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

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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 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-CONTROLLAP-B — PEP or MNP error control is being used.

Part 2. Two Year Extended Warranty

Please extend my One Year Limited Warranty for an additional two years. This extension entitles me to service and maintenance of my unit as needed in accordance with Telebit's warranty policy for a total of three years from the purchase date.

Enclosed is a check or money order payable to Telebit Corporation for the Extended Warranty fee of \$ _____ (Do not send cash)

Signature _____

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
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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 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 interface speed.
11	CONNECT 4800 — Connected at 4800 bps interface speed.
12	CONNECT 9600 — Connected at 9600 bps interface speed.
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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.

Command Summary

Command	Parameter	Description	Default
-		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	Bell Mode Selection 0 CCITT (V.21 or V.22) 1 Bell (103J or 212A)	B1
D(n)	0-9, A-D, * Modifiers:	Dial number W Wait for dial tone P Pulse dialing T Tone dialing I Timed wait i on-hook flash @ Wait for quiet answer R Switch to answer mode when remote modem answers : Remain in command mode after dialing \$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 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

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 initialize modem	O0
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	
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 - 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 Defined Control 0 DCD always on 1 DCD on when carrier detected	C0
&D(n)	0 - 3	Data Terminal Ready 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	0 - 3	Recall Factory Parameters See Reference Manual	&G0
&G(n)	0 - 2	Guard Tone Selection 0 No guard tone 1 550 Hz guard tone 2 1800 Hz guard tone	
&J(n)	0	Jack Type Selection 0 RJ-11 jack 1 AA1 control selected	&J0

Command Summary (continued)

Command	Parameter	Description	Default
&K(n)	0, 3 - 5	Flow Control 0 No flow control 3 RTS/CTS Flow Control 4 XON/XOFF Flow Control 5 Transparent XON/XOFF	&K3
&L(n)	0 or 1	Line Type Selection 0 Dial-up line 1 Leased line	&L0
&M(n)	0 - 3	Communications Mode Selection 0 Synchronous Mode 1 Synchronous Mode 1 2 Synchronous Mode 2 3 Synchronous Mode 3	&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 - 5	Communications Mode Selection 0 Same as &M0 1 Same as &M1 2 Same as &M2 3 Same as &M3 5 Asynchronous, Error Control Mode	&Q0
&R(n)	0 or 1	RTS/CTS Signal Interpretation 0 CTS goes ON with RTS 1 RTS ignored, CTS ON when modem ready for receiving	&R0
&S(n)	0 or 1	Data Set Ready Interpretation 0 DSR ON always if modem is connected and ready 1 DSR ON when modem is connected and ready	&S0
&T(n)	0 - 8	Initiate Test Function See Reference Manual	&T4
&V		View Active Configuration and User Profiles See Reference Manual	
&W(n)	0 or 1	Write Configuration Parameters 0 Save to profile A 1 Save to profile B	
&X(n)	0 - 2	Synchronous Transmit Clock Source 0 Modem generates signal 1 DTE generates signal 2 Signal derived from incoming data signal (slave operation)	&X0
&Y(n)	0 or 1	Default User Profile Selection 0 Recall profile A after power up 1 Recall profile B after power up	
&Z(n)-(x)	0 - 3	Set Number Directory See Reference Manual	

Register Summary

Register	Range	Description	Default
S0	0 - 255	Answer on Ring Number	0
S1	0 - 255	Count of Rings	43
S2	0 - 255	Escape Character (ASCII)	13
S3	0 - 97, 123-127	Carriage Return Character (ASCII)	10
S4	0 - 255	Line Feed Character (ASCII)	8
S5	0 - 97, 123-127	Backspace Character (ASCII)	2
S6	2 - 255	Dial Tone Wait Time (seconds)	30
S7	1 - 255	Wait for Carrier Time (seconds)	2
S8	0 - 255	Pause Time for Commat (seconds)	6
S9	1 - 255	Carrier Detect Time (100 ms units)	14
S10	1 - 255	Carrier Leets to Disconnect Time (100 ms units)	95
S11	50 - 255	Touch Tone Timing (milliseconds)	50
S12	0 - 255	Escape Sequence Guard Time (1/50 second units)	0
S18	0 - 255	Test Termination Timer	5
S25	0 - 255	DTR Delay Timing (10 ms units)	1
S26	0 - 255	RTS to CTS Delay Interval (100 ms units)	1
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	0
S37	0 - 9	Transmission Mode 0 Connect at last AT speed 1-3 300 bps (Bell 103 or V.21) 5 1200 bps (Bell 212A or V.22) 6 2400 bps (V.22bis) 7 PEP mode 9 PEP mode	20
S38	0 - 255	Delay Before Disconnecting	

