CH1782 — V.22 bis/2400 bps
CH1782SF — With Send Fax
Ultra Small Modem Module

INTRODUCTION

The CH1782 is the smallest full function 2400 bps modem component that is FCC Part 68 approved. It offers a fast and easy way to integrate a modem into an OEM product while utilizing a minimum amount of PCB space and having only an 0.50" height. The modem component has two interfaces, a CCITT V.24 serial interface that can be routed directly to a UART and the Tip and Ring signal which goes directly to an RJ11 jack for telephone line connection. The modem can be controlled with industry standard AT commands and is hence compatible with available industry communication software.

The CH1782 supports asynchronous and synchronous operations at 2400 bps and 1200 bps, and asynchronous operation at 300 bps to Bell and CCITT standards.

The resident telephone line interface, or Data Access Arrangement (DAA), while being FCC approved, is also Canadian DOC approvable and can be approved in other international countries that require 1000 VAC isolation.

The CH1782 operates off a loosely regulated single 5 volt supply. The low power operation and automatic standby mode make it ideal for portable equipment, which is further enhanced by its small size.

The CH1782SF is identical to the CH1782 but contains the ability to communicate at 9600 bps in a Send Fax mode. The CH1782SF supports additional AT commands that initiate the Send Fax operation when used with appropriate Fax software. See Table 3A and Table 7.

GENERAL DESCRIPTION

Figure 1 is a functional block drawing of the CH1782. The CH1782 is a highly integrated, full function modem, comprised of a modulator/demodulator, control, and an FCC Part 68 approved telephone interface, also called a Data Access Arrangement (DAA).

Modulation/Demodulation and Control

This Functional Block is comprised of a monolithic modem integrated circuit, with built-in facilities to accommodate integrated "AT" command control and resident interfaces for general communication and routing to an appropriate DAA.

DAA

The CH1782 is designed to meet North American telephone standards as set by FCC Part 68 and DOC. The telephone line interface is designed to meet 1000 VAC and 1500 volt peak surge isolation, among other parameters. As such it will meet U.S. and Canadian requirements and other international requirements that specify that level of isolation. Cermetek manufactures other modules that meet more stringent international requirements. The CH1782 comes with the FCC Part 68 approval; a label is provided with the registration number and ringer equivalent. This label should be prominently displayed. As with most countries, except the U.S., Canada requires submission of the product containing the CH1782 for DOC approval. This can be done by submitting the design to a test house or consultant. Call Cermetek for assistance.

FEATURES

- Supports Standards CCITT V.22 bis, V.22, Bell 212, V.21, and Bell 103
- CH1782SF—with Send Fax
- FCC Part 68 approved and DOC approvable
- Asynchronous and synchronous operation
- AT command structure - with extensions
- Single 5 volt operation
- Low power operation with automatic reduced power standby mode
- Automatic adaptive and fixed compromise equalization
- Test modes and diagnostics
- Size -1.125" x 2.00" x 0.50"

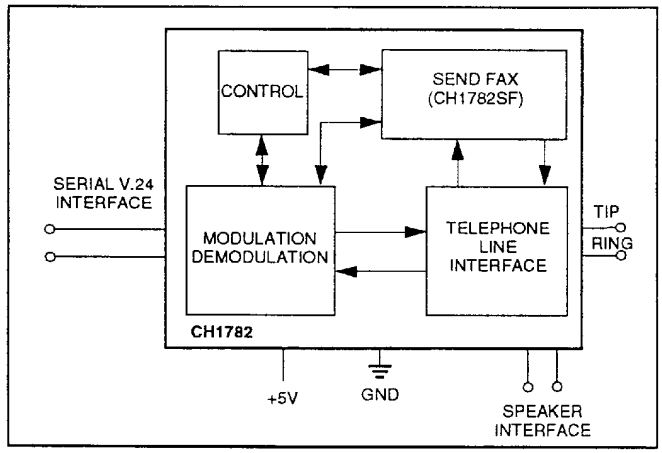


Figure 1. CH1782 Functional Block Diagram.

Supported Features

"AT" Command Set

A 40 character command line is provided. The command line starts with AT and may contain standard or enhanced commands. The commands are compatible with EIA document TR302.2/88-08006.

Serial Host Interface

The serial interface is V.24 (EIA-232-D) compatible interface. See pin description.

Synchronous Operation

The commands and command states are inherently asynchronous, thus all synchronous communication modes are entered from the command state, and the CH1782 goes back to the command state when the call is terminated. The &M0 command selects asynchronous communication, which is also the default mode. When connected to an asynchronous serial interface the CH1782 can be directly configured and utilized. The &M1 assumes the CH1782 serial interface is both synchronous and asynchronous. The command is issued asynchronously. After the connection is established (Connect XXX) the CH1782 switches to synchronous communications for the duration of the call.

Note: Synchronous mode is not supported by the CH1782SF.

Speaker Interface

An interface to an externally supplied speaker circuit is provided. The speaker can be used to monitor call progress. The AT L (n = 0 to 3) command can be used to adjust the volume in suitable steps. (See Figure 4).

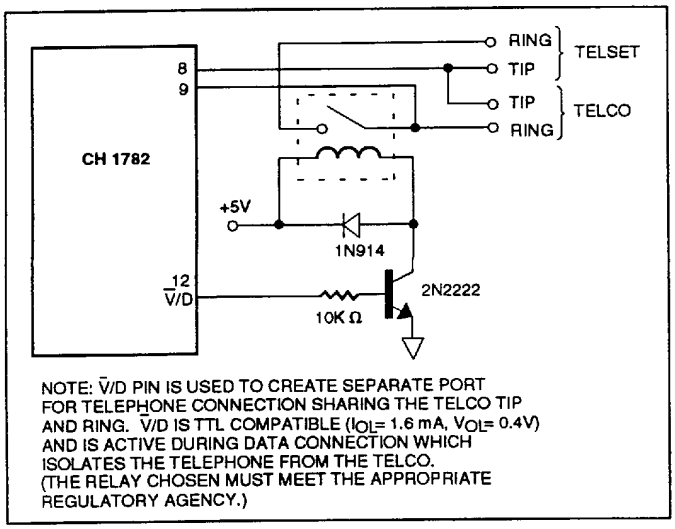


Figure 2. Voice/Data Port Control.

Phone Control

The CH1782 contains a pin called Voice/Data ($\overline{V}$/D). This pin toggles high when the modem goes off hook. This pin can be used to activate a relay which can switch a telephone on or off the Tip and Ring Telco lines. This allows the telephone to be isolated when a data call is in progress, preventing the data from being disturbed by an inadvertent telephone pick-up. See Figure 2.

