APEX DATA

The Peak of Performance

User Technical Reference Guide

V.32, V.32*bis* Data/Fax

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The V.32, V.32*bis* Data/FAX Modem

The V.32, V.32*bis* Data/FAX modem offers state-of-the art performance, improving on its predecessors in *speed*, *transmission accuracy*, and *security*. This manual provides the technical data required to obtain optimum performance from this modem.

Features

The following are some of the features of this modem:

- V.32, V.32*bis*, V.22, V.21
- Bell 212A and Bell 103 modes
- AT command set compatibility
- Autobaud operation
- Automatic dialing and answering
- Non-volatile storage of parameters and telephone numbers
- MNP Class 2-5 error correction and data compression
- V.42 LAPM error protection, V.42*bis* (BTLZ) data compression
- CCITT V.54 test mode implementation
- AutoSync SNA and BSC synchronous operation
- Group 3 Facsimile (Class 1) at 9600, 4800, 2800 bps
  FAX Software Interfaces
  - Class I, EIA578
  - Class II, EIA2388

Optional features available for the modem include the following:

- V.32*bis* operation at 14,400 bps, 12,000, 7200 bps
- V.17 Group 3 Facsimile send and receive at 14,400, 12,000, 7200 bps

- MNP 10
- Integrated FLASH memory programmer
- Voice option

Basic Commands

To initiate or answer a call and to carry out many other built-in functions, the user must use a telecommunications program. The commands recognized by the modem are compatible with the AT command set. For this reason most available telecommunications programs will work with the V.32, V.32*bis* Data/FAX modem.

NOTE: Most computers or laptops require the modem to be set up correctly. Typically the modem is set up as COM2.

Sometimes it is advantageous to be able to enter commands to the modem directly. This chapter discusses how to control your modem directly and describes some frequently-used commands (grouped by function). The Appendices contain a complete listing of the commands recognized by the V.32, V32*bis* Data/FAX modem.

NOTE: In the tables of commands given in this manual, default command settings are given in bold.

The modem has two operating modes:
- Command mode: The mode used to issue commands to the modem.
- Data mode: The mode used to send data to another modem.

Entering Commands

The modem must be in command mode to accept commands. Often, after loading, telecommunications programs initialize the modem and then enter command mode. To talk to the modem, have the software go to a

'terminal' screen To get the modem's attention, type "AT [Enter←]."

Most typed commands are stored in a 40-character temporary storage area until the [Enter←] key is pressed. When a command is entered, the modem usually responds with **OK** (not always) when the command is accepted as correct; or **ERROR**, when the command is incorrect.

NOTE: All commands must begin with the characters **AT** (with the exception of **A/**, which is "repeat last command") and may contain one or more instructions.

Example:
To set the speaker to its highest volume use the command:
ATL3

To view your current profile use the command:
&V

These commands can be used separately (press the [Enter←] key after each) or you can combine them by typing:

ATL3&V

Then press the [Enter←] key. AT is used only once at the beginning, in each command.

Modem Configuration

Profiles

A **profile** is a set of parameters used to adjust the modem's operation.
The modem has **five profiles**: three are factory-set and cannot be changed, while two are user-definable. In addition, 20 frequently-called telephone numbers can be stored in the modem. Profile configuration and phone number storage are described in the following sections.

Profile Configuration

Three Factory-Set Profiles (cannot be changed)

1. The <u>first profile</u> is recalled using the &F0 command and sets the modem for auto-reliable operation with LAPM or MNP error correction and data compression.
2. The <u>second profile</u> is recalled using the &F1 command and sets the modem for auto-reliable operation with MNP error correction and data compression.
3. The <u>third profile</u> is recalled using the &F2 command and sets the modem for operation in standard asynchronous mode, without error correction, data compression.

Two User-Adjustable Profiles

1. For specific purposes, the two user profiles, which are set to the same as the first factory profile described above, can be changed
2. New settings are saved using the &W0 and &W1 commands.
3. When the modem is turned on or reset (ATZ) the modem will load user profile 0 or 1 depending on the &Y setting.

The factory default configuration recalls user profile 0.

The current operating parameters (both factory-set and user-definable profiles) can be recalled for use either for the current session or for every session. Settings used frequently, which differ from the standard settings, can be saved and made the default. The commands required for these adjustments and other related commands are listed in the table that follows.

Command	Description
Z, Z0	Reset modem and recall User Profile 0
Z1	Reset modem and recall User Profile 1
&F, &F0	Recall factory profile as active configuration
&F1	Recall second factory profile as active: \N3
&F2	Recall third factory profile as active: \N0
\S, &V, %R	View active configuration
&W, &W0	Save active configuration as User Profile 0
&W1	Save active configuration as User Profile 1
&Y, &Y0	**Recall User Profile 0 on power-up**
&Y1	Recall User Profile 1 on power-up

Phone Number Storage

The modem has a memory area where you can store up to 20 (0 . . .19=20) 32-digit phone numbers. Use the commands in the table following. Please note that the S modifier cannot be stored.

Command	Description
&Z0=x	Store phone number x in directory entry 0
&Zn=x	Store phone number x in directory entry n, for n=1..19.
\F	Views all 20 numbers

Dialing: Originating and Answering

The V.32, V.32*bis* Data/FAX modem is capable of originating and answering calls either manually or automatically. The modem can also dial telephone numbers. The commands to dial, answer and to set answer and originate follow.

Command	Description
D	Initiate dial (followed by T for tone or P for Pulse and the number to be dialed)
A	Answer incoming call in Answer mode
O	Go back online
S0=n	Auto-answer call after n rings (disabled with 0)

Modems can be set to answer incoming calls automatically with the S0=*n* command (*n* must be greater than 0 in order for the modem to auto answer).

The A command can be used to cause the modem to issue the Answer tone when the phone is picked up manually.

Dial String Modifiers

Numbers and certain other characters can be used as part of the phone number (0-9, -, *, and the letters A, B, C and D found on four-column touch-tone telephones).

The characters (modifiers) listed in the table following can also be used in phone number entries.

Modifier	Description
P	Pulse dial
T	Tone dial
<,> (comma)	Pause for the # of seconds specified in register S8
!	Flash (on-hook for value in register S29)
@	Wait for silence for 5 seconds
W	Wait for dial tone for the number of seconds specified in register S7
;	Return to Command Mode after dialing
Sn	Dial number stored in directory entry &Zn where n=0...19
R	Send Answer tone after dialing (Reverse)
L	Redial last number
^	Enable, disable calling tone

Example:

The string 9,7654321 commands the modem to dial 9, pause for the number of seconds specified in register S8 (default 2), and then dial the number 765-4321.

Modem Command Modifiers

The information sent to the user by the modem can be changed. These controls include the speaker control during dial and connect, whether the modem echoes characters back to the screen, and in what format result codes are reported.

Speaker Control

The following commands control the speaker volume and the conditions under which the speaker is active.

Command	Description
L, L0	Lowest speaker volume
L1	Low speaker volume
L2	Medium speaker volume
L3	High speaker volume
M, M0	Speaker off
M1	Speaker on until carrier detect (CD)
M2	Speaker always on
M3	Speaker on until CD except during dialing

Character Echo

The following commands control whether characters typed by the user are echoed back to the screen by the modem.

Command	Description
E, E0	Disable character echo to terminal in command mode
E1	**Enable character echo to terminal in command mode**

Result Codes Format

The modem produces result codes during use. These codes can be written to the screen (in several formats), or they can be completely suppressed.

Details of the commands follow. The result codes are listed in the Appendices.

Command	Description
Q, Q0	Modem returns result codes
Q1	Modem does not return result codes
V, V0	Numeric codes enabled
V1	Numeric codes and status messages enabled
W0	Negotiation progress codes disabled. Result code is DTE rate
W1	Negotiation progress codes enabled. \V setting is ignored. Result code is DTE rate
W2	Negotiation progress codes disabled. Result code is DCE rate
&N, &N0	Hayes compatible numeric result codes
&N1	Microcom-compatible numeric result codes
&N2	Rockwell-compatible numeric result codes
\V, \V0	Disable /REL connect codes
\V1	Enable /REL connect codes (ignored if W1 set)
\V2	LAPM or MNP added to /REL connect codes.

The **\V1** command sets the modem to append the characters /REL to the CONNECT *nnnn* result code when it establishes an MNP or LAPM connection. The **\V2** command causes the modem to indicate which protocol is in use.

NOTE: Entering the W1 command causes the modem to ignore the \V commands. In this case, the carrier, protocol, compression, and DTE rate are reported in a four-line format.

Tone Detect

The following commands enable or disable dial tone and busy signal detection. Result codes are displayed.

Command	Description
X, X0	Smartmodem 300 compatible
X1	Modem ignores dial tone and busy
X2	Modem recognizes dial tone and ignores busy
X3	Modem ignores dial tone
X4	Modem recognizes dial tone and busy (hang-up after 5 seconds if no dial tone)

Line Types

The V.32 and V.32*bis* modems can be used with either a dial or leased, 2-wire line (a cellular line is considered to be a dial line).

Command	Description
&L, &L0	Dial Line
&L1	Leased line

Leased Line

A leased line is a direct connect line between two locations. While it is not necessary to dial a number to achieve a connection with a leased line, it is still necessary for one of the two connected parties to use originate and the other to use answer. A connection is made by both of the parties' entering the &L1 command. One of their modems then issues the D command (without a phone number) and the other modem issues the A command. The modems should then establish communication parameters automatically. The commands in the above table are used to set the modem according to the type of line in use.

Error Protection and Data Compression

Your modem supports error-protection and data-compression protocols which provide faster, more reliable communication. The following sections discuss the commands used to enable these protocols.

Error-Protection Modes

The V.32, V.32*bis* Data/FAX modem supports both Microcom Network Protocol (MNP) and V.42 Link Access Procedure for Modems (LAPM) error protection. The following table shows the commands you can use to enable these modes or to switch between these modes and the modem's normal, non-error-protected mode.