ASCII Code Chart

Code	Mem	Dec	Hex	Code	Dec	Hex	Code	Dec	Hex
CTRLA	00	01	01	SP	32	20	@	64	40
CTRLB	02	02	02	!	33	21	A	65	41
CTRLC	03	03	03	"	34	22	B	66	42
CTRLD	04	04	04	#	35	23	C	67	43
CTRL E	05	05	05	\$	36	24	D	68	44
CTRL F	06	06	06	%	37	25	E	69	45
CTRL G	07	07	07	&	38	26	F	70	46
CTRL H	08	08	08	'	39	27	G	71	47
CTRL I	09	09	09	(	40	28	H	72	48
CTRL J	0A	0A	0A	)	41	29	I	73	49
CTRL K	0B	0B	0B	*	42	2A	J	74	4A
CTRL L	0C	0C	0C	+	43	2B	K	75	4B
CTRL M	0D	0D	0D	,	44	2C	L	76	4C
CTRL N	0E	0E	0E	-	45	2D	M	77	4D
CTRL O	0F	0F	0F	.	46	2E	N	78	4E
CTRL P	10	10	10	/	47	2F	O	79	4F
CTRL Q	11	11	11	0	48	30	P	80	50
CTRL R	12	12	12	1	49	31	Q	81	51
CTRL S	13	13	13	2	50	32	R	82	52
CTRL T	14	14	14	3	51	33	S	83	53
CTRL U	15	15	15	4	52	34	T	84	54
CTRL V	16	16	16	5	53	35	U	85	55
CTRL W	17	17	17	6	54	36	V	86	56
CTRL X	18	18	18	7	55	37	W	87	57
CTRL Y	19	19	19	8	56	38	X	88	58
CTRL Z	1A	1A	1A	9	57	39	Y	89	59
CTRL [	1B	1B	1B	:	58	3A	Z	90	5A
CTRL \	1C	1C	1C	;	59	3B	[	91	5B
CTRL]	1D	1D	1D	<	60	3C	]	92	5C
CTRL ^	1E	1E	1E	=	61	3D	^	93	5D
CTRL _	1F	1F	1F	>	62	3E	_	94	5E
DEL	1F	1F	1F	?	63	3F	DEL	127	7F

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 "X" or "a" and the last command followed by a carriage return. Note that if the SRS register is set to 0, you should not enter the "X" at the beginning of the command line.

The notation "(n)" in the descriptions represents a decimal numeric option, and "(M)" represents an assigned value. The parentheses should not be typed, and 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 "X" 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.

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, with 30 seconds when an @ modifier was encountered in the dial string.
10	CONNECT 2400—Connected at 2400 bps (V.22 bis Compatible).
11	CONNECT 4800—Connected at 4800 bps (V.32 bis back).
12	CONNECT 9600—Connect at 9600 bps (V.32 Mode).
50	CONNECT FAST—Connected to a modem using the Packetized Ensemble Protocol (PEP).
52	FRING—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.
24	CONNECT 4800/REL—MNP connection at 4800 bps.
25	CONNECT 9600/REL—MNP connection at 9600 bps.
61	CONNECT FAST/KERM—PEP connection with Kermit support.
62	CONNECT FAST/XDM—PEP connection with X-modem support.
63	CONNECT FAST/ULCP—PEP connection with ULCP support.
70	CONNECT FAST/COMP—PEP connection with data compression.

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:	D Dial number W Wait for dial tone N Return to number in number directory P Pulse dialing T Tone dialing I Initial speed i Initial speed @ Wait for quiet answer R Switch to answer mode when remote modem answers : Remain in command mode # Reference a number in number directory \ 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 On 1 On 2 On plus linefeed after carriage return	F1
G		Go to Voice	
H(n)	0 or 1	Hook ON/OFF 0 Hook up (on-hook) 1 Pick up phone line (off-hook)	
I(n)	0-4	Information 0 Return product ID code 1 Return registration 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 during call 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	

Number	Message and Description
71	CONNECT FAST/KERM/COMP—PEP connection with Kermit support and data compression enabled.
72	CONNECT FAST/XDM/COMP—PEP connection with X-modem support and data compression enabled.
73	CONNECT FAST/ULCP/COMP—PEP connection with ULCP support and data compression enabled.