Sleep (Power Down) Mode

To minimize the modem power consumption, the CH1782 includes a sleep (power down) mode. The CH1782 enters sleep mode whenever the modem has been inactive from 30 seconds to one minute. (Note that the modem never enters power down mode while in data mode.) The modem returns to full operation whenever a ring signal occurs, or the host writes to the DSP, or the DTR input is asserted.

GUARD TONE

A guard tone of 550 Hz or 1800 Hz can be generated at 6 dB or 9 dB below the transmit level, respectively.

ANSWER TONE

A CCITT (2100 Hz) or Bell (2225 Hz) answer tone is generated depending on the selected configuration.

Data Encoding

The data encoding conforms to CCITT Recommendations V.22 bis or V.22, or to Bell 212A, V.21, or 103, depending on the selected configuration.

Line Equalization

Transmitter and receiver digital filters compensate for delay and amplitude distortion during operation on nominal phone lines. In addition, automatic adaptive equalization in the receiver minimizes the effects of intersymbol interference.

Transmission Speed

The transmission rate of the host computer must be 300, 1200, or 2400 bps. The modem will connect at the selected speed or will fallback to the speed set by the remote modem with the serial interface, the DTE transmission speed is speed sensed.

When the modem answers a call, it determines the transmission speed from the carrier signal of the originating modem. V.22 bis ORG can also adapt so that the setting of the modem is matched to the remote system.

Speed and Parity Selection

Before a call, the modem adjusts to the host speed (2400,1200, 300 or 110 bps) and parity (odd, even, mark, space or none) via a host-initiated training sequence. This also selects the speed of the data call for originate calls. The modem automatically adapts to the caller's speed on answer calls.

The modem matches the host's parity when it returns status messages to the host. During a data connection, however, the modem passes parity through without interpretation or alteration.

Power Supply

The modem module is a complex sub-system that may be treated as any other component. Special attention should be paid to the power supply connections. The modem decodes analog signals from the telephone line that are in the millivolt range and even though the modem is designed to withstand significant induced power supply noise, there is a limit. Steps must be taken to guarantee that power supply noise on all supply lines including ground does not exceed 50 mV peak to peak. If necessary, this should include the use of dedicated power and ground planes. Failure to provide such operating conditions could cause the modem to malfunction.

The CH1782 requires a single +5V ±10% supply. It Is recommended that by-pass capacitors be placed on the power supply line as close to the modem's supply input as practical. It is recommended that a 100 µF Electrolytic capacitor in parallel with a 0.01µF disc capacitor be used.

MODEM CONTROL

The CH1782 modem may be controlled by sending serial ASCII command sequences. The commands are sent to the modem

serially on TXD. After execution of the command, the modem returns a serial status message on RXD, to indicate the completion status of the command.

Initializing the Modem

Before commands may be sent to the modem, the modem must be initialized. This consists of two events: 1) after power-up, a hardware reset pulse must be applied to the modem, and 2) the modem must be trained to the host's speed (2400,1200, 300,110 bps) and parity (odd, even, mark, space or none).

Power-Up Reset

After applying power to the modem, a high-going reset pulse can be applied on RST for at least 10 ms. after the +5V power supply has stabilized. A pulse is generated at power up by an internal 2.2 µF capacitor to Vcc and 10 kΩ resistor to GND. If desired this internal circuit may be overridden by an external driver. A current limiting resistor is suggested to avoid current surges when driving the 2.2 µF capacitor.

Training the Modem

The modem must be trained to match the host's speed and parity so that it is able to recognize serial asynchronous commands sent to it by the host UART. The host must retrain the modem each time a reset signal is applied on RST or after a RESET serial command. The modem is trained by sending it the following three character sequence:

AT[CR]
where: **A** and **T** must be upper case or lower case
[CR] represents carriage return

The modem will respond with either one of the following status messages, depending on whether it is optioned for abbreviated or English status messages.

0[CR] (abbreviated form)
[CR][LF]OK[CR][LF] (English form)
where: **[CR]** represents carriage return (ASCII 13)
[LF] represents line feed (ASCII 10)
The modem may be retrained any time while it is idle.

Another attention sequence "A/" is much like the "AT" sequence except it repeats the previously entered command specified with an "AT" prefix. When given, it must also be in upper case ASCII. No carriage return is needed.

The Command Format

Typical commands consist of three elements, the attention sequence, the commands themselves, and a terminating carriage return.

AT[commands][CR]
where: **[CR]** represents carriage return (ASCII 13)

When entering commands to the modem, the backspace character—control-H (ASCII 8)—can be used to edit mistakes. "AT" and "A/" may not be edited however. Multiple commands may be placed in the command line. A command line may be as long as 40 characters, excluding AT. The command below instructs the modem to configure itself to not echo characters in the command mode (E0) and then go to answer mode.

ATE0A[CR]