Command	Description
&Q0	Asynchronous mode
&Q4	Hayes AutoSynch
&Q5	Set Auto-reliable mode (MNP with fallback to normal)
&Q6	Set Auto-reliable mode (LAPM with fallback first to MNP, then normal mode)
&Q7	Set Auto-reliable mode (LAPM with fallback to normal mode)
\N, \N0	Set normal mode
\N1	Set direct mode
\N2	Set Reliable mode (MNP only)
\N3	Set Auto-reliable mode (MNP, fallback to normal)
\N4	Set Reliable mode (LAPM only)
\N5	Set Auto-reliable mode (LAPM only), fallback to normal

Command	Description (continued)
\N6	Set Reliable mode (LAPM with fallback to MNP)
\N7	**Set Auto-reliable mode (LAPM with fallback first to MNP and then normal mode)**

There are four error-protected modes supported by your modem: normal, direct, reliable and auto-reliable.

- *Normal mode*

  No error protection is used. The DTE speed remains the same.

- *Direct mode*

  No error protection is used. The DTE speed adjusts to the telephone line (DCE) speed

- *Reliable mode*

  Specifies that error protection (either MNP or LAPM) is required. If the remote modem does not support either of the error protection protocols used by the V.32, V.32*bis* Data/FAX modem, the link will be terminated.

- *Auto-reliable mode*

  Specifies that error protection is enabled but not required. In this mode the local modem attempts to establish an error-protected connection. If this is not possible it falls back to normal mode.

MNP 10 Commands

Command	Description (MNP 10)
-B	Initiate fallback to next lowest speed.
-C0	**Class 10 selection, synchronous**
-C1	Class 10 selection, asynchronous
-C2	Class 3 selection
-C3	Class 2 selection

Command	Description (MNP 10) (continued)
-K0	Disable MNP 10 expended services
-K1	**Enable MNP 10 expended services**
-Q0	Disable fallback modulation speed
-Q1	**Enable fallback to 2400 bps or 12 bps**
-Un	Initiate fall forward to next highest speed n=..7
)M0	**Disable power level adjustments**
)M1	Enable power level adjustments for use on cellular telephones only
@M0	**Initial transmit level is fixed, for cellular telephone only**
@M1	Initial transmit level is last used, for cellular telephone only
***H0**	**Link negotiation occurs at highest level**
*H1	Link negotiation occurs at 1200 bps
*H2	Link negotiation occurs at 4800 bps

Data Compression

When using an error-protected link, data compression can significantly improve throughput. When using the LAPM protocol, the modem uses the V.42*bis* standard to compress data. With MNP protocols, the modem uses MNP5 data compression. The commands in the following table relate to data compression.

Command	Description
%C, %C0	Data compression disabled
%C1	**Data compression enabled (V.42*bis*, MNP5)**
%C2	V.42*bis* compression only (max=4:1)
%C3	MNP5 compression only (max=2:1)

Command	Description (continued)
&U, &U0	Data compression disabled
&U1	Data compression enabled (%C1)

Block Size

The V.32, V.32*bis* Data/FAX modem allows the size of data blocks to be set when using MNP protocols, as shown in the following table.

Command	Description
\A, \A0	Maximum MNP block size = 64 characters
\A1	Maximum MNP block size = 128 characters
\A2	Maximum MNP block size = 192 characters
\A3	**Maximum MNP block size = 256 characters**

Usually a larger block size will give a higher data throughput unless the link between modems is causing frequent re-transmission of data, in which case better throughput may result from using a smaller block size.

Flow Control

Flow control is the process by which devices signal each other that they are ready to send or receive data. The following commands specify the flow control method or methods used by your modem.

Command	Description
&K, &K0	Disable flow control
&K3	Enable bi-directional hardware flow control
&K4	Enable bi-directional XON/XOFF flow control
&K5	Enable XON/XOFF flow control with pass-through

Command	Description (continued)
&K6	Hardware and XON/XOFF flow control
\G, \G0	Disable port flow control
\G1	Enable port XON/XOFF flow control
\Q, \Q0	Disable flow control
\Q1	Bi-directional XON/XOFF flow control
\Q2	Unidirectional hardware flow control
\Q3	Bi-directional hardware flow control
\Q4	Unidirectional XON/XOFF flow control
\Q5	Unidirectional hardware flow control with CTS off until CONNECT
\Q6	Bi-directional hardware flow control with CTS off until CONNECT
\X, \X0	**Disable XON/XOFF pass through (ignored if \Q1 not set)**
\X1	Enable XON/XOFF pass through (ignored if \Q1 not set)

The V.32, V.32*bis* Data/FAX modem supports either XON/XOFF or hardware flow control. Each is specified by a separate command, and both types of flow control can be enabled or disabled

The &K and \Q commands determine whether flow control is used between the modem and the computer. The &K0 and \Q0 commands disable all flow control. If either of these commands is in effect, the \G, \H and \X commands are non-operational. The &K and \Q commands also set the type of flow control to be used. Flow control can be set to bi-directional (whether flow control is performed by both the modem and the computer) or unidirectional (flow control is performed by the modem only).

The \G commands are used to set whether XON/XOFF flow control should be used between the local modem and a

remote modem. The \G0 command disables XON/XOFF flow control. XON/XOFF is not necessary when V.42 or MNP is used.

BREAK Signal Processing

The BREAK signal is a space (digital zeros) of a certain zlength. In broad terms this signal is used to force a break in the normal course of data communications. The effect of this signal is dependent on hardware and software settings.

BREAK Signal Commands

The length of the BREAK signal and the effect on modem operation can be changed. See the table below.

Command	Description
\Bn	Send an n*100 msec. BREAK to remote; default is 300msec
\K, \K0	BREAK from DTE = Enter command mode BREAK Command = Purge buffers and transmit BREAK BREAK from remote = Purge buffers relay BREAK to DTE
\K1	BREAK from DTE = Purge buffers BREAK Command = Purge buffers and transmit BREAK BREAK from remote = Purge buffers relay BREAK to DTE
\K2	BREAK from DTE = Enter command mode BREAK Command = Transmit BREAK immediately BREAK from remote = relay BREAK to DTE immediately

Command	Description (continued)
\K3	BREAK from DTE = Transmit BREAK immediately BREAK Command = Transmit BREAK immediately BREAK from remote = relay BREAK to DTE immediately
\K4	BREAK from DTE = Enter command mode BREAK Command = Transmit BREAK in sequence with data BREAK from remote = relay BREAK to DTE in sequence with data
\K5	**BREAK from DTE = Transmit BREAK in sequence with data** **BREAK Command = Transmit BREAK in sequence with data** **BREAK from remote = relay BREAK to DTE in sequence with data**

The **\B command** lets you send a BREAK signal to the remote modem. Enter this command without a value to send a 300 millisecond BREAK. Entering a value with the command specifies the length of the BREAK in 100 millisecond increments. For example the command \B5 sends a 500 millisecond BREAK to the remote modem.

The **\K command** specifies the action taken by your modem when it receives a BREAK signal. Your modem can receive this signal from any of three sources: the DTE (that is, your computer, by pressing the BREAK key on the keyboard), the BREAK command (by entering the \B command in command mode), or from the remote modem.

Hardware Signal Processing

To exchange data, the modem and computer must have a way to communicate their states to each other. Hardware signaling achieves this. These signals include:

- Carrier Detect (CD)
- Data Terminal Ready (DTR)
- Clear to Send (CTS), and
- Data Set Ready (DSR)
- AutoSync Operation
- Other Hardware Signalling Commands

The &K, \Q, &C, &D, &R and &S commands are used to select the correct protocol. Details are in the following sections.

Carrier Detect Signal Processing

Carrier Detect (CD) is a signal issued by the modem when it has detected a carrier signal from another modem. The following commands allow you to specify when the signal is issued.

Command	Description
&C	&C0, Carrier Detect always on
&C1	**Carrier Detect follows data carrier**

The **&C0 command** causes the modem always to indicate that a carrier has been detected. The **&C1 command** only indicates to the computer that a carrier has been detected when it is true.

Data Terminal Ready

Data Terminal Ready (DTR) is a signal issued by the computer to indicate that it is ready to send and receive

data. The following commands let you specify how the
modem responds to an on-to-off transition of this signal.

Command	Description
&D, &D0	Modem ignores DTR
&D1	Go to command mode on on-to-off DTR transition
&D2	**Hang up and go to command mode on on-to-off DTR transition.**
&D3	Reset modem on on-to-off DTR transition
&D4	Deliver all buffered data before hang up on On-to-Off transition of DTR

The **&D0 command** causes the modem to ignore DTR.
The **&D1 command** causes the modem to go to command
mode when DTR drops without disconnecting the line.

The **&D2 command** causes the modem to disconnect the
line and go to command mode. The **&D3 command** causes
the modem to reset to its default profile when DTR drops.

When the **&D4 command** is used, any data in the buffer is
delivered to the local computer before disconnect and return
to command mode.

If error correction is in use the line will not be dropped until
the remote modem has acknowledged that a current data
send or receive has been completed.

Clear To Send

The Clear To Send (CTS) signal is issued by the modem to
indicate that it is ready to receive data from the computer.
The following commands are used to specify how the CTS
signal reacts to communication conditions.

Command	Description
&K3	Enable bi-directional hardware flow control
&R, &R0	CTS follows RTS after delay specified in S register 26 (unless hardware flow control is effect)
&R1	**CTS always true (unless hardware flow control is effect)**

Hardware flow control has the highest priority, and if it is in use, the &R commands will have no effect. The &K3, \Q2, \Q3, \Q5 or \Q6 commands specify use of hardware flow control.

Data Set Ready

Data Set Ready (DSR) is a signal to the computer, provided by the modem, to indicate that a connection to another modem has been successfully made. The following commands let you specify when this signal is sent.

Command	Description
&S,	&S0, DSR always true
&S1	DSR is false until connect

AutoSync Operation (Optional Feature)

The **&Q4 command** sets AutoSync mode. In this mode, the modem translates the asynchronous data from the computer to BiSync or SDLC (HDLC) on the communications link. Software in the computer must be able to control the modem in this mode. When this command is in effect, three registers are used to store AutoSync values.

Register 19

The AutoSync Line Protocol options are stored as bit values
with the meanings shown in the following table.