Command Summary (continued)

Command	Parameter	Description	Default
C(n)	0-9	<ul style="list-style-type: none"> 0: Quiet Enable 1: Return result code for both local and remote modems 2: Return result code for remote modem only 3: Do not return result code for either local or remote modem 4-9: Partial quiet modes (see your Reference Manual) 	C0
S(n)-(x)		Set register n to value x	
S(n)?		Read contents of register n	
V(n)	0 or 1	Verbose ON/OFF	V1
W(n)	0 or 1	<ul style="list-style-type: none"> 0: Return numeric response 1: Return English response 	W0
X(n)	0-3, 10-14	<ul style="list-style-type: none"> 0: Progress not reported 1: Progress reported 	X1 - EGM X14 - COM
Y(n)	0 or 1	<ul style="list-style-type: none"> 0: Modem ignores break 1: Modem disconnects on break 	Y0
Z(n)	0-2	<ul style="list-style-type: none"> 0: Reset and recall default profile 1: Recall profile A 2: Recall profile B 	
&B		Blind Command	
&E(n)	0-2	<ul style="list-style-type: none"> 0: Use EEPROM Parameters 1: Recall profile A 2: Recall profile B 	
&F		Recall Factory Parameters <i>See Reference Manual</i>	
&N(n)	0-2	<ul style="list-style-type: none"> 0: Display EEPROM Parameters 1: Display default profile 2: Display profile B 	
&P(n)	0 or 1	<ul style="list-style-type: none"> 0: U.S. timing 1: U.K. timing 	P0
&R(n)	0 or 1	<ul style="list-style-type: none"> 0: Retrain or Renegotiate 1: Renegotiate 	
&T(n)	0-8	Initiate Test Function <i>See Reference Manual</i>	
&W(n)	0-2	<ul style="list-style-type: none"> 0: Write Configuration Parameters 1: Save to default profile 2: Save to profile A 3: Save to profile B 	
%		Remote Modem Access	

Register Summary

Register	Range	Description	Default
S0	0-255	Answer on Ring Number	See Manual
S1	0-255	Count of Rings	43
S2	0-255	Escape Character (ASCII)	13
S3	0-96, 123-127	Carriage Return Character (ASCII)	10
S4	0-255	Line Feed Character (ASCII)	8
S5	0-96, 123-127	Backspace Character (ASCII)	2
S6	2-255	Dial Tone Wait Time (seconds)	40 - EGM 30 - COM
S7	1-255	Wait for Carrier Time (seconds)	2
S8	0-255	Pause Time for Comms (seconds)	2
S9	1-255	Carrier Detect Time (100 ms units)	6
S10	1-255	Carrier Loss to Disconnect Time (100 ms units)	7 - EGM 14 - COM
S11	50-255	Touch Tone Timing (milliseconds)	70 - EGM 95 - COM
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
S26	0-255	RTS to CTS Delay Interval (100 ms units)	1
S38	0-255	Delay Before Disconnecting	0
S41	0-255	Inactivity Timer (lengths of hours)	0
S45	0 or 255	<ul style="list-style-type: none"> 0: Remote Access Enable 255: Enable Remote Access 	0
S47	0-255	DSRRDCC Delay Time (50 ms units)	4
S48	0 or 1	<ul style="list-style-type: none"> 0: Compare lower seven bits only 1: Compare all eight bits 	0
S49	0 or 1	<ul style="list-style-type: none"> 0: Product Identification String 1: 0 returns 96X ID code 10 returns 123 ID code 	0
S50	0, 9, 254, 255	<ul style="list-style-type: none"> 0: Transmission Mode 9: Termination 1: 300 bps (Bell 103 or V.21) 2: 1200 bps (Bell 212 A or V.22) 3: 2400 bps (V.22bis) 4: 300 bps (V.21) 5: 2300/75 bps (V.23) 6: 9600 bps (V.35) 254: Use last AT command speed 255: PEP mode 	9 - EGM 254 - COM
S51	0-5, 252, 254, 255	<ul style="list-style-type: none"> Interface Speed 0: 1200 bps 1: 2400 bps 2: 2400 bps 3: 4800 bps 	255 - EGM 252 - COM

Register Summary (continued)