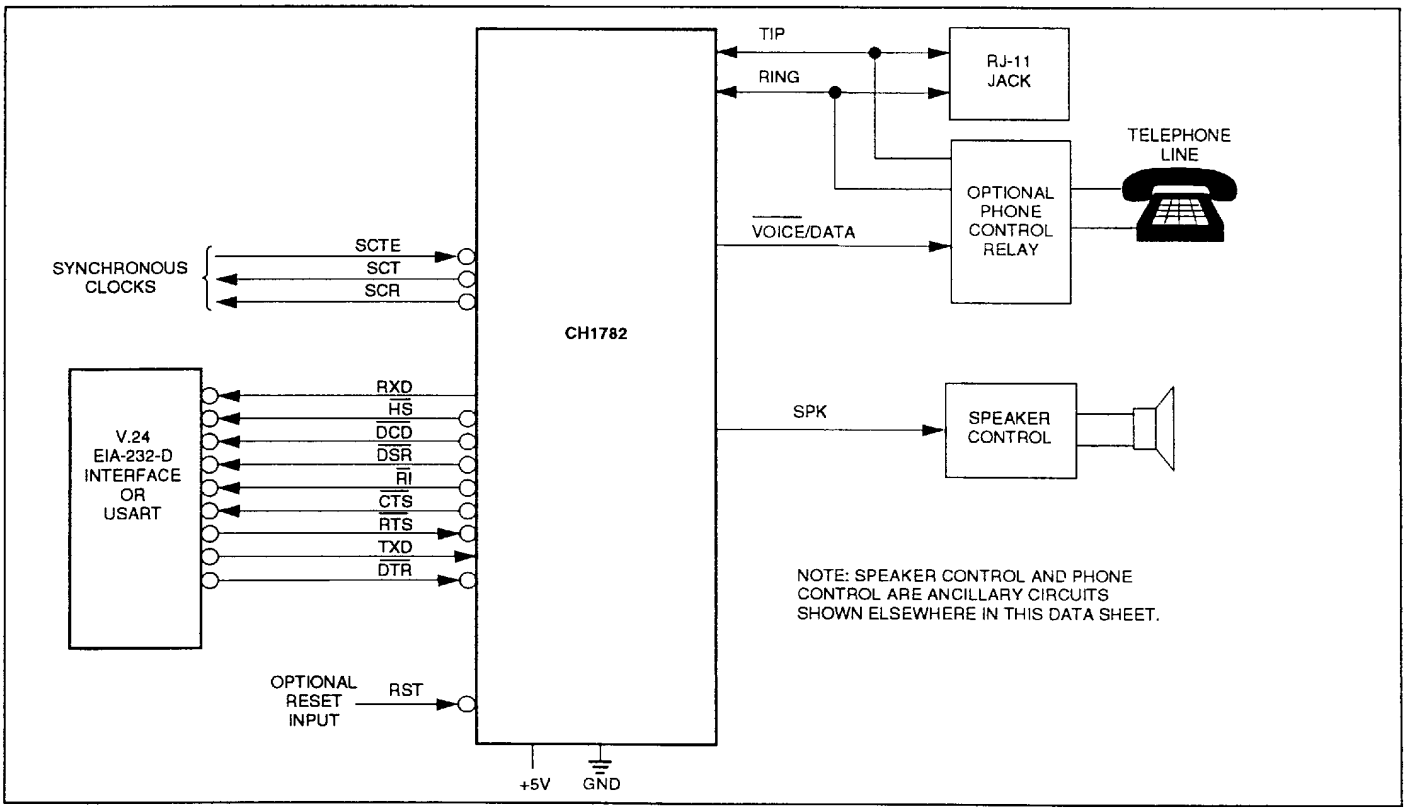


Figure 3a. CH1782 Application Diagram.

Table 1. CH1782 Pin Descriptions

PIN	NAME	I/O	FUNCTION
1	$\overline{RTS}$	I	**REQUEST TO SEND.** A LOW on this input is used to condition the CH1782 for data.
2	GND	I/O	**GROUND.** Signal and power.
3	VI	I	**VOICE INJECTION.** Use this port to transmit and receive voice or DTMF signals on the Telco line.
4	VCC	I	5 Volts ±10%.
5	RXD	O	**RECEIVE DATA.** Serial receive data output. Received MARKING or a binary 1 condition is indicated by a HIGH.
6	$\overline{DTR}$	I	**DATA TERMINAL READY** input. Active Low. Switching off DTR can either return modem to command state, disconnect phone call, or reset modem. The default is for the modem to ignore DTR.
7	$\overline{DSR}$	O	**DATA SET READY** output. A LOW indicates the modem is OFF-HOOK.
8	$\overline{DCD}$	O	**DATA CARRIER DETECT** output. When asserted LOW, the received data carrier is present.
9	TIP	I/O	Directly connects to the telephone line's Tip lead through a user supplied RJ-11C jack.
10	RING	I/O	Directly connects to the telephone line's Ring lead through a user supplied RJ-11C jack.
11	$\overline{RI}$	O	**RING INDICATION.** A LOW indicates that the local telephone line is ringing. This signal follows the envelope of the ringing signal (normally 2 seconds LOW, 4 seconds HIGH).
12	$\overline{V}$/D	O	**VOICE/DATA** output. Used to control a switch between modem and attached phone. See application diagram.
13	$\overline{CTS}$	O	**CLEAR-TO SEND** output. When LOW the modem has set up the data call and is ready to transmit data.
14	RST	I	**RESET** input (active HIGH). This input may be asserted HIGH for at least 10 ms to reset the modem. RESET is then returned LOW for normal operation. A power up reset is internally generated by 2.2 µF to V_{CC} and 10 kΩ to GND, but circuit may be overridden by an external driver with a current limiting resistor
15	$\overline{HS}$	O	**SPEED INDICATION.** High speed select output. A LOW on this pin indicates the modem is operating at 2400 bps.
16	TXD	I	**TRANSMIT DATA.** Serial transmit data input. Marking, or a binary 1 condition, is transmitted when a HIGH is asserted.
17	SCR	O	**SYNCHRONOUS CLOCK RECEIVE - RXD.** Data valid on rising edge of this clock - only in synchronous mode. (The CH1782SF does not support synchronous operation, so leave this pin unconnected).
18	SCT	O	**SYNCHRONOUS CLOCK TRANSMIT - TXD.** Clocked data must be valid on rising edge – synchronous mode only. (The CH1782SF does not support synchronous operation, so leave this pin unconnected).
19	SCTE	I	**SYNCHRONOUS CLOCK TRANSMIT EXTERNAL.** External clock input. Watches TXD data on rising edge. (The CH1782SF does not support synchronous operation, so leave this pin unconnected).
20	SPK	O	**SPEAKER.** Audio output for speaker. See speaker control diagram.
21			Reserved. Leave this pin unconnected.

Table 2.
CH1782 Register Summary

Register	Function
S0*	Ring to Answer On
S1	Ring Count
S2	Escape Code Character
S3	Carriage Return Character
S4	Line Feed Character
S5	Back Space Character
S6	Wait For Dial Tone
S7	Wait Time for Data Carrier
S8	Pause Time for Comma
S9	Carrier Detect Response Time
S10	Lost Carrier to Hang-up Delay
S11	DTMF Dialing Speed
S12	Escape Code Guard Time
S14*	Bit Mapped Options Register
S16	Modem Test Options
S18*	Test Timer
S21*	Bit Mapped Options Register
S22*	Bit Mapped Options Register
S23*	Bit Mapped Options Register
S25*	Delay to DTR
S26*	RTS to CTS Delay Interval
S27*	Bit Mapped Options Register

Notes:
*This S-Register is stored in the modem RAM upon receipt of the S= command so that the contents are not preserved when modem power is removed.

AT Command Data Rate

With the serial interface, the rate is speed sensed for parity and format.

AT Command Set

The commands are divided into three types; basic commands, dial modifiers, and ampersand commands as listed in Table 3. The supporting S registers are listed in Table 2.

The Status Messages

The modem responds with a status message after each command is executed. This status message may either be a single digit followed by a carriage return or it may be a carriage return and line feed with a message in English followed by a carriage return and line feed.