Bit #	Value=Use
1	0=BiSync 1=SDLC
2	1=SDLC address detect on
3	0=NZRI, 1=NRZ mode
Bit #	Value=Use (continued)
4	0=SDLC idle on MARK 1=SDLC idle on FLAG

Use the S19=n command to change the value of this
register.
The following table lists the values of n and their functions.

Value	Value=Use
0	Bisync operation
2	SDLC operation: address detect off, idle on MARK
4	SDLC operation: address detect on, idle on MARK
18	SDLC operation: address detect off, idle on FLAG
22	SDLC operation: address detect on, idle on FLAG

Register 20

In BiSync mode it contains the ASCII value of the SYNC
character.

In SDLC mode it contains the ASCII value of the ADDRESS character if Address Detect (bit 2 of register 19) is on. The default value of this register is 32.

Register 25

Contains the time in seconds that the modem will wait for DTR to go TRUE after a connection has been made. Make sure the value in this register allows time for the computer to switch from asynchronous to AutoSync mode.

Other Hardware Signal Commands

The Y commands control whether the the modem uses a long-space disconnect. The Y0 command sets the modem not to use long-space disconnect. It is the default. The Y1 command sets the modem to use long-space disconnect. When long-space disconnect is set and the modem receives a break of 1.6 seconds or more, it will respond with a 4 second break and then terminate the connection. When enabled at both ends of the connection it will prevent line noise from being displayed on the screen.

The &G commands provide European compatibility during V.22 and V.22*bis* operation by providing an additional guard tone, required by some European systems. The &G0 command is the default and disables the guard tone. The &G1 command enables a 550Hz guard tone. The &G2 command enables an 1800 Hz guard tone.

The &J commands are typically used to specify the type of telephone jack in use. These have no effect and are provided for compatibility only.

The &P commands specify the pulse rate for pulse dialing. The &P0 command sets the modem to the American standard and the &P1 command sets it to the European and Far Eastern standard.

The &B and \J commands control the rate of communication through the serial port.

The \Tn command allows specification of an inactivity timeout, in minutes. If this period passes with no data passing between the modems the connection will be terminated. The default is zero which disables the auto-disconnect. Issuing the command \T20 would cause the modem to disconnect after 20 minutes of inactivity.

The %B command allows the maximum data transfer rate to be set.

The &E and %E commands control the automatic adjustment of transfer rate when a connection changes in quality (known as auto-retrain).

FAX Commands

More complicated FAX commands are handled by software applications. Refer to the EIA Spec. for further information.

Class 1 = EIA 578
Class 2 = EIA 2388

+FCLASS=n   Set FAX Class (EIA-578)
? = Return available Fax Class
0 = data only
1 = Fax Class 1
2 = Fax Class 2

+FAE=n Fax answer mode, Class 1
+FAA=n Fax answer mode, Class 2
0 = According to +fclass setting
1 = detect fax, data modem

Other Commands

The V.32 and V.32*bis* modems recognize other less frequently used commands as detailed below

The B commands specify the type of modulation the computer will use. The B0 command sets the modem to use CCITT-standard modulation. These are: V.22 at 1200 bps and V.21 at 300bps. The B1 command sets the modem to use Bell-standard modulation. These are 212A at 1200 bps and 103 at 300 bps.

The H command is used to pick-up or hang-up a connection under manual control. The H0 command hangs-up the line and clears the transmit and receive buffers. The H1 command picks-up the line.

The I and %V commands read the modems ROM and flash memory settings.

Testing the Modem

The V.32, V.32*bis* Data/FAX modem has built-in diagnostic testing capabilities. The tests will help to determine where a fault lies if the modem does not seem to be working properly. The tests are listed and described below.

The length of time each test is run can be changed by altering the value of register S18. This register specifies the duration, in seconds, of any test started with one of the **&T commands**. If the value in register S18 is zero the test will continue until you issue the **&T0 command**. This command can be used to terminate any of the diagnostic tests.

NOTE: To enter command mode type +++ and the Enter key.

Internal Testing

The **I commands** start the tests of the modem's Read Only Memory (ROM) and Random Access Memory (RAM). Some of the tests are used by software to determine modem compatibility.

Displaying the Modem's ID Code

The I0 command displays the identification code of the modem on the screen.

Testing the Modem's ROM

The ROM contains the system code and factory profiles for your modem. Using **I1 command** computes a checksum of the modem ROM and displays it on the screen. The checksum is used to determine whether your modem's ROM is correct.

Testing the Modem's RAM

The RAM is used by the modem for input and output buffers and for storing the current operating parameters. The **I2 command** starts the test of the modem's RAM The result will be displayed on screen as either OK, if the test is successful, or ERROR if the test fails.

Displaying the ROM ID

The **I3 command** displays the part number of the modem and ROM version number.

Displaying the Firmware Version

The **%V command** displays the part number and version number of the firmware installed in the modem.

Analog Loopback Tests

The analog loopback tests check the local operation of the modem.

During these tests, data from your computer is converted from digital to analog form. This converted data is sent internally from the modem's transmitter to its receiver. The modem then converts the received data from analog to digital form and compares it with the original data.

The length of the analog loopback test is determined by the S18 register. If the value of register S18 is zero the test loop length is infinite. To end the test in this case or to end a timed test before the timer expires, you must first enter the escape sequence (+++), to put the modem in command mode, and then enter the &T0 command. The modem then displays OK to indicate that the test has ended.

Local Analog Loopback Test

During this test characters you type are routed through the modem and displayed on the screen. The &T1 command starts the local analog loopback test.

Local Analog Loopback with Self-Test

In this test, the modem generates a test pattern which is transferred internally between the modem's transmitter and receiver. The send and receive pattern is compared internally and at the end of the test a result code is displayed on the screen. Use the &T8 command to begin the test.

The resulting number, between 0 and 255, indicates the number of errors that occurred. If more than 255 errors occur, the number 255 is displayed. The modem displays OK on the screen to indicate the test has ended and it is in command mode.

Remote Digital Loopback Tests

The digital loopback tests check operation the local modem, a remote modem and the link (usually a telephone line) between them.

During these tests data is converted from digital to analog form and sent over the link from the local modem to the remote modem. The remote modem takes the received analog signal, converts it to digital form and transfers it internally to its own transmitter. The transmitter converts the signal to analog form and sends it along the link to the local modem. The local modem converts the received signal from analog to digital form for comparison.

By default, the V.32, V.32*bis* Data/FAX modem allows remote loopback test requests from a remote modem. This can be disable with the &T5 command. The &T4 command sets the modem to allow remote digital loopback test requests.

NOTE: Before you can run either of these tests you must establish a link to a remote modem.

NOTE: The length of the digital loopback tests is determined by the S18 register. If the value of register S18 is zero the test loop length is infinite. To end the test in this case to end a timed test before the timer expires, you must first enter the escape sequence (+++), to put the modem in command mode, and then enter the &T0 command. The modem then displays OK to indicate that the test has ended.

Remote Digital Loopback Test

During this test characters you type are routed through the local modem, along the link, through the remote modem, back along the link to the local modem and displayed on the screen. Use the &T6 command to start the remote digital loopback test.

Remote Digital Loopback with Self-Test

In this test, the modem generates a test pattern which is transferred from the local modem along the link to the remote modem and back along the link to the local modem. The sent and receive pattern is compared internally and at the end of the test a result code is displayed on the local screen. Use the &T7 command to begin the test.

The result code, a number between 0 and 255, indicates the number of errors that occurred. If more than 255 errors occur, the number 255 is displayed. The modem displays OK on screen to indicate the test has ended and it is in command mode.

Local Digital Loopback Test

During this test characters type at a remote terminal are routed through the remote modem, along the link, through the local modem, back along the link to the remote modem and displayed on the remote screen.

NOTE: It is only necessary to use this test if the remote modem has no capability to initiate its own remote digital loopback test.

Use the &T3 command to start the local digital loopback test.

Boosting Throughput

If you are having problems with data transfer speeds or frequent transmission errors and the modem is passing the tests in the previous section, this section may help to isolate the problem.

Various factors affect the reliability and transfer speed of modem connections between computers. Each of the sub-sections below addresses a particular aspect of that

communications process. Using the techniques described may reduce or eliminate the problems you are experiencing.

Flow Control

Different computers handle data at different speeds. To prevent loss of data when a computer receives data faster than it can move it to storage modems use a process known as flow control.

To help speed up data transfers, modems and communications programs are usually equipped with buffers. When data is received by the local computer it is placed in the buffer. When the buffer is full, the local computer needs to move it to permanent storage.

If the remote computer were to continue to send data it would be lost. So, when the buffer is full, the local computer signals the remote computer to stop sending data. The local computer then moves the data in the buffer to storage. When the move is complete it then signals the remote computer that it is again able to receive data.

On systems where error correction is not available, frequent loss of data during a transfer or missing or corrupt typed characters may indicate flow control is not in operation and that it may be necessary. See the section headed Frequently Used Commands sub-section Error Protection and Data Compression for details of the types of flow control available.

Communication Rate Commands

Your modem has to communicate in two ways:

- with the remote modem
- with the computer it is attached to.

The rate of data transfer may be different between the two modems and between your modem and computer. For data to be transferred successfully, the rates must be set correctly for each of the two situations.

Modem to Modem Communication

When modems first connect they establish a communication speed, usually the highest both modems can support. The %B and \F commands can limit the rate at which your modem can connect to a remote modem. The %B command sets the maximum data rate that can be used. The \F command sets a specific data rate.

The condition of a connection can vary even after the connection is established. Data will be retransmitted more often at higher speed on a poor quality line, slowing data transfer rates dramatically. It may be beneficial to set the maximum rate of transfer to a slower speed reducing the number of data blocks retransmitted. This can sometimes improve overall transfer speed.

Modem to Computer Communication

The modem can operate at speeds from 300 bps to over 57600 bps. The modem automatically adjusts its speed to that of a remote modem it is connected to but by default does not alter the rate the modem communicates with the computer. The &B0 and \J1 commands cause the modem to set the transfer rate between the modem and the computer to match the speed of the remote modem. If the remote modem can communicate at a higher rate then the local

modem can communicate with your computer characters or other data can be corrupted.

To change this situation use the &B1 or the \J0 commands.