Register	Range	Description	Default
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 is 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 specified by A/B or reset. Disable A/B switch. 1 Recall profile A after power on or reset. Disable A/B switch. 2 Recall profile B after power on or reset. Disable A/B switch.	0

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	Reverse Answer/Originate Mode 0 Reverse mode 1 Originate mode	0
S101	0-4	Continuous Answer/Originate 0 Connect normally 1 Attempt to connect as answer every 20 seconds 2 Attempt to connect as originate every 20 seconds 3 Immediately attempt to connect as answer modem 4 Immediately attempt to connect as originate modem	0
S102	0-2	Auxiliary Telex Lead Settings (Backmount and SDLC-version only) 0 Ignore telex lead 1 Use M/M function 2 Use M/MIC function	0
S103	0-1	Redemurited Controller Exclusive Access (P- and M-versions only) 0 Non-exclusive access 1 Exclusive access	0
S104	0-3	Automatic Dialing Options 0 Disable automatic dialing 1 Auto dial when DTR goes active 2 Reserved 3 Enable auto dial from TTD switch	0
S105	0-3	TTD Switch Enable/Disable 0 Disable the TTD switch 1 Enable the TTD switch 2 Enable TTD switch only when modem is on-hook	0
S110	0-1, 255	PEP Data Compression Enable 0 Disable data compression 1 Enable data compression 255 Enable data compression with parameters S110 register is set to 1	255
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 1 DSR is always on 2 DSR is turned on when answer tone is detected 3 DSR is on when modem ready 4 DSR is on when modem ready if carrier is lost, DSR turns off for time specified by S47 5 DSR is turned on when carrier is detected	2

SDLC Register Summary (Optional)

Register	Range	Description	Default
S150	0 or 1	Async/SDLC Mode Selection 0 Asynchronous Mode 1 SDLC Mode	0 SA 1 RM
S151	1-5	SDLC Interface Speed 1 1200 bps 2 2400 bps 3 4800 bps 4 9600 bps 5 19200 bps	5
S152	0-2	SDLC Switched/Nonswitched 0 Nonswitched Mode 1 Switched Mode 2 Special Switched Mode	1
S153	0 or 1	SDLC Full/Half Duplex 0 Full Duplex Mode 1 Half Duplex Mode	1
S154	0 or 1	SDLC Clock Options 0 Use DCE clocking 1 Use DTE clocking	0
S155	0 or 1	SDLC NRZI/NRZI Data Encoding 0 Use NRZ encoding 1 Use NRZI encoding	0
S160	0-255	SDLC Frame Retransmit Limit	10
S161	0-255	SDLC Device Timeout	20
S162	0-255	SDLC Nonproductive Timeout	2
S163	0-255	SDLC Retransmit Timeout	3
S164	1-32	SDLC Primary Poll Rate	7

Register Summary (continued)

Register	Range	Description	Default
S52	0-4	<p>4. 9600 bps</p> <p>5. 19200 bps</p> <p>252. Autobaud (no type-ahead)</p> <p>254. Autobaud (19200 bps default)</p> <p>255. Autobaud (9600 bps default)</p> <p>DTR Interpretation</p> <p>0 DTR is ignored</p> <p>1 When modem connects and disables auto-answer if DTR is not present</p> <p>2 The modem disconnects and re-reads operating parameters if DTR is dropped, and will not auto-answer if DTR is not present</p> <p>3 Modem enters command mode when DTR is dropped</p> <p>4 Modem hangs up and enters command mode when DTR is dropped</p>	See Manual
S54	0-4	Break Signal Interpretation See Reference Manual	0-ECM 3-COM
S55	0-3	Escape Character/Sequence Interpretation. See Reference Manual	0
S56	0-255	XOFF Character (ASCII)	17
S57	0-255	XON Character (ASCII)	19
S58	0-7	Flow Control Used by DTE	3-ECM 2-COM
		<p>0 No flow control</p> <p>1 Use RTS/CTS flow control in half duplex mode</p> <p>2 Use RTS flow control in full duplex mode</p> <p>3 Use XON/XOFF protocol</p> <p>4 Use both XON/XOFF and RTS flow control</p> <p>5 Use ENQ/ACK protocol</p> <p>6 Use both ENQ/ACK and XON/XOFF protocol</p> <p>7 Use transparent XON/XOFF</p>	
S59	0-255	Prompt Character (ASCII)	0
S61	0-255	Speaker Volume	150
		<p>Speaker is off</p> <p>1-99 Low volume</p> <p>100-199 Medium volume</p> <p>200-255 High volume</p>	
S62	2-255	Break Length Time (50 ms units)	3
S63	0-2	Command Mode Selection	1-ECM 2-COM
		<p>0 Enhanced Command Mode</p> <p>1 AT prefix not allowed</p> <p>2 Enhanced Command Mode</p> <p>3 Conventional Command Mode</p>	
S64	0 or 1	Dial/Answer Sequence Abort	0
		<p>0 Abort dial/answer sequence if answer is received before connection is established</p> <p>1 Ignore characters sent by DTE while dialing or answering a call</p>	
S65	0 or 1	XON/XOFF Failure	0
		<p>0 Normal XON/XOFF flow control</p> <p>1 Release XOFF if DTE does not suspend data transmissions</p>	