The basic status code subsets are enabled with the Xn command. Where n = 0,1, 2, 3, 4 the status codes can be in message form or result code form. The following are the result codes selected for the five Xn commands:
X0 - Result Codes 0, 1, 2, 3, 4
X1 - Result Codes 0, 1, 2, 3, 4, 5, 10
X2 - Result Codes 0, 1, 2, 3, 4, 5, 6, 10
X3 - Result Codes 0, 1, 2, 3, 4, 5, 7, 10
X4 - Result Codes 0, 1, 2, 3, 4, 5, 6, 7, 10 (factory default)

Result Codes, or Status Messages	Meaning
0 or OK	Command executed
1 or Connect	Carrier detected at 300 bps
2 or Ring	Ring detected
3 or No Carrier	Did not detect carrier
4 or Error	Entry error
5 or Connect 1200	Carrier detected at 1200 bps
6 or No Dial Tone	Off-Hook, but no response after 5 seconds
7 or busy	Busy signal detected
10 or Connect 2400	Carrier detected at 2400 bps

Table 3.
CH1782 "AT" Command Set Summary

Basic Commands	Function
AT	Attention Code
A	Answer Command
A/	Repeat Last Command
Bn	Communications Standard Option
C	Squelch Transmitter
D	Dial Command
En	Off-line Character Echo Option
Hn	Switch Hook Control Option
Ln	Speaker Volume Option
Mn	Speaker Control Option
On	On-line Command
P	Pulse Dial
Qn	Result Code Display Option
Sn	Select an S Register
Sn=	Write to an S Register
Sn?	Read an S Register
Vn	Result Code Form Option
Xn	Result Code Set/Call Progress Option
Yn*	Long Space Disconnect Option
+++	Escape Code Sequence
,	Pause
?	Returns Last Addressed S Register
Dial Modifiers	**Function**
P	Pulse Dial
R	Originate Call in Answer Mode
T	Touch Tone Dial
W	Wait for Dial Tone
;	Return to Idle State
@	Wait for Quiet Answer Command
!	Flash Hook
,	Pause
0-9 A,B,C,D #*,	Dial Digits/Characters
Ampersand Commands	**Function**
&Cn	Data Carrier Detect Option
&Dn	Data Terminal Ready Option
&F	Load Factory Defaults
&Gn	Guard Tone Option
&Mn*	Communications Mode Option
&Pn	Make to Break Ratio Selection
&R	Clear to send Option
&Sn	Data Set Ready Option
&Tn*	Test Command Selection
&V*	Display current profile
&Xn	Synchronous Transmit Clock Source Option

*These commands are not supported by the CH1782SF.

Table 3A
Fax/Send AT Commands
(CH1782SF only)

Speed Control
#B4 Fax transmission speed of 2400 bps
#B5 Fax transmission speed of 4800 bps
#B6 Fax transmission speed of 7200 bps
#B7 Fax transmission speed of 9600 bps

Fax/Modem Mode Selection
#F0 Modem placed into Normal (asynchronous) mode
#F1 Modem placed into FAX mode

DTE Flow Control
#K0 Disable flow control
#K3 CTS flow control
#K4 X on/X off flow control

Pages Transmitted
#Pn n equals number of pages to be sent

Resolution Control
#R0 Sends documents with normal resolution
#R1 Sends documents with fine resolution

Note: A detailed definition of all commands and registers is available from Cermetek Microelectronics, Inc.

Modem States

The modem can be in either a command state or a data mode state. When the modem is idle, it is in the command state. When a data call is in progress it is in the data mode state. The modem does not recognize commands when in the data state. To recognize commands, the computer must send an "escape sequence" to the modem that forces it out of the data mode and into the command mode.

The escape sequence consists of a "guard time" (a period where no characters are sent to the modem) followed by 3 escape characters followed by a "guard time" again. At power-up, the guard time is set to 1 second minimum and the escape character is set as "+". These two parameters can be modified via registers S2 and S12.

The modem will stay off-hook with its carrier on after the escape sequence is received. It returns an OK status message when it is ready to accept commands. You may re-enter the data mode by issuing the ONLINE command **ATO[enter]**.

"AT" COMMAND APPLICATIONS

Pause ","

When placing a call from an office with a telephone connected to a PBX, it may be necessary to dial an access code (usually the digit 9) to get an outside line. Inserting a comma in the telephone number commands the modem to pause for a specific length of time. The factory default pause time is 2 seconds.

Example: Dial 9, pause, dial number.

Enter: AT DT9, 1234567

Multiple commas may be used for a greater delay time.

Touch Tone and Pulse Dialing "T and P"

The modem can use DTMF (touch-tones) or dial pulses when dialing a telephone number. If the dial command does not specify which type to use, the modem defaults to the type last specified. The power-on default value is P.

Example: Pulse dial 9, pause, touch-tone dial number.

Enter: AT DP9, T1234567

Originate a Call in Answer Mode "R"
The D command forces the modem into originate mode. To call an originate-only modem, dial the number and set the modem to answer mode via the R (reverse originate). Enter the R command at the end of the telephone number.

Example: Dial number in answer mode.

Enter: AT D1234567R

Redial Last Number "A/"
Use A/, the repeat command, to redial the last telephone number dialed when a busy signal is received.

Return to Command State ";"
The modem can be forced to reenter the command state after dialing (without hanging up) by ending the dial command with a semicolon. This is useful when using the modem as an auto dialer.

Example: Touch-tone dial 9, pause, dial number, return for command.

Enter: AT DT9, 1234567;

Result: OK

Automatic Answering
The S0 register controls the number of rings that must occur before the modem answers a call. The register may range in value from 0-255.

S0 = 0 DO NOT ANSWER TELEPHONE
S0 = 1 ANSWER ON RING 1
S0 = 2 ANSWER ON RING 2
S0 = 3 ANSWER ON RING 3
. . .
S0 = 255 ANSWER ON RING 255

When S0 is set to 0, the modem will not auto-answer.

Example: Assign the value "6" to S0 to set the modem to answer on the sixth ring.

Enter: AT S0 = 6

Result: OK

Dial a Number "D"
The Dial Command takes the form Dn, where n is a string of characters. In the simplest form, n will be only the digits of the phone number to be dialed.

Example: Dial number.

Enter: AT D1234567

In response to this command, the modem dials the telephone number "123-4567" and then waits for carrier from a distant modem. If no carrier is detected within a given time (the default time is 30 seconds), the modem automatically releases the line and sends a NO CARRIER result code. If carrier is detected, the modem gives a CONNECT result code and goes on-line, permitting communication with the distant modem.