Error Correction and Data Compression

The modem supports a number of error correction and data compression protocols. Some of the ways in which you can maximize data throughput are addressed in the following paragraphs.

Error Correction

Error protection protocols send data in blocks. To verify that the data in the blocks has been transmitted correctly, a checksum is sent along with the block. If the checksum indicates that the block may have been corrupted during transmission a request is made for retransmission of the data.

The same amount of verification data is sent with each, so larger block sizes usually mean increased total throughput because of a reduced amount of verification data. On lines that have excess background noise, it may be advantageous to reduce the block size so that whenever a block is resent it has more chance of not being corrupted and when a block is resent, the amount of data being resent is reduced. Use the \A command to reduce the block size.

Data Compression

Data compression works by creating a table of frequently sent data. A shorter encoded sequence is sent instead of the data. The receiving modem then decodes the sequence.

Communication between the local modem and the computer, of necessity, must take place at a higher rate than

between the local and remote modems, if the throughput is to be kept at its maximum.

The &B1 or \J0 commands should be used to disable the modem to modem/modem to computer speed matching option. Flow control should also be enabled (usually hardware flow control, by using the \Q3 command) to manage the compression and decompression.

Command Cross-Reference

Command	Function
Auto Answer/Auto Logon	
ATSO=1 [Enter←]	Sets modem to auto-answer.
Request Remote Access	
*E, *E0	Remote configuration exit.
*E1	Enables remote access.
*C	Change remote configuration password (must be 6 chars. long). Default=QWERTY.
AT*Pn: password: callback number	Security callback passwords
*R	Enter Remote Configuration Mode in MNP mode. Sends remote configuration request to the other modem with password set in *C. (MNP only)
*X	Exit remote access.
Error Correction	
&F, &F0	Recall factory settings as active configuration. Error Correction Mode, V.42*bis* Configuration⇒ MNP⇒Async
\N, \N0	Set normal mode, no error correction, Speed buffered.
\N1	Set Direct mode, no error correction, No speed Buffering. DTE speed changed to DCE rate after CONNECT message. note: 7200=9600 rate; 14400, 12000=19200 DTE rate.
\N2	Set Reliable mode (MNP only)
\N3	Set Auto-reliable mode (MNP with fallback to normal)
\N4	Set Reliable mode (LAPM only)

Command (cont.)	Function (cont.)
\N5	Set Auto-reliable mode (LAPM fallback to normal)
\N6	Set Reliable mode (LAPM with fallback to MNP)
\N7	Set Auto-reliable mode (LAPM with fallback to MNP then to normal)
&Q5	Error Correction Mode. V.42$\Rightarrow$ MNP$\Rightarrow$Async Fallback
&Q6	Asynchronous Normal mode, Speed buffered (\J0)
&Q7	V.42*bis* mode$\Rightarrow$Async fallback, see \N5
Data Compression	
&U0	Data compression disabled.
&U1	Data compression enabled.
%C, %C0	Data compression disabled.
%C1	Data compression requested (V.42*bis* is LAPM, MNP5 is MNP)
%C2	V.42*bis* compression only.
%C3	MNP 5 compression only.
Flow Control	
&K0	Flow control is off.
&K3	Hardware flow control (RTS/CTS)
&K4	XON/XOFF flow control
&K5	Transparent XON/XOFF flow control
&K6	Hardware and XON/XOFF flow control
\G1	Enable port XON/XOFF flow control, DCE to DCE
\Q, \Q0	Disable flow control.
\Q1	Bidirectional XON/XOFF flow control.

Command (cont.)	Function (cont.)
\Q2	Unidirectional hardware flow control.
\Q3	Birdirectional hardware flow control.
\Q4	Unidirectional XON\XOFF flow control.
\Q5	Unidirectional hardware flow control with CTS off until CONNECT.
\X, \X0	XON/XOFF pass through disabled.
\X1	XON/XOFF pass through enabled.

Glossary

Adaptive Packet Assembly. The process by which MNP-10 automatically adjusts the size of data packets based on the quality of the telephone line. When the line quality is good and there are few retransmissions, packet size increases. When the line quality is poor and retransmissions are frequent, packet size decreases to maintain high throughput.

Adverse Channel Enhancements (ACE). Optimizes performance of the modem when operating under poor line quality conditions.

Analog. A signal which can take on any value within the overall allowable range

Analog loopback with self-test. A local test mode used to test the local serial port and the local computer or terminal.

Analog transmission. Transmission where data is sent as a continuous range of changes in amplitude or frequency. Standard telephone lines use analog transmission.

Answertone. The tone an answering modem emits before carrier is exchanged.

ASCII. Acronym for American Standard Code for Information Interchange. A standard code using 7- (or 8-) bit patterns to transfer data between computers and associated equipment.

Asynchronous. Communication in which the time period between parts of the message may be of unequal or unknown length, and which uses start and stop signals to identify the beginning and end of the bit stream. Data is usually sent using 8 bits of which the most significant may be a parity bit.

AT mode. The state the modem is in when it can accept commands that you enter at the keyboard.

Attention code. The characters AT which tell the modem that a command follows.

Auto-answer mode. The state in which the modem automatically answers the telephone when it rings.

Auto-logon. The host modem executes an auto-logon that allow the remote system to log on.

Auto-reliable mode. The state in which the modem can establish connections with modems that support MNP or LAPM and modems that do not support MNP or LAPM. A protocol connection scheme LAPM-MNP-ASYNC with fallback capability.

AutoSync. In this mode the modem translates the asychnronous data from the computer to BiSync or SDLC (HDLC) on the communications link. Software in the computer must be able to control the modem in this mode.

Baud. A measurement unit which defines the number of bits per second (or signaling units per second when several bits represent a signaling unit) bit a binary digit (0 or 1).

Bit rate. The rate at which information is sent. A unit of measure equal to the number of bits transmitted or received per second. Also called speed or communications rate.

Bps rate adjust. The ability of the modem to adjust its serial port speed automatically to match the connection speed, known as normal or direct mode.

Buffer. A group of memory locations that serve to store data bits temporarily until the system processor can accept and handle them.

Carrier. The frequency exchanged by modems used to transmit and receive data.

Carrier Detect or Data Carrier Detect (CD or DCD). An EIA232 signal sent from the modem to the local computer or terminal, usually indicating that the modem has detected a carrier signal over the communications line.

CCITT. Acronym for the International Telegraph and Telephone Consultative Committee. An international organization that decides upon recommended communication protocol standards .

Cellular network. A RF or radio network in which the overall area to be covered is divided into small cells, each with its own transmitter/receiver, and in which each cell coordinates its activities with those of adjacent cells to allow more users within an available bandwidth.

Central Office. The local telephone exchange that handles all phone lines that have the same three-digit prefix and so handles phone lines -0000 through -9999.

Clear to send (CTS). A handshake line indicating that it is OK to send data.

Connect state. The state the modem is in when transmitting or receiving data over the communications line.

CRC. Acronym for Cyclic Redundancy Check. A method of error-checking used by MNP (based CRC code), where the sender and receiver both perform a polynomial algorithm on each data packet transmitted over the communications line. If the results do not match, a transmission error occurred and the packet is retransmitted.

CTS. Acronym for Clear To Send.

Data communications equipment (DCE). A communications unit designed as the interface between data terminal equipment, such as a computer or terminal, and the data link or modem.

Data compression. A technique that combines duplicate characters and recodes characters based on the frequency and/or order in which they appear, to achieve increased throughput.

Data set ready (DSR). A handshake line using an RS232 signal sent from the modem to the local computer or terminal indicating that the data set is ready to accept new data bits or that the modem is ready to establish a connection.

Data terminal equipment (DTE). A communications end user, such as a terminal or computer.

Data terminal ready (DTR). A handshake line indicating that the data terminal is ready to accept new data bits.

DCD. Acronym for Data Carrier Detect. See CD.

Default setting. A profile that the modem always uses unless specified otherwise.

Demodulation. The process of extracting the information-bearing modulation from the modulated signal.

Dial-up line. A standard Public Telephone Switch Network (PTSN) telephone line, for example, when an ordinary, dialed phone is connected to the telephone central office

Digital. Information which exists with only a specific group of allowed values, in contrast to analog, in which any value can exist within a range.

Digital transmission. Transmission where data is sent as a stream of electrical pulses. Each pulse is an off or on electrical signal that represents a 0 or 1 data bit. Computers and terminals use digital transmission.

Disconnect. To hang up.

Direct mode. The modem will adjust the DTE rate to the DCE rate.

DSR. Acronym for Data Set Ready.

DTR. Acronym for Data Terminal Ready.

Duplex. A communications system which is capable of communicating in both directions can be half duplex or full duplex. Half duplex allows communication in both directions but only one direction at a time, while full duplex allows data to be transmitted in two directions simultaneously.

Dynamic Transmit Level Adjustment. The capability to calculate automatically optimal transmit levels to compensate for cellular telephone signal distortion, MNP10 only.

EIA. Acronym for Electronic Industries Association.

Error correction. A communications protocol which allows errors to be corrected by the receiver once the receiver determines that an error exists.

Error detection. A communications protocol which allows the receiver to determine that the received data bits contain one or more errors.

Escape code. (+++). A series of three consecutive characters preceded and followed by a guard time that is sent to the modem, causing the modem to exit the connect state and enter the command state.

Facsimile. A method of sending printed information by scanning across the page and converting the written lines to digital signals, with a 1 for a dot and a 0 for blank on the page.

Factory default profile settings. The configuration profiles that are in effect when the modem is shipped from the factory.

Flow control. The use of characters or RS232 signals to start and stop the flow of data to avoid data loss during buffering.

Guard tone. A constant tone generated by the answering modem during connections.

Guard time. An interval of time that must be present before the first character and after the last character of the escape code in order for the modem to recognize the escape code and enter command state. Also, the time that precedes and follows the remote access attention character sequence.

LAPM. Acronym for Link Access Procedure for Modems. An HDLC error correction protocol for use with error-correcting modems. Part of the CCITT V.42 protocol.

Leased line. A dedicated, specially conditioned telephone line used for communications.

Link. Any physical path between two subsystems or stages in a communications system.