Register Summary (continued)

Register	Range	Description	Default
S66	0-2	Lock Interface Speed	0-ECM 2-COM
		<p>0 Change speed to match connection, no flow control</p> <p>1 Lock speed, use flow control</p> <p>2 Lock speed, use flow control if HUP connection established</p>	
S67	0 or 1	CTS Interpretation	0
		<p>0 CTS is on when modem is ready to accept data</p> <p>1 CTS turns on 30 ms after RTS goes active</p>	
S68	0, 2-6, 255	Flow Control Used by DCE	255
		<p>0 No flow control</p> <p>1 Use RTS flow control in half duplex mode</p> <p>2 Use RTS flow control in full duplex mode</p> <p>3 Use XON/XOFF protocol</p> <p>4 Use both XON/XOFF and CTS flow control</p> <p>5 Use ENQ/ACK protocol</p> <p>6 Use both ENQ/ACK and XON/XOFF protocol</p> <p>255 Use flow control specified by S58</p>	
S69	0-2	XON Signal Handling	0
		<p>0 XON processed, not passed on</p> <p>1 XON processed, passed on</p> <p>2 See Reference Manual</p>	
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
		<p>0 212A Emulation</p> <p>1 V.22 Emulation</p>	
S91	0-2	Guard Tone Selection	0
		<p>0 No guard tone</p> <p>1 1800 Hz guard tone</p> <p>2 550 Hz guard tone</p>	
S92	0-2	Answering Sequence Selection	0
		<p>0 Normal search sequence</p> <p>1 PEP answer tones last</p> <p>2 Normal search sequence but preceded by V.25 answer tone</p>	
S94	0 or 1	Transmission Speed Negotiation	1
		<p>0 Use speed specified by S50 register only</p> <p>1 Negotiate speed to maximum specified by S50 register</p>	
S95	0-2	MNP Operating Mode	0-ECM 2-COM
		<p>0 Normal mode - MNP disabled</p> <p>1 MNP reliable mode</p> <p>2 MNP autoreliable mode</p>	

V.42 sup
 V.42bis I
 V.42bis s
 Verbose

View Ac
 Wait For
 Wait For
 Wait Tin
 Warranty
 Write Cc

X/Ymod
 XOFF C
 XON Ch
 XON Sig
 XON/XO

Register Summary (continued)

Register	Range	Description	Default
		4 9600 bps 5 19200 bps 252 Autobaud (no type-ahead) 254 Autobaud (19200 bps default) 255 Autobaud (9600 bps 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	See Manual
S54	0 - 4	Break Signal Interpretation <i>See Reference Manual</i>	0 - ECM 3 - CCM
S55	0 - 3	Escape Character/Sequence Interpretation <i>See Reference Manual</i>	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



For Your Records

Date Warranty Card Returned _____
Extended Warranty Purchased Yes No Amount Sent \$ _____ Check No. _____

Telebit Corporation Warranty Registration Card

Important: Read the preceding Warranty Statement and Return for Repair Procedure. Complete this form and return within 10 days to validate the warranty.
Complete **Part 1** to register your product with Telebit. Complete **Part 1** and **Part 2** of this form if you wish to purchase the Extended Warranty option.

Part 1. Standard One Year Limited Warranty

Name _____ Modem _____
 Company _____ Model Number _____
 Address _____ Serial Number _____
 City _____ State _____ Zip _____ Communications Software _____
 Phone _____ Release Number _____
 Serial Number _____
 Dealer purchased from _____ Computer Type _____
 Dealer Address _____ Operating System _____
 City _____ State _____ Zip _____ Amount of Memory _____
 Date of Purchase _____

Part 2. Two Year Extended Warranty

Please extend my One Year Limited Warranty for an additional two years. This extension entitles me to service and maintenance of my unit as needed in accordance with Telebit's warranty policy for a total of three years from the purchase date.