The Dial Command may also be issued without a telephone number. ATD causes the modem to pick up the telephone line without dialing a number.

VOICE INJECTION PORT

The CH1782 provides a pin to allow the user to share the telephone line interface associated with the modem for voice and DTMF applications. Figure 3b of the application diagrams shows the configuration for voice utilization.

Typically, voice communication would precede data communication; in which case, the following commands should be used to configure the CH1782:

ATS0 = 0 [CR] — Disables auto-answer.
ATS7=255 [CR] ┐
ATS10=255 [CR] ┘ — Eliminates hang-up due to lack of carrier signal.

1. To answer a voice call
   (a) ATH1 [CR]
   (b) Drive VOICE/MODEM (V/$\overline{M}$) high to activate relay.
   (c) Begin voice conversation.

2. To switch to data mode, drive V/M low, then:
   (a) At the Originate modem:
   ATX1D [CR]
   (b) At the Answer modem:
   ATA [CR]

3. To disconnect (hang-up) a voice call or a data call:
   ATH [CR]

4. To place a voice call using CH1782's DTMF:
   (a) ATDT #;C0 [CR]
   (b) Drive V/M high

WARNING: The CH1782 has been FCC Part 68 approved as a data modem. Utilization of the Voice Injection Port requires further registration. FCC will require that the system, including the CH1782 and the handset or DTMF transceiver, adhere to Part 68 rules.

Connecting to the Host UART/USART

Since a modem communicates data serially and most host products handle data in a parallel format, a UART or USART is needed to make parallel-to-serial and serial-to-parallel translations.

The Serial Interface Lines

The module supports a full RS-232C/V.24 serial interface. Signal levels are TTL rather than RS-232C level compatible, which allows you to directly connect the modem to your host's UART/USART without level translating circuitry. A complete description of each signal follows under Pin Description.

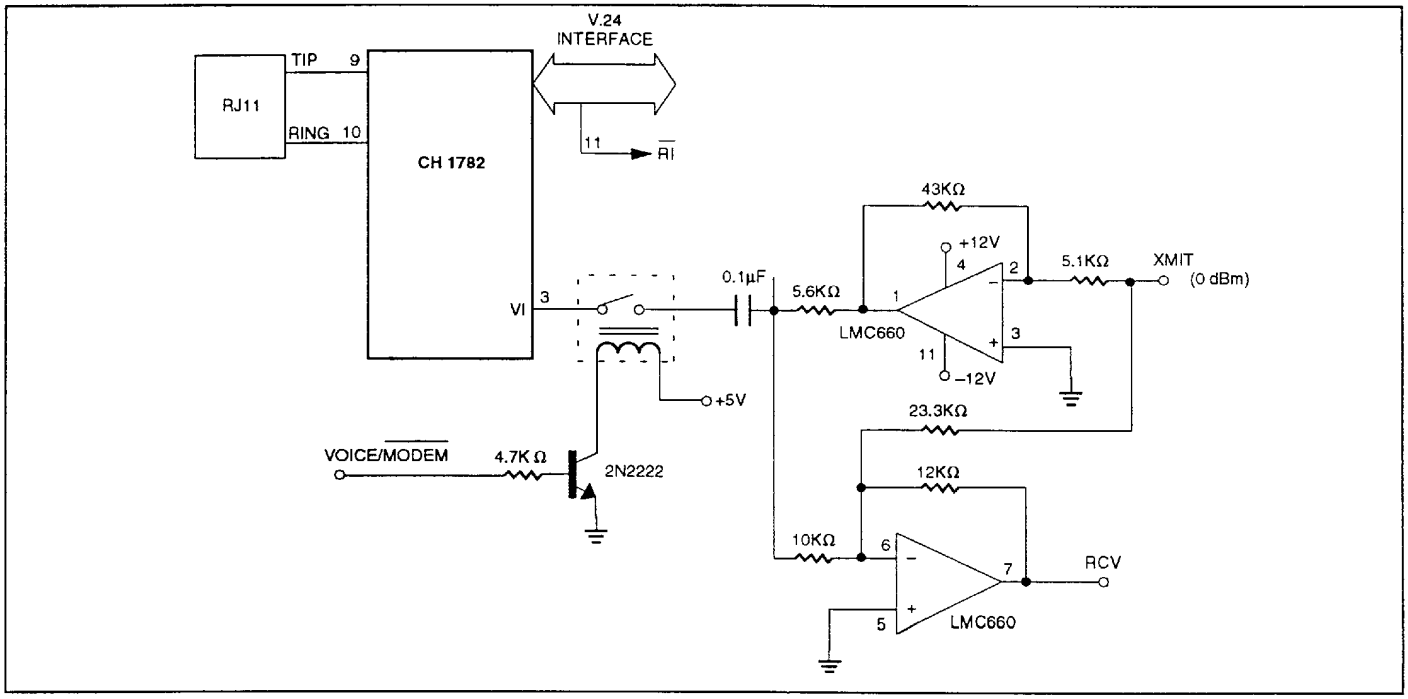


Figure 3b. Using the CH1782 for Voice Application.

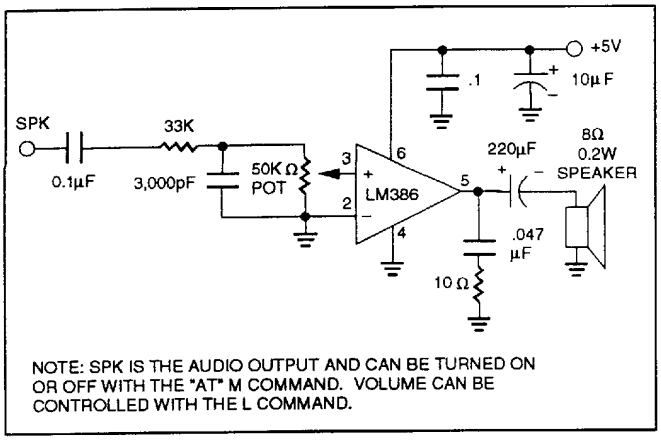


Figure 4. Speaker Control Circuit – optional to allow for call progress monitoring.

Three of these lines must be utilized for proper modem operation; TXD, RXD and DTR. The modem is controlled by sending it serial commands over TXD and can be monitored by serial status messages returned on RXD. DTR must be asserted ON (LOW) for the modem to interpret commands sent to it on TXD and will disconnect a call if DTR is asserted OFF (HIGH) during a call.