Local analog loopback with self-test. See analog loopback with self-test.

Local analog loopback. See analog loopback.

Local computer or terminal. The computer or terminal the modem is attached to via the DTE serial port.

Local digital loopback. A test in which any data received by the modem is looped back and sent to the remote modem.

Loopback. A communications test and diagnosis tool which causes the signal as received to be turned back to the sender, at various stages in the system, so the sender can determine whether the message as received agrees with what was sent.

Microcom Networking Protocol (MNP). A data communications protocol that allows error-free interactive communications with a variety of computers or terminals over ordinary voice-grade telephone lines.

MNP reliable link. Communications established with a remote computer or terminal, using only an MNP or LAPM error checking and correction protocol with no fallback.

Modem. MOdulator-DEModulator. A device which permits a computer or terminal to communicate with other computers or terminals over analog telephone lines. The local modem converts digital input (1 and 0 binary voltages) from the local computer or terminal into analog signals, which are then transmitted over the telephone line. The remote modem on the other end of the connection reconverts the analog signals into digital signals, which are then transmitted to the remote computer or terminal.

Modem port. Modem-to-remote system connection. The port through which analog signals are exchanged over the telephone line.

Modulation. The act of impressing a data-or information-bearing signal on a carrier signal for transmission over the medium.

Network. A communications system which interconnects many users who have something in common, either with respect to the type of data being transferred or to the geographic areas that the users cover.

Noise. Unwanted signal disturbances over a communication line, such as variation in voltage or current, that can affect the integrity of data transmitted over the line or cause the loss of connection.

Normal Mode. The modem DTE rate will automatically speed buffer the DCE rate. The DTE rate will not change.

Off hook. The condition which is similar to picking up a telephone receiver and creating the condition in which the phone loop is a completed circuit The modem goes off hook to dial or answer and remains off hook while connected.

On hook. The condition which is similar to hanging up a telephone receiver so the phone loop is an open circuit. You cannot enter the connect state when the modem is on hook.

Online. Connected to a remote system.

Originate modem. The modem that emits carrier in response to an answertone from an answering modem.

Packet switching. A communications protocol used over large distances, in which messages are grouped into packets of various sizes, and each packet is sent by the best way available at that instant. At the receiving end the packets are disassembled and sent to the correct users.

Parity. An error-detection scheme which uses an extra checking bit, called the parity bit, to allow the receiver to determine whether there has been an error in the received data bits. The value of the bit is set so that the sum of the data bits and the parity bit is always either even (for even parity) or odd (for odd parity).

Profile settings. The command and register settings that determine how the modem communicates over the serial port and modem port.

Protocol. A set of rules or parameters for communicating between two computers.

Pulse dialing. Telephone dialing accomplished by sending a series of pulses, which sound like loud clicks. In this kind of dialing, the loop is opened/closed as many times as the number being dialed.

Remote digital loopback with self-test. A test performed using the local modem and a remote modem, that tests the remote modem port, the telephone line, and the local serial and modem ports.

Remote digital loopback. A test performed using the local modem and a remote modem, that tests the remote modem port, the telephone line, the local serial and modem ports, and the local computer or terminal.

Remote system. Any computer or terminal with which you communicate using the modem and a communications line.

Request to send (RTS). A handshake line in which the DTE device tells the modem it can accept new data.

Retrain. A method of re-establishing a better quality connection when the quality of the current connection causes data to be continuously retransmitted.

Result code. A message the modem sends to the local computer or terminal containing information about the state of the last command issued.

RS-232/422/423/485. Standards for serial communications, which define the voltages, currents, data rates, and other factors about the signals to be used, as well as single ended, differential, and multidrop operation.

RTS. Acronym for Request To Send. An RS232 signal sent from the local computer or terminal to the modem, usually indicating that the computer or terminal is ready to begin receiving data from the modem.

Serial port. Modem-to-local system connection. The port through which digital signals are exchanged between the modem and the local computer or terminal.

Start bit. The first bit in asynchronous communications signaling a data word is to follow.

Stop bit. The last bit(s) of an asynchronous transmission, in which the signal goes from space to mark values.

Synchronous. A communications system in which the data flows continuously (clock-driven) and does not use a start/stop protocol, and the receiver must synchronize to the time of the transmitter.

Synchronous data-link control (SDLC). An advanced protocol for synchronous control and management of the data link.

Throughput. The rate at which bits or characters can be sent through a system and can be expressed as bits per second, characters per second, or messages per second.

Tone dialing. A technique for dial and signaling telephone numbers, using precise tone pairs, which is faster and more computer-compatible than pulse dialing: also called DTMF dialing.

Transmitter. A device which sends out data and messages.

Twisted pair. Communications cable made of two wires twisted together to minimize effects of external noise.

XON/XOFF. A handshaking, flow control mechanism that communicates that the device is ready to accept more data. The flow control is embedded into the data stream by using special characters; hence transmit on (XON), transmit off (XOFF). Often referred to as software flow control.

Appendixes

These Appendices list all the commands recognized by the Apex modem and group these commands according to the modem's function as follows:

Appendix A: **AT Commands by lead-in character:**

    1) no leadin character;

    2) "&";

    3) "\";

    4) "%";

    5) "*";

    6) "-";

    7) MNP; and

    8) Caller ID.

Appendix B: **Modem S Registers:**

    1) Standard Registers and

    2) Nonstandard Registers;

Appendix C: **Modem Response Codes:**

    1) Result Codes and

    b) Negotation Progress Codes; and

Appendix D: **FAX command set.**

Appendix A

AT Commands

NOTE: *With the exception of the A/ command (repeat last command), all of the commands listed below must be preceded by the letters "AT."*

NOTE: *Entering a command without a value has the same effect as entering a command with zero (0) as the value.*

NOTE: *In the tables of commands given in this appendix, default command settings are given in bold.*

AT Commands with no lead-in character	
Command	Description
=	Write last accessed S register (AT=nnn)
?	Read last accessed S register (AT?)
A/	Repeat last command, no 'AT' precedes this command
A	Go off-hook in ANSWER mode
B, B0	CCITT V.22 mode when at 1200bps;V.21 at 300bps
B1	**Bell 212A mode when at 1200bps; Bell 103 at 300bps**
C1	Normal TX carrier switching (responds OK); has no effect, for Hayes compatibility
D	Dial number that follows D in command line
	L Redial last number
	P Pulse dialing
	T Tone dialing
	R Reversed, Originate will answer, vice versa

AT Commands with no lead-in character (Continued)	
Command	Description
	S=n Dial stored number n
	! Flash for time specified in S29
	W Wait for dial tone, time in S6
	@ Wait for silence, 5 seconds
	, Pause for time in S8
	; Return to command state
	^ Disable, enable calling tone
E, E0	Disable character echo to terminal in command mode
E1	**Enable character echo to terminal in command mode**
F, F0	Select Line Modulation, Auto-detect mode, connect at highest speed. See N command, and S37 register
F1	300 Baud Carrier, either V.21 or Bell 103 set by B command
F2	Reserved
F3	V.23 Line Carrier, Originate = 75 Bps, Answer = 1200 Bps
F4	1200 Baud Carrier, either V.22 or Bell 212 set by B command
F5	2400 Baud Carrier, V.22bis
F6	4800 Baud Carrier, V.32bis or V.32 according to modem capabilities
F7	7200 Baud Carrier, V.32bis at 7200
F8	9600 Baud Carrier, V.32 or V.32bis according to modem capabilities
F9	12000 Baud Carrier, V.32bis
F10	14400 Baud Carrier, V.32bis
H, H0	Go on-hook (hang up)
H1	Go off-hook
I, I0	Display product ID code
I1	Return checksum on ROM
I2	Return OK/ERROR on RAM checksum
I3	Return Firmware Revision

AT Commands with no lead-in character (continued)	
Command	Description
I4	Return Manufacturer's test string
I5	Return Country Code
I6	Return Data Pump type
L, L0	Lowest speaker volume
L1	Low speaker volume
L2	**Medium speaker volume**
L3	High speaker volume
M, M0	Speaker off
M1	**Speaker on until carrier detect**
M2	Speaker always on
M3	Speaker on only while answering
N, N0	Connection speed set to that set in S37; if S37 = 0, DCE rate equals last DTE rate, or AT command
N1	**Connection speed set to highest possible DCE rate, Automode**
O, O0	Return to on-line data mode from on-line command mode
O1	Go on-line and initiate retrain (2400 bps or higher)
P	Pulse dialing
Q, Q0	**Modem returns result codes (Quiet disabled)**
Q1	Modem does not return result codes (Quiet enabled)
Sr=n	Set register 'r' to value 'n'
Sr?	Show value in register 'r'
T	**Tone Dialing**
V,V0	Short form result codes (Verbose disabled)
V1	**Full-word result codes (Verbose enabled)**
W0	Negotiation progress codes disabled. Result code is DTE rate.