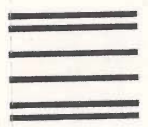
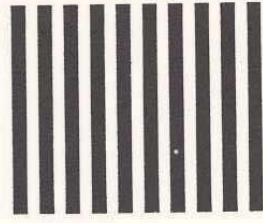
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Signature _____

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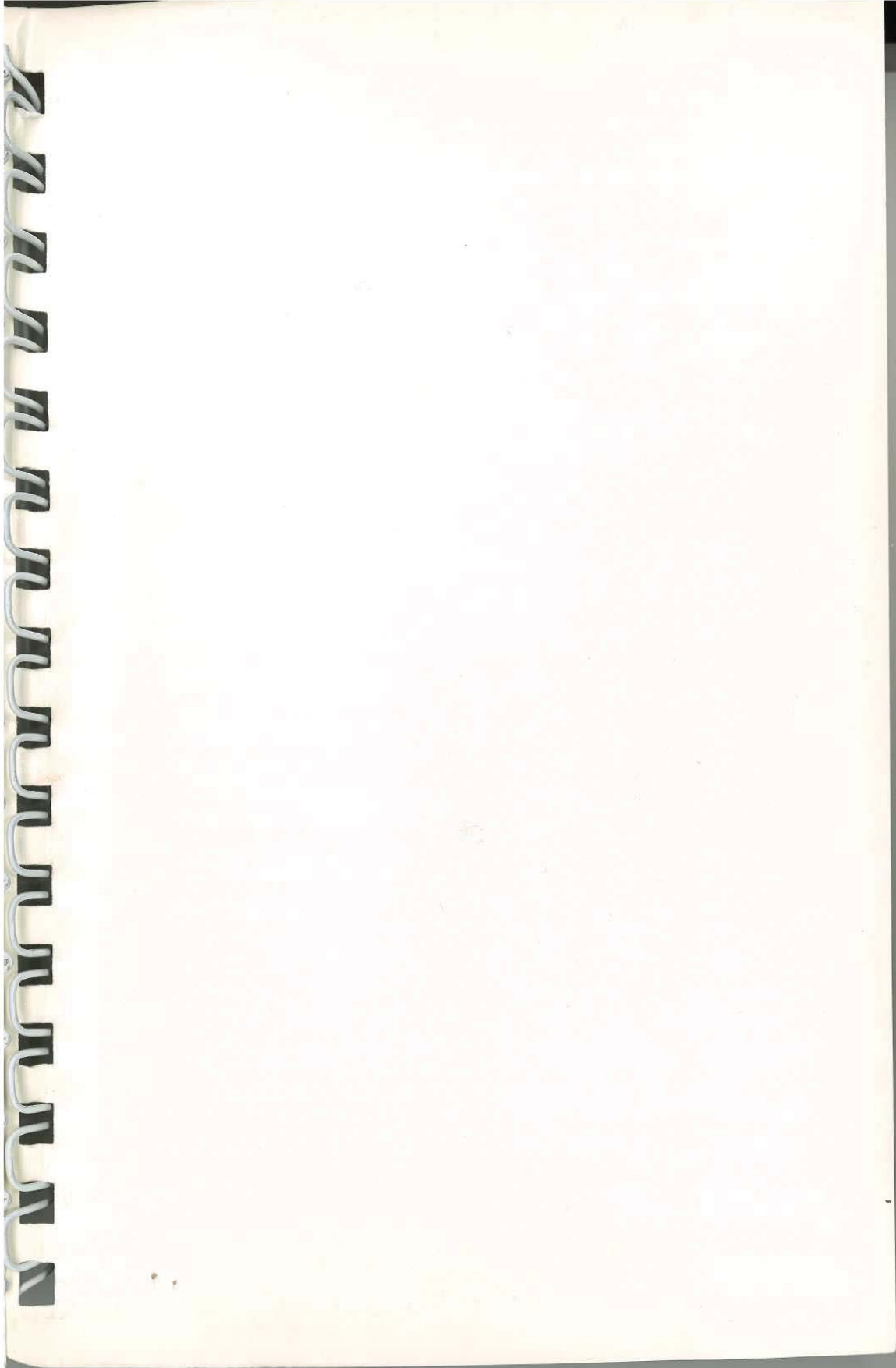
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