All other serial interface lines may be utilized for the convenience of your application but are not required by the modem. Unused outputs (from modem) should be left unconnected. Unused inputs should be tied to the proper logic level.

Phone Line Connection Guidelines

1) The mounting of the CH1782 in the final assembly must be made so that it is isolated from exposure to any hazardous voltages within the assembly. Adequate separation and restraint of cables and cords must be provided.

2) The circuitry from the CH1782 to the telephone line interface must be provided in wiring that carries no other circuitry than that specifically allowed in the rules (such as A and A1 leads).

3) Connection to the phone line should be made through an RJ-11C jack.

4) Traces from the modem's RING and TIP pins to the RJ-11C jack must exceed 0.1 inch spacing to one another and 0.2 inch spacing to all other traces. The traces should have a nominal width of 0.020 inches or greater.

5) The RING and TIP traces should be as short as possible and oriented to prevent coupling other high speed or high frequency signals onto the host circuit card. It is essential to keep the control signals for the CH1782 well isolated from the switching noise generated by TIP and RING.

6) No additional circuitry other than that shown in the following Figure may be connected between the modem module and the RJ-11C jack.

7) The supplied FCC registration label must be applied visibly on the outside of the host product.

8) The host product's User Manual must provide the user with instructions for connection and use as recommended in Section FCC Registration.

International Approvals

The CH1782 can additionally be approved for some international telephone connections. This must be done, however, after the modem is installed in the host product. The entire host product must then be submitted to the international country's Telephone Network for approval.

Mounting the Modem

The modem contains static sensitive devices and should only be handled by personnel and in areas that are properly protected against static discharge.

There are two popular mounting techniques that are recommended for physically connecting the modem to your circuit

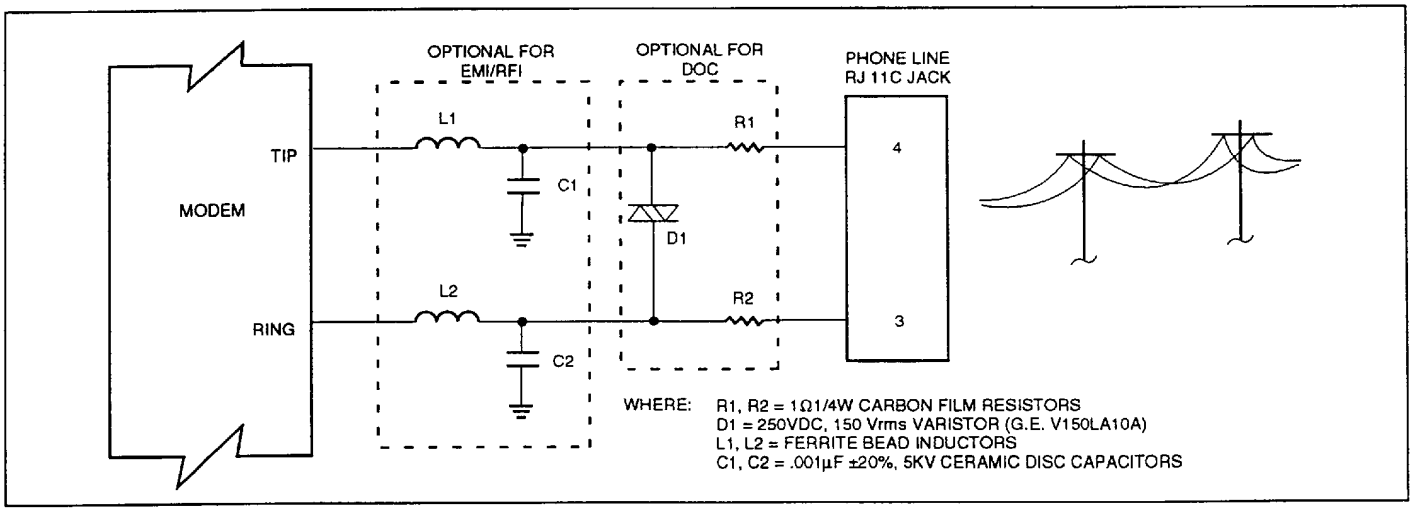


Figure 5. Canadian Phone Line Interface.

card; 1) sockets, and 2) direct soldering. Each approach has its own set of benefits and challenges.

The direct soldering approach solders the modem directly into the host circuit card. This approach provides the most sound mechanical mounting and also the best electrical connection. However, it does present a couple of challenges.

If the modem is wave soldered on a circuit card, flux and other corrosive chemicals can be left inside the modem's plastic housing. Care should be taken during the freon rinse cycle to fully wash the chemical residue away. Ideally, the modem should be soldered in by hand after the rest of the card is wave soldered to minimize this problem. Also, soldering can present a sizable challenge if the modem ever needs to be removed from the card.

If the direct soldering approach is selected, it is recommended that 0.040 inch diameter plated through holes be used with 0.060 inch minimum diameter pads.

The socketing approach to mounting eliminates cleaning and desoldering concerns. When a socket is used, it must make a solid connection to all modem pins. Failure to do so will cause unreliable modem operation. Also, steps should be taken to assure that the module remains tightly seated in the socket after the host product is shipped.

If you decide to select the socket approach, make sure that the socket is designed to accept square 0.025 inch pins. Single-in-line sockets may be purchased from manufacturers such as SAMTEC or Augat.

FCC REGISTRATION

The CH1782 is registered with the FCC (Federal Communications Commission) under Part 68. To maintain the validity of the registration, you must serve notice to the end user of the product that contains the modem of several restrictions the FCC places on the modem and its use. The following notice is recommended and should be included in the host product's USER MANUAL. Also, the FCC requires that Cermetek make all repairs to the modem. If repair is necessary after the modem is installed in your product and has been delivered to your customer, the modem must be returned to you where it can be removed from the host product and then forwarded to Cermetek for repair.

FOR YOUR USER'S MANUAL

The Part 68 rules require the following or the equivalent information be provided to the end user of equipment containing a DAA:

Type of Service: The (insert your product name) is designed to be used on standard device telephone lines. It connects to the telephone line by means of a standard jack called the USOC RJ-11C (or USOC FJ45S). Connection to telephone company provided coin service (central office implemented systems) is prohibited. Connection to party lines service is subject to state tariffs.

Telephone Company Procedures: The goal of the telephone company is to provide you with the best service it can. In order to do this, it may occasionally be necessary for them to make changes in their equipment, operations or procedures. If these changes might affect your service or the operation of your equipment, the telephone company will give you notice, in writing, to allow you to make any changes necessary to maintain uninterrupted service.