AT Commands with no lead-in character (Continued)	
Command	Description
W1	Negotiation progress codes enabled. \V setting is ignored. Hayes 4 line format, Carrier, Protocol, Compression, DTE rate.
W2	**Negotiation progress codes disabled. Result code is DCE rate.**
X, X0	Smartmodem 300 compatible; CONNECT result code enabled.
X1	Modem ignores dialtone and busy, CONNECT nnnn result code enabled.
X2	Modem ignores busy, CONNECT nnnn result code enabled.
X3	Modem ignores dialtone, CONNECT nnnn result code enabled.
X4	**Modem recognizes dialtone and busy, CONNECT nnnn result code enabled.**
Y, Y0	**Disable long-space disconnect**
Y1	Enable long-space disconnect
Z, Z0	Reset modem and recall User Profile 0
Z1	Reset modem and recall User Profile 1

AT "&" Commands

The following commands begin with "&" as indicated:

AT "&" Commands	
Command	Description
&B0	DTE speed equals line speed (\J1)
&B1	**Disable port rate adjust. Serial port is independent of the connection. NORMAL connection (\J0).**
&C, &C0	Carrier always ON, DCD
&C1	**Carrier Detect follows data carrier**
&D, &D0	Modem ignores DTR
&D1	Go to command mode on ON-to-Off DTR transition
&D2	**Hang up & go to command mode on On-to-Off DTR transition. DTR off does not allow an incoming call.**
&D3	Reset (ATZ) on On-to-Off DTR transition, causes modem to Hang up
&D4	Deliver all buffered data before disconnecting on On-to-Off transition of DTR, S21 = &D2, S38 = 255 (send all data)
&E0	Disable auto retrain
&E1	**Enable auto retrain, Fall back**
&E2	Enable Fall Back, Fall Forward
&F, &F0	Recall factory settings as active configuration. Error Correction Mode, V.42 bis Configuration $\Rightarrow$ MNP $\Rightarrow$ Async
&F1	Recall second factory settings as active: MNP format $\Rightarrow$ Async
&F2	Recall third factory settings as active, Async modem. Standard modem with no error correction protocols.
&G, &G0	**No guard tones**
&G1	550 Hz guard tone
&G2	1800 Hz guard tone

AT "&" Commands (Continued)	
Command	Description
&J, &J0, &J1	RJ11 telco jack (not used)
&K0	Flow control is off
&K3	**Hardware flow control (RTS/CTS)**
&K4	XON/XOFF flow control
&K5	Transparent XON/XOFF flow control
&K6	Hardware and XON/XOFF flow control
&L, &L0	Standard switched line
&L1	Leased line
&M0	**Asynchronous mode, See &Q0**
&M1, M2, M3	See &Q1, Q2, Q3 Sync mode (ignored)
&N, &N0	Normal numeric result codes displayed, Hayes format
&N1	**Microcom QX/4232hs-compatible numeric result codes displayed**
&N2	Rockwell numeric result codes displayed. Also allows forced messages enabled in S95
&On	Negation Buffer control, see \Cn, n=0..2
&P, &P0	**Pulse dial make-break 39% / 61%**
&P1	Pulse dial make-break 33%/ 67%
&Q0	Asynchronous mode (same as &M0)
&Q1	Synchronous mode 1 (ignored)
&Q2	Synchronous mode 2 (ignored)
&Q3	Synchronous mode 3 (ignored)
&Q4	Hayes AutoSync mode
&Q5	**Error Correction Mode.V.42 $\Rightarrow$ MNP $\Rightarrow$ Async Fallback**
&Q6	Asynchronous Normal mode, Speed buffered (\J0)
&Q7	V.42bis mode $\Rightarrow$ Async fallback, see \N5
&R0	CTS follow RTS with S26 delay, per V.25bis Specification

AT "&" Commands (continued)

Command	Description
&R1	**CTS always on, Unless Hardware Flow Control**
&S0	**DSR is always on**
&S1	DSR is FALSE until CONNECT
&T, &T0	Terminate test
&T1	Initiate local analog loopback test (transmit and receive in low channel)
&T3	Initiate local digital loopback test
&T4	**Grant request from remote for remote digital loopback test**
&T5	Deny request from remote for remote digital loopback test
&T6	Initiate remote digital loopback test
&T7	Initiate remote digital loopback with self-test
&T8	Initiate local analog loopback with self-test
&U0	Data compression disabled
&U1	**Data compression enabled**
&V	View active configuration, profiles (0,1), and numbers
&W, &W0	Save active configuration as User Profile 0
&W1	Save active configuration as User Profile 1
&Y, &Y0	**Recall User Profile 0 on power-up**
&Y1	Recall User Profile 1 on power-up
&Zn=x	Store phone number 'x' in directory entry n (n = 0...19, x = 40 character max)
&Zn?	Display phone number stored in position n

AT "\" Commands

The following commands begin with "\" as indicated:

AT "\" Commands	
Command	Description
\A,\A0	Maximum MNP block size = 64 characters
\A1	Maximum MNP block size = 128 characters
\A2	Maximum MNP block size = 192 characters
\A3	**Maximum MNP block size = 256 characters**
\Bn	Send a n*100 msec. BREAK to remote; default is 300msec. n = 0...9
\F	Display Phone Number at locations, n=0...19. Phone number saved with AT&Zn= command
\G, \G0	**Disable port flow control DCE to DCE**
\G1	Enable port XON/XOFF flow control, DCE to DCE
\J,\J0	**Disable port rate adjust. Serial port is independent of the connection. NORMAL connection.**
\J1	Enable port rate adjust. After a connection is made, the serial port adjusts to the rate of the connection. Same as a DIRECT connection.
\K, \K0	BREAK from DTE = Enter command mode, do not transmit BREAK
	BREAK Command = Purge buffers and transmit BREAK
	BREAK from remote = Purge buffers, relay BREAK to DTE
\K1	BREAK from DTE = Purge buffers, transmit BREAK
	BREAK Command = Purge buffers and transmit BREAK

AT "\" Commands (continued)	
Command	Description
	BREAK from remote = Purge buffers, relay BREAK to DTE
\K2	BREAK from DTE = Enter command mode, do not transmit BREAK
	BREAK Command = Transmit BREAK immediately
	BREAK from remote = relay BREAK to DTE immediately
\K3	BREAK from DTE = Transmit BREAK immediately
	BREAK Command = Transmit BREAK immediately
	BREAK from remote = relay BREAK to DTE immediately
\K4	BREAK from DTE = Enter command mode, do not transmit BREAK
	BREAK Command = Transmit BREAK in sequence with data
	BREAK from remote = relay BREAK to DTE in sequence with data
\K5	**BREAK from DTE = Transmit BREAK in sequence with data**
	BREAK Command = Transmit BREAK in sequence with data
	BREAK from remote = relay BREAK to DTE in sequence with data
\L,\L0	**MNP stream link**
\L1	MNP block link
\N, \N0	Set normal mode, no error correction, Speed buffered
\N1	Set Direct mode, no error correction, No speed Buffering. DTE speed changed to DCE rate after CONNECT message. note: 7200 = 9600 rate; 14400,12000 = 19200 DTE rate

AT "\" Commands (Continued)	
Command	Description
\N2	Set Reliable mode (MNP only)
\N3	Set Auto-reliable mode (MNP with fallback to normal)
\N4	Set Reliable mode (LAPM only)
\N5	Set Auto-reliable mode (LAPM fallback to normal)
\N6	Set Reliable mode (LAPM with fallback to MNP)
\N7	**Set Auto-reliable mode (LAPM with fallback to MNP then to normal)**
\Q, \Q0	Disable flow control
\Q1	Bidirectional XON/XOFF flow control
\Q2	Unidirectional hardware flow control
\Q3	**Bidirectional hardware flow control**
\Q4	Unidirectional XON/XOFF flow control
\Q5	Unidirectional hardware flow control with CTS off until CONNECT
\Q6	Bidirectional hardware flow control with CTS off until CONNECT
\S	Display current Configuration, Long Version
\Tn	Inactivity timer (0-90 minutes) default=0, disabled
\V, \V0	Disable /REL connect codes
\V1	**Enable /REL connect codes**
\V2	Enable MNP or LAPM
\X,\X0	**XON/XOFF pass through disabled**
\X1	XON/XOFF pass through enabled

AT "%" Commands

The following commands begin with "%" as indicated:

AT "%" Commands	
Command	**Description**
%Bn	Maximum modem port rate, bps; n=300, 1200, 2400, 4800, 9600; 7200, 12000, 14400 with V.32bis option. See %G
%C, %C0	Data compression disabled
%C1	**Data compression requested (V.42Bis in LAPM, MNP5 in MNP)**
%C2	V.42bis compression only
%C3	MNP 5 compression only
%Dn	**Delay to clear the receive buffer before hang up.** n = number of seconds to wait for buffer to clear. same as S38, default = 20. If S38=255, the modem will empty all data before hang up. Set to 255 by &D4.
%E, %E0	Disable Auto-retrain, See &En
%E1	**Enable Auto-retrain, Fall back**
%E2	Enable Fall Back, Fall Forward retrain
%G0	**Reset %Bn to disabled mode, DCE carrier is highest possible or set according to F command or S37 and N commands.**
%G1	Set %Bn to current DTE rate.%Bn is enabled by %G1 or by %Bn
%L	Report Line Signal Level, in -DBm
%Q	Report Line Signal Quality
%R	Display all S registers
%V	Display firmware version

AT "*" Commands

The following commands begin with "*" as indicated:

AT "*" Commands	
Command	Description
*C	Change remote configuration password, MUST BE 6 CHARS. LONG. Default = QWERTY
*E, *E0	Remote Configuration exit
*E1	Enable Remote Configuration access, four '*' from remote modem allows entry, *E will exit. RCM is not stored, must be configured for use each time.
*H0	**MNP10, Link negotiation occurs at highest speed**
*H1	Link negotiation occurs at 1200 bps
*H2	MNP10, Link negotiation occurs at 4800 bps
*L	List callback directories 0...19, see *P and callback
*NCn	Change Country Code to n, Not available in North America version.
*Pn: word: number	Set Password for logon or callback security. Enable by -S command. n = position to save password, 0...19. word = PASSWORD, length = 6 (min.) to 12. Number = Call back number, if empty then logon access only. If Security is enabled and all callback entries are empty, the modem will not allow any incoming passwords and hang up.
*R	Enter Remote Configuration Mode in MNP mode. This mode sends a remote configuration request to the other modem with your password set in *C. MNP only!!!
*X	Exit remote configuration

AT "-" Commands

The following commands begin with "-" as indicated:

AT "-" Commands	
Command	Description
-B	MNP10, Initiate fallback to next lowest speed
-C0	**MNP10, Class 10 selection, synchronous**
-C1	MNP10, Class 10 selection, asynchronous
-C2	MNP10, Class 3 selection
-C3	MNP10, Class 2 selection
-J0	Disable V.42 handshake detection phase
-J1	**Enable V.42 handshake detection phase**
-K0	MNP10, Disable MNP 10 extended services
-K1	**MNP10, Enable MNP 10 extended services**
-K2	MNP10, Enable MNP 10 extended services without MNP indication during answer detect phase.
-Q0	MNP10, disable fallback modulation speed
-Q1	**MNP10, Enable fallback to 2400 Bps or 1200 Bps**
-S0	**Disable Security for logon and callback**
-S1	Enable Security for logon and callback
-S2	Save current Security settings in Profile (nvram)
-Un	MNP10, Initiate fall forward to next highest speed

AT "MNP" and "Caller ID" Commands

The following commands configure MNP and Caller ID:

AT "MNP" and "Caller ID" Commands	
Command	Description
)M0	**MNP10, Disable power level adjustments**
)M1	MNP10, Enable power level adjustments. For use on cellular telephones only.
@M0	**MNP10, Initial transmit level is fixed, for cellular tel. only**
@M1	MNP10, Initial transmit level is last used, for cellular tel. only
#CID=0	**Disable caller ID**
#CID=1	Enable caller ID, formatted presentation
#CID=2	Enable caller ID, unformatted presentation

Appendix B

Modem S Registers:

Standard and Non-Standard

Standard Modem S Registers are described first, followed by Non-Standard S Registers.