If you have any questions about your telephone line, such as how many pieces of equipment you can connect to it, the telephone company will provide this information upon request.

In certain circumstances, it may be necessary for the telephone company to request information from you concerning the equipment which you have connected to your telephone line.

Upon request of the telephone company, provide the FCC registration number and the ringer equivalence number (REN) of the equipment which is connected to your line; both of these items are listed on the equipment label. The sum of all of the REN's on your telephone lines should be less than five in order to assure proper service from the telephone company. In some cases, a sum of five may not be usable on a given line.

If Problems Arise: If any of your telephone equipment is not operating properly, you should immediately remove it from your telephone line, as it may cause harm to the telephone network. If the telephone company notes a problem, they may temporarily discontinue service. When practical, they will notify you in advance of this disconnection. If advance notice is not feasible, you will be notified as soon as possible. When you are notified, you will be given the opportunity to correct the problem and informed of your right to file a complaint with the FCC.

In the event repairs are ever needed on the (insert your product name), they should be performed by (insert your company name) or an authorized representative of (insert your company name). For information contact: (insert your company address).

DIAGNOSTIC TESTS

The CH1782 supports the following tests to help diagnose the source of data communications problems that may be encountered.

Analog Loop Test

In an analog loop test, transmitted characters are looped back to the sending terminal or computer. This allows verification of the modem's analog circuits. These circuits modulate and demodulate the host's data. Since the modem uses different circuits to originate and answer calls, it is important to test both answer and originate modes.

An analog loop self test can also be performed. In a self test the modem automatically generates characters back as before. In addition, the modem transmits a character stream and compares it with the received character stream for accuracy. This is a more rigorous test than is possible with the basic analog loop set-up.

Digital Loop Test

In a digital loop test, data that is received from the remote modem is looped back or re-sent to the remote modem. This test is performed after a data connection has been established and after the local modem is enabled to enter this test mode. To go back on line and return to the data mode, type ATO.

If the remote terminal or computer is having trouble exchanging data with the local host, the problem is usually related to either a poor modem-to-modem connection or incompatible communication settings (parity, data bits, etc.). If a digital loop test is performed and the remote modem receives exactly what is sent, *then the data exchange* difficulties are probably due to incompatible communication settings.

Remote Digital Loop Test

Once a connection has been established, this command makes it possible for a local operator to put the remote modem into Digital Loop. When this is done, characters sent to the remote modem are looped back to the local modem.

DEFAULT STATUS, PERFORMANCE AND SPECS

Default Configuration Profile

Async mode selected
2400 bps
Bell 212A operation at 1200 bps
Even parity
Auto answer disabled
Command echo ON
All result codes enabled - extended
Wait for dial tone before dialing - 2 seconds
Detects busy signal
Full word result codes
Pulse dial make/break ratio = 39/61
Test timer set to 0 seconds
Dial-up lines
CTS always active
DSR always active
RTS to CTS delay - .01 seconds
Modem ignores DTR
DCD active with carrier detect
Long space disconnect disabled
Speaker enabled but off when receiving carrier
Speaker volume set to medium
Local modem will grant RDL request from remote modem
Guard tones disabled
Minimum DTR pulse width = .01 seconds
Modem sources transmit clock (synchronous only)
Ring count - 00
Escape code character = 43
Carriage return character =13
Line feed character = 10
Back space character = 08
Duration of wait for dial tone = 02 seconds
Duration of wait for carrier after dialing = 30 seconds
Duration of dial pulse (comma) = 02 seconds
Carrier detect response time = 0.1 seconds
Escape code guard time = .02 seconds
Length of pause after comma = 2.0 seconds
Last carrier to hang up delay = 0.1 seconds
DTMF interdigit delay = .001 seconds

Table 4.
CH1782 System Compatibility Specifications

Parameter	Specification
Synchronous	2400 bps ±0.01% V.22 bis 1200 bps +0.01% V.22 and 212A
Asynchronous	2400, 1200, 600 bps, character asynchronous. 0 - 300 bps asynchronous
Asynchronous Speed Range	+2.3% - 2.5%, extended range option of CCITT standards in character asynchronous mode.
Asynchronous Format	8, 9, 10 bits, including start, stop, parity
Synchronous Timing Source	Internal, derived from the local oscillator. External, provided by DTE through SCTE Slave, derived from the received clock.
Telephone Line Interface	Two wire full duplex over public switched network. On-chip hybrid and billing delay timers.
Modulation	V.22 bis, 16 point QAM at 600 baud. V.22 and 212A, 4 point DPSK at 600 baud. V.21 and 103, binary phase coherent FSK
Output Spectral Shaping	Square root of 75% raised cosine, QAM/PSK.
Transmit Carrier Frequencies V.22 bis, V.22, 212A	Originate 1200 Hz ±.01% Answer 2400 Hz ±.01%
V.21 at 300 bps	Originate 'space' 1180 Hz ±.01% Originate 'mark' 980 Hz ±.01% Answer 'space' 1850 Hz ±.01% Answer 'mark' 1650 Hz ±.01%
Bell 103 mode	Originate 'space' 1070 Hz ±.01% Originate 'mark' 1270 Hz ±.01% Answer 'space' 2020 Hz ±.01% Answer 'mark' 2225 Hz ±.01%