Standard Modem S Registers		
Reg-ister	De-fault	Description
0	0	Ring to answer on
1	0	Rings currently counted
2	43	Escape character (+) (ASCII value in decimal), disabled if value is greater than 127.
3	13	Carriage Return <CR> character code (ASCII value in decimal)
4	10	Line Feed <LF> character code (ASCII value in decimal)
5	08	Back Space <BS> character code (ASCII value in decimal)
6	02	Seconds to wait before blind dialing
7	50	Seconds to wait for carrier. Tenths of a second to wait for silence in '@' dial modifier.
8	02	Seconds to delay for comma (,) dial modifier
9	06	Tenths of seconds to determine whether CD is true.
10	14	Tenths of seconds to detect lost carrier before hang up.
11	95	Duration and spacing of DTMF tones, in milliseconds

Standard Modem S Registers (Continued)		
Register	Default	Description
12	50	Escape sequence guard time, in 1/50 of a second. Default = 1 sec.
14	138	Read Only bit mapped register:
		Bit 1 - command echo, En = 1; Bit 2 - result codes, Qn = 0; Bit 3 - verbose, Vn = 1; Bit 4 - reserved; Bit 7 - answer (0), originate (1) mode = 1
16	00	Read Only bit mapped test register:
		Bit 0 - Local Analog Loop, &T1; Bit 2 - Local Digital Loop, &T3; Bit 3 - Local modem in RDL, &T4-&T5; Bit 4 - RDL initiated, &T6; Bit 5 - RDL with self-test initiated, &T7;
18	00	Modem test timer (seconds), for &T7, &T8
		0 = test forever.
19	16	AutoSync Protocol Support Mode
		Bit 1 - 0 = BSC, 1 = SDLC
		Bit 2 - SDLC address enable
		Bit 3 - NRZI, NRZ mode
		Bit 4 - SDLC idle on Mark (0), or Flag (1)
20	32	AutoSync Sync/Address Character (ASCII value in decimal)
21	00	Read Only bit mapped options: RS232 control
		Bit 0 - Telco Jack, &J
		Bit 1 - Status of &D4, clear buffers before hang up
		Bit 2 - CTS options, &R
		Bits 3,4 - DTR options, &D0..3
		Bit 5 - DCD options, &C
		Bit 6 - DSR options, &S
		Bit 7 - Long space disconnect options, Y
22	52	Read Only bit mapped options:
		Bits 0,1 - Speaker volume options, L = 2

Standard Modem S Registers (Continued)		
Reg- ister	De- fault	Description
		Bits 2,3 - Speaker control options, M = 1
		Bits 4-6 - Result code options, X0..4 = 4
		Bit 7 - Pulse dial options, &P = 0
23	59	Read Only bit mapped options:
		Bit 0 - Enable RDL, &T4, &T5 = 1
		Bits 1-3 - DTE baud rate = 5
		0 = 300; 1 = 600; 2 = 1200; 3 = 2400; 4 = 4800; 5 = 9600; 6 = 19200; 7 = 38400 and above; Bits 4-5 - DTE parity = 0; Bits 6-7 - Guard tone options, &G = 0
24	05	Sleep Inactivity Time, time to go into Low Power mode. Measured in seconds, default = 5 seconds.
25	05	DTR transition detect timer (.01 seconds)
26	01	Time delay from RTS true to CTS true (non-MNP modes). (.01 seconds)
27	73	Read Only bit mapped options:
		Bits 0,1,3 Sync, Async Mode, &Mn/&Qn = 5
		0,0 = &M0, &Q0 = Async mode
		1,0 = &M1, &Q1 - Disabled
		2,0 = &M2, &Q2 - Disabled
		3,0 = &M3, &Q3 - Disabled
		0,1 = &Q4 = Auto-Sync Mode
		1,1 = &Q5 = Error Correction Mode
		2,1 = &Q6 = Async normal mode
		Bits 2 - Leased line, &L = 0
		Bits 4,5 - Internal clock source, &Xn =0
		Bits 6 - CCITT, Bell options, B = 1
		Bits 7 - MNP10, Initial transmit level, @M = 0

The following are the Non-Standard Modem S Registers:

Non-Standard Modem S Registers		
Reg-ister	De-fault	Function
28	0	Bit Mapped
		Bits 3,4 - Pulse mode, &P = 0
		Bits 6,7 - MNP10, negotiation speed, *H = 0
29	70	Flash Timer in .01 seconds, used by '!' dial modifier
30	0	Disconnect Inactivity timer, \T in minutes, 0 = disable.
31	202	Bit mapped, Speed and Result control
		Bits 1 - Automode detect, N (0 ⇒ S37) = 1
		Bits 2,3 - extended result code, W = 2
		Bits 4,5 - call ID, #CID = 0
		Bits 6,7 - Reserved = 3
32	17	XON Character used in flow control
33	19	XOFF Character used in flow control
36	7	LAPM failure control, fallback options
		0 = disconnect, \N4
		1 = direct mode attempt, \N5, \J1
		2 = reserved
		3 = normal mode attempt, \N5, \J0
		4 = MNP only attempt, \N6
		5 = MNP, then direct mode attempt, \N7, \J1
		6 = reserved
		7 = MNP, then normal mode attempt, \N7, \J0
37	0	DCE Speed Desired, Ignore if N1 mode (goto highest)
		Related to F command
		0- Last AT command DTE rate, F0
		1-300, F1; 2-300; 3-300; 4-reserved

Reg- ister	De- fault	Function
		5-1200, V.22 or Bell 212, F4
		6-2400, V.22bis, F5; 7-V.23, 1200/75, F3
		8-4800, F6; 9-9600, V.32 TCM, F8
		10-12000, V.32bis, F9; 11-144000, V.32bis,F10; 11-144000, V.32bis, F10
		12-7200, V.32bis, F7
38	20	Delay before forced Hang up, 0...255 seconds. Default 0 = disabled, 255 = Empty buffers before hangup.
39	3	Bit mapped flow control
		Bits 0...2 - Flow control, &K
		0 = none
		3 = RTS/CTS hardware flow, &K3 = default
		4 = XON/XOFF software flow, &K4
		6 = XON/XOFF software flow, &K5
		5 = Both RTS/CTS, XON/XOFF, &K6
		Bits 7 - XON/XOFF pass through, \Xn
40	233	Bit mapped, MNP control
		Bits 0,1 - MNP10, extended service, -K = 1
		Bits 2 - MNP10, cellular power adjust,)M = 0
		Bits 3..5 - Break control, see \K = 5
		Bits 6,7 - MNP block size, **\A = 3**
		0 = 64 bytes; 1 = 128 bytes; 2 = 192 bytes; **3 = 256 bytes**
41	135	Bit Mapped, Compression, Retrain
		Bits 0,1 - Compression control, %C = 3
		0 = None, %C0
		1 = MNP5 only, %C3
		2 = V.42bis only, %C2
		3 = Both V.42bis, MNP5, %C1
		Bits 2 - Retrain enable, %E0-1 = 1

Non-Standard Modem S Registers (Continued)

Non-Standard Modem S Registers (Continued)		
Reg- ister	De- fault	Function
		Bits 3 - Remote flow, \G = 0
		Bits 4 - MNP stream, block link, \L = 0
		Bits 5 - DTE rate change, \J = 0
		Bits 6 - Fallback, fall forward enable, %E2 = 0
		Bits 7 - MNP10, allow fall back, -Q = 1
46	138	V.42bis Data Compression Control
		136 = Execute error correction with no compression.
		138 = Execute error correction with compression.
48	7	V.42 Negotiation Action
		0 = Disable negotiation, proceed with LAPM (not recommended)
		7 = Enable negotiation
		128 = Disable negotiation, proceed with action in S36.
86	0	Disconnection Cause response (read only)
		0 = Normal disconnect, no error
		4 = Lost of carrier
		5 = V.42 negotiation failed a reliable connect
		9 = Modems could not find a common protocol
		12 = Normal disconnect from remote modem
		13 = Remote modem does not respond after 10 re-transmissions
		14 = Protocol violation
91	10	PSTN Transmit level, not adjustable in North America version
92	10	Fax Transmit level, same as S91
95	2	Extended Result code control

Non-Standard Modem S Registers (Continued)		
Reg- ister	De- fault	Function
		Bits 0 - Force DCE instead of DTE for Connect message
		Bits 1 - Append /REL to CONNECT message, \V0-1 = 1
		Bits 2 - Force Carrier XXXX result code
		Bits 3 - Force Protocol XXXX result Code
		Bits 4 - Append -MNP, -LAPM to CONNECT message, \V2
		Bits 5 - Force Compression message on
		Bits 6 - numeric results type Microcom, Hayes
		Bits 7 - numeric results type Rockwell

Appendix C

Modem Responses:

Result Codes and Negotiation Progress Codes

This appendix lists result codes and negotiation progress codes returned by the modem in response to commands entered. Numeric responses are given in the following order:

Line 1 = Rockwell, Hayes, Microcom for \V0
Line 2 = Rockwell, Hayes, Microcom for \V1 or \V2
\V1 will add /REL
\V2 will add /REL - MNP, /REL - LAPM

Three additional commands reflecting: **display form** ("V" commands), **modem chipset compatibility** ("&N"), and **type of progress code/transmission speed** ("W") are reported as follows:

Display Form

Two levels of "V" commands specify the form in which all codes are displayed, and the tables that follow are organized accordingly:

       "numeric" (V0 = Numeric form);
       "verbose" (V1 = Verbose [English long form])

Modem Manufacturer Compatibility

For codes displayed in **numeric** form, an associated "&N" command specifies whether these codes are compatible with:

Hayes standards = &N0;
Microcom QX/4232hs standards = &N1; or
Rockwell ACL standard = &N2

Type of Negotiation Progress Code/Transmission Speed

For **negotiation progress codes**, an associated "W"
command determines the type of negotiation progress codes
displayed:
DTE connect rate is displayed by a W0 command
The four line modes of **Carrier, Protocol, Compression,
DTE connect rate** are displayed by a W1 command
DCE connect rate is displayed by a W2 command
Whether **Force bits were optionally set in S95** will be
reflected by a result code displayed by a W0 or W2
command.

The modem will report the **proper DTE rate** in W1, W2
mode. "PC" UART software usually does not support
transmission speeds of 7200, 12000, and 14400 bps.
Therefore, for Direct Connections, \N1, \J1: DTE = DCE
rate:
7200 = 9600 bps
12000 = 19200 bps
14400 = 19200 bps

Refer to Appendix A for the "X" command that will affect
result codes.

Result Codes

The following table lists the Result Codes recognized by the modem.

Result Codes		
Numeric	Verbose	Description
0	OK	Command executed
1	CONNECT	Connection if X0 selected, otherwise connection at 0-300 bps.
2	RING	Ring signal detected
3	NO CARRIER	Carrier signal not detected or lost
4	ERROR	Invalid command, or error detected.
5	CONNECT 1200	Connection at 1200 bps. Disabled by X0.
		See below for /REL, and V.23 RESULTS.
6	NO DIALTONE	No dialtone detected. Enabled by X2, X4.
7	BUSY	Busy detected. Enabled by X3 or X4.

Result Codes (Continued)		
Numeric	Verbose	Description
8	NO ANSWER	No silence detected when dialing a system not providing dialtone. Enabled by @ dial modifier.
9,21,21	CONNECT 600/REL	MNP, V.42 \V1 or \V2
10,10,10	CONNECT 2400	Connection at 2400 bps.
10,23,10	CONNECT 2400/REL	MNP, V.42 \V1 or \V2
11,11,30	CONNECT 4800	Connection at 4800 bps.
11,24,31	CONNECT 4800/REL	MNP, V.42 \V1 or \V2
12,12,32	CONNECT 9600	Connection at 9600 bps.
12,26,33	CONNECT 9600/REL	MNP, V.42 \V1 or \V2
13,34,40	CONNECT 7200	Connection at 7200 bps
13,37,33	CONNECT 7200/REL	MNP, V.42 \V1 or \V2
14,35,32	CONNECT 12000	Connection at 9600 bps.
14,38,33	CONNECT 12000/REL	MNP, V.42 \V1 or \V2

Result Codes (Continued)		
Numeric	Verbose	Description
15,13,34	CONNECT 14400	Connection at 14400 bps.
15,39,35	CONNECT 14400/REL	MNP, V.42 \V1 or \V2
16,14,36	CONNECT 19200	Connection at 19200 bps.
16,27,37	CONNECT 19200/REL	MNP, V.42 \V1 or \V2
17,15,38	CONNECT 38400	Connection at 38400 bps.
17,28,39	CONNECT 38400/REL	MNP, V.42 \V1 or \V2
18,16,42	CONNECT 57600	Connection at 57600 bps.
18,29,43	CONNECT 57600/REL	MNP, V.42 \V1 or \V2
19,17,46	CONNECT 115200	Connection at 115200 bps.
19,30,47	CONNECT 115200/REL	MNP, V.42 \V1 or \V2
1,20,20	CONNECT/REL	Error protected connection at 300bp
5,22,22	CONNECT 1200/REL	MNP, V.42 \V1 or \V2
Note, V.23 will appear as a 1200 bps connect.		
22,5,5	CONNECT 75tx/1200rx	Connect V.23 Originate

Result Codes (Continued)		
Numeric	Verbose	Description
22,22,22	CONNECT 75tx/1200rx/REL	MNP, V.42 \V1 or \V2
23,5,5	CONNECT 1200rx/75tx	Connect V.23 Answer
23,22,22	CONNECT 1200rx/75tx/REL	MNP, V.42 \V1 or \V2
33	FAX	Detected a Fax connection
34	+FCERROR	Fax connection error
35	DATA	Detected a data carrier in Fax mode.

Negotiation Progress Codes

The following table lists the negotiation progress codes recognized by the modem. These codes are displayed by the W1 command.

Negotiation Progress Codes		
Numeric	Verbose	Description
40	CARRIER 300	Carrier detected at 300 bps.
44	CARRIER 1200/75	Transmit at 1200 bps, receive at 75 bps.
45	CARRIER 75/1200	Transmit at 75 bps, receive at 1200 bps.
46	CARRIER 1200	Carrier detected at 1200 bps.
47	CARRIER 2400	Carrier detected at 2400 bps.
48	CARRIER 4800	Carrier detected at 4800 bps.
49	CARRIER 7200	Carrier detected at 7200 bps.
50	CARRIER 9600	Carrier detected at 9600 bps.
51	CARRIER 12000	Carrier detected at 12000 bps.
52	CARRIER 14400	Carrier detected at 14400 bps.
66	COMPRESSION: CLASS5	MNP compression negotiated.
67	COMPRESSION: V42BIS	V.42bis compression negotiated.

Negotiation Progress Codes (Continued)		
Numeric	Verbose	Description
69	COMPRESSION: NONE	No compression negotiated.
70	PROTOCOL: NONE	Asynchronous mode
77	PROTOCOL: LAPM	V.42 LAP-M
80	PROTOCOL: ALT	Alternative protocol (MNP)
81	PROTOCOL: ALT - CELLULAR	MNP10 PROTOCOL

Appendix D

Telephone Company/FCC

The following regulations apply to modems used within the United States and Canada.

FCC Regulations

- The FCC has established rules that permit this device to be directly connected to the telephone network, using a standardized jack. Do not use this equipment on a party line or coin line.
- Malfunctioning equipment may cause damage to the telephone network. If this device is not functioning properly, disconnect it until the problem has been determined and the device has been repaired. Otherwise, the telephone company may temporarily disconnect service.
- Repair of the modem can only be carried out by APEX DATA, INC. It is the responsibility of the user to report the need for any service to the device to APEX DATA, INC. or to one of our authorized agents. Service can be obtained by calling: 510-803-2020.
- If you encounter any problems with your telephone after installing any new device, disconnect it from the telephone line to see if the device is the source of the problem.
- The telephone company may make changes to its technical operations and procedures. It such changes affect the compatibility or use of this device, the telephone company is required to provide adequate notice of the changes.
  This device complies with Part 15 & 68 FCC rules. Operation is subject to the following conditions:
  1) This device may not cause harmful interference.
  2) This device must accept any interference received, including interference that may cause undesired operation.

Phone Company Requests

If the telephone company requests information about the equipment connected to their lines, inform them of:

1. The telephone number to which the device is connected.
2. The ringer equivalence number (REN), which is found on the FCC sticker attached to the device The REN determines how many devices may be connected to the same telephone line. If too many devices are attached, they may not ring properly. In most areas, the sum of the ringer equivalence numbers of all devices connected to the same line should not exceed five.
3. The USOC telephone jack required (RJ11, RJ41, or RJ45).
4. The FCC registration number, which is found on the FCC sticker attached to the device.

Interference

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, it not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

However, where is no guarantee that interference will not occur in a particular installation. In this equipment does

cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient the receiving antenna.
- Relocate the receiving antenna and/or equipment away from the modem.
- Relocate the modem away from the receiving antenna and/or equipment.
- Plug the modem into a different outlet so that the modem and the receiving equipment are on different electrical circuits.

If none of these actions resolves the problem, consult your distributor or an experienced radio/television technician for additional suggestions.

Shielded Cables

This product has been tested and found to comply with the FCC limits for a Class B computing device. The testing was done with the use of shielded cables. The use of any cable other than the shielded type will allow your system to emit more radio frequency interference than the FCC limits, thereby increasing the likelihood of interference. Therefore, in order to comply with the FCC regulations, it is necessary that you use good quality shielded cables with your installation.

Canadian Requirements

The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that their local telecommunications company permits connecting

it to their facilities. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with single line, individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure, for their own protection, that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Users should not attempt to make such connections themselves, but should contact electric inspection authorities or electricians, as appropriate.

To prevent overloading, a Load Number (LN) has been assigned to each terminal device to denote the percentage of the total load to be connected to a telephone loop which is used by the device. The termination on a loop may consist of any combination of devices subject only to the requirement that the total number of devices not exceed one hundred.

Canadian EMI Limits

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the

Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class B prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada

ASCII

DEC	HEX	Char	Meaning	
0	00	NUL	Null (nothing; idle)	
1	01	SOH	Start of Heading	
2	02	STX	Start of Text	
3	03	ETX	End of Text	
4	04	EOT	End of Transmission	
5	05	ENQ	Enquiry or Who Are You	
6	06	ACK	Acknowledged	
7	07	Bell	Bell or Alarm	
8	08	BS	Backspace	
9	09	HT	Horizontal Tabulation	
10	0A	LF	Line Feed	
11	0B	VT	Vertical Tabulation	
12	0C	FF	Form Feed	
13	0D	CR	Carriage Return	
14	0E	SO	Shift Out	

15	0F	SI	Shift In
16	10	DLE	Data Link Escape
17	11	DC1	Device Control #1
18	12	DC2	Device Control #2
19	13	DC3	Device Control #3
20	14	DC4	Device Control #4
21	15	NAK	Not Acknowledged
22	16	SYN	Synchronize
23	17	ETB	End Transmission Block
24	18	CAN	Cancel
25	19	EM	End of Medium
26	1A	SUB	Substitute
27	1B	ESC	Escape
28	1C	FS	File Separator
29	1D	GS	Group Separator
30	1E	RS	Record Separator
31	1F	US	Unit Separator
32	20	SP	Space
33	21	!	Exclamation point
34	22	"	Double Quote