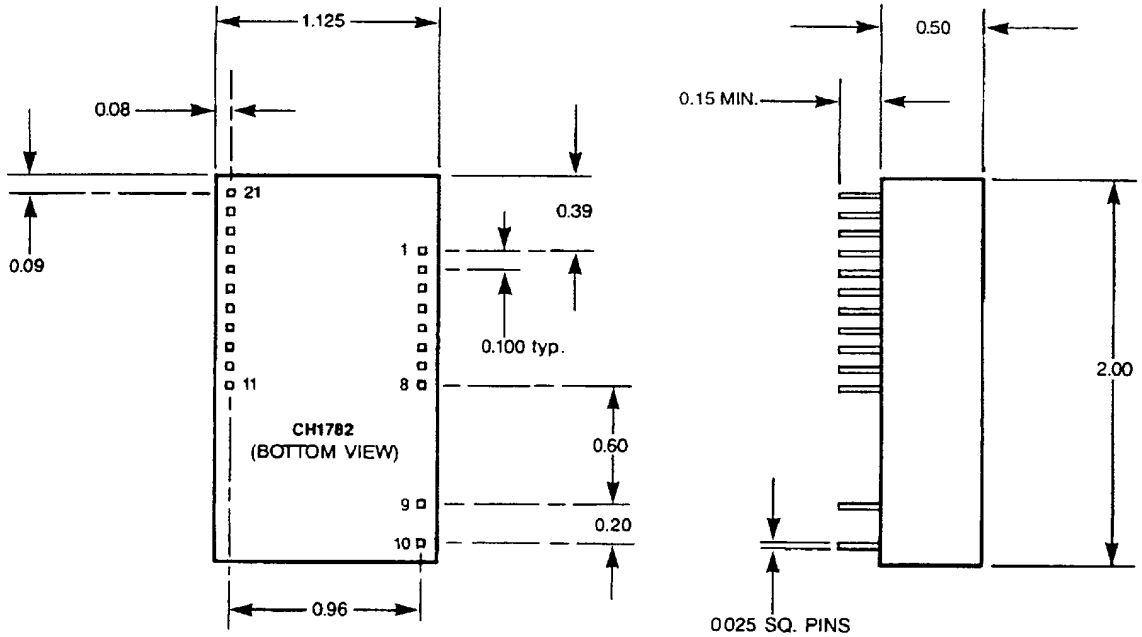
Parameter	Specification
Receive Carrier Frequencies V.22 bis, V.22 212A	Originate 2400 Hz ±7 Hz Answer 1200 Hz ±7 Hz
V.21	Originate 'space' 1850 Hz ±12 Hz Originate 'mark' 1650 Hz ±12 Hz Answer 'space' 1180 Hz ±12 Hz Answer 'mark' 980 Hz ±12 Hz
Bell 103	Originate 'space' 2020 Hz ±12 Hz Originate 'mark' 2225 Hz ±12 Hz Answer 'space' 1070 Hz ±12 Hz Answer 'mark' 1270 Hz ±12 Hz
Receiver Sensitivity	OFF to ON threshold -45 dBm ON to OFF threshold -48 dBm
Line Equalization	Fixed compromise equalization, transmit. Adaptive equalizer for PSK/QAM, receive
Diagnostics Available	Local analog loopback. Local digital loopback. Remote digital loopback. Request remote digital loopback. Local interface loopback modem with self test.
Self Test Pattern Generator	Alternate 'ones' and 'zeros' and error detector, to be used along with most loopbacks. A number indicating the bit errors detected is sent to DTE.
Call Progress Tones Detected:	With speaker or quiet screen messages (no dial tone, busy, ring-back, modem answer tone and voice.)
Computer Interface:	IBM PC/XT/AT bus compatible with an INS8250 UART as a serial controller.

Table 5
CH1782 Electrical Specifications
T_A= 0°C to 50°C, V_{CC} = +5V ±10%

Parameter	Description	Min.	Typ.	Max.	Units
V_{CC}	Positive Supply Voltage	4.5	5.0	5.5	V
I_{CC}	Nominal Operating Current @ V_{CC}= 5.5V		63	115	mA
I_{CCPD}	Power Down Current @ V_{CC} = 5.5V		10	20	mA
V_{IH}	High Level Input Voltage	2			V
V_{IL}	Low Level Input Voltage			0.8	V
VT+	Positive Hysteresis Threshold for RESET pin		2.5		V
VT-	Negative Hysteresis Threshold for RESET pin		1.8		V
V_{OH}	High Level Output (I_{OH} = 0.5 mA)	2.4			V
V_{OL}	Low Level Output (I_{OL} = 1.6 mA)			0.6	V
I_{IL}	Input Current Low			-500	µA
I_{IH}	Input Current High			500	µA

Table 6
Other Performance Specifications

Parameter	Min.	Typ.	Max.	Units	Comments
Tone 2nd Harmonic Distortion			-35	dB	HYB enabled into 600 Ω
DTMF Twist (Balance)		3		dB	
DTMF Tone Duration	50		255	ms	
Default Duration		70		ms	
Pulse Dialing Rate		10		pps	
Pulse Dialing Make/Break		39/61 33/67		% %	US UK, Hong Kong
Pulse Interdigit Interval		785		ms	
Billing Delay Interval			2.1	sec	
Guard Tone Frequency Amplitude Frequency Amplitude		550 -6 1800 -9		Hz dB Hz dB	referenced to High channel transmit
High Channel Transmit Amplitude		-1		dB	referenced to Low channel, Guard Tone enabled
Guard Tone 2nd Harmonic Distortion		-40		dB	
Tone Detection Passband Frequency		480		Hz	3 dB Point
Tone Detection OFF to ON Threshold	-43			dBm	Into 600 Ω
Tone Detection ON to OFF Threshold			-48	dBm	Into 600 Ω
Dial Tone Detect Duration	3.0			sec	



PACKAGE CONNECTION TABLE			
PIN NO.	FUNCTION	PIN NO	FUNCTION
1	$\overline{RTS}$	12	$\overline{V/D}$
2	GND	13	$\overline{CTS}$
3	VI	14	RST
4	VCC	15	$\overline{HS}$
5	RXD	16	TXD
6	$\overline{DTR}$	17	SCR
7	$\overline{DSR}$	18	SCT
8	$\overline{DCD}$	19	SCTE
9	TIP	20	SPK
10	RING	21	RESERVED
11	$\overline{RI}$		

ALL DIMENSIONS IN INCHES

Figure 6. CH1782 Physical Dimensions and Pin Functions.

Table 7.
List of Fax Software Vendors

Alien Computing
(805) 947-1310
38733 9th Street East, Unit R
Palmdale, CA 93550

Bit Software, Inc.
(408) 263-2197
830 Hillview Ct., Ste. 160, Milpitas, CA 95035

Delrina Technology, Inc.
(408) 356-9981
15495 Los Gatos Blvd., Suite #8
Los Gatos, CA 95032

MagicSoft Inc.
(708) 953-2374
8 E. St. Charles Rd., Suite 105
Lombard, IL 60148

Magna Carta Software, Inc.
(214) 226-6909
5302 Anchor Bay, Garland, TX 75043

Smith Micro Software
(714) 964-0412
21062 Brookhurst St., Suite 106
Huntington Beach, CA 92646

Solutions International, Inc.
(802) 658-5506
P.O. Box 783, Willistor, VT 05495

STF Technologies, Inc.
(816) 463-2021
Junction I-70 and Highway 23
Concordia, MO 64020

Tradewind Software
(818) 335-7007
1301 East Alosta Ave., Suite 39
Glendora, CA 91740

This list of software vendors is provided to make the modem operational in Fax mode. These vendors provide a broad range of products. No liability is assumed or compatibility insured with any vendor on this list as each application is specific to the user.