



HIGH SPEED INTERNET MODEM FAMILY

CH2156	-	3 I/O Ports Send Email Only.
CH2157	-	2 I/O Ports & Temp Sense. Send Email Only.
CH2158	-	Send Serial Data to/from Internal RAM. Send Email Only.
CH2159	-	Send/Receive Data Internal Cache 4MEG RAM memory
CH2160	-	Send/Receive Data. Streaming Data Format

FEATURES

- Uses Point-to-Point Protocol (PPP) with Password Authentication Protocol (PAP) to connect to the Internet.
- Uses TCP/IP and Simple Mail Transfer Protocol (SMTP) to send emails.
- On Demand and event driven email transmission and reception.
- Programmable using serial interface or using PSTN.
- Remote programming using PSTN.
- Supports V.90, V.34bis, V.34, V.32, V.22bis, V.22A/B, V.23, V.21, Bell 212A and 103.
- Supports V.80 Synchronous operation.
- Error correcting: V.42 LAMP, MNP 2-4 and MNP10.
- Data Compression: V.42bis and MNP5.
- MNP10 Data throughout enhancement for cellular operation.
- DTE serial interface with speeds up to 230.4kbps.
- Automative baud rate adaptability utilizing speed sensing, flow control and data buffers.
- Send & Receive FAX Class 1, Group 3 supported.
- Serial V.24, 5 volt interface.
- NVRAM directory and stored profiles.
- Standard AT Command structure with extensions.
- Cermetek iNet AT@ Command extensions.
- Built-in DAA with 1500 VAC RMS isolation 2122V peak surge protection.
- UL 1950 and CSA C22.2 950 (Third Edition) Listed, Reference UL File E104957.
- FCC Part 68 Approved/DOT CSA CS-03 Part I Approvable.
- Pin for Pin compatible with CH179X and HS Family of modems.
- +5 Volt operation with zero power option.
- Small size: 1.35" x 1.97" x 0.61" (nominal).

INTRODUCTION

Cermetek's iModem® Family of Internet products are the industries first self contained modules providing a complete PSTN internet communication solution. Further, the iModem® can operate autonomously without the need for host processor intervention.

The iModem® Family offers a variety of internet communication features ranging from simple on demand or event triggered email transmission (CH2156) to full send and receive unlimited length email (CH2160). Internet communication control of the iModem® exercised by using one of the following basic control methods:

1. Fully Autonomous or event driven control requiring no host processor intervention.
2. Semiautonomous control, requiring one command to be issued from the host processor.
3. Complete host intervention and supervision.

When choosing an implementation scheme utilizing a host processor, the host controls the iModem® by issuing Cermetek iNet AT@ Commands which are extensions of the standard Hayes AT command set.

Each iModem® contains a fully functional 56kbps modem along with the hardware and software needed to provide the internet capability.

Because of this architecture, the iModem® has the unique ability to operate as either an internet email transceiver or as simply a high speed modem.

Additionally, the presence of the modem function allows for remote access to reprogram or reconfigure the iModem® should the need arise.

A valid ISP account ID and password are required to use the internet features. As a convenience to our customers, and to facilitate operational use of the iModem®, Cermetek provides on an interim basis a pre-programmed ISP account and password with each iModem® delivered.

The iModem® Family is pin compatible with Cermetek's HS Modem family and is FCC Part 68 approved and Canadian DOT approveable. The modules are designed for PCB throughhole mounting and are 1.35" x 1.97" x 0.61" in size.

TECHNICAL AND OPERATIONAL OVERVIEW

The iModem® Family of products are pin for pin compatible with the CH179X and CH2056 modem products. Referring to Figure 1, the CH21XX iModem® Family consists of an industrial grade high speed modem module and a mP controller with associated internal logic. The mP controller and the logic provide all the functions required for internet communication via standard PSTN telephone lines. The iModem® utilizes TCP, IP, PPP, PAP, SMTP and POP3 internet protocols.

The iModem® requires an external RJ11C jack for the PSTN line connection. An optional CCITT V.24 serial interface is required when host processor control of the iModem® is either required or desired in the specific application.

The iModem® receives iNet AT@ commands from the host processor or receives an event status flag on the Send Email Control Pin (Pin #6) and proceeds to dial up the local ISP, log on to the Internet and authenticate and verify user ID and password, and either send or receive email depending on the command/status flag received. All received emails are presented on the RS232 interface for possible further host processing and retention.

The send and receive email function may be aborted at any time during the email activity by activating the Send Email Control Pin (Pin #6). This will cause the iModem® to terminate the email activity and revert to the idle state.

The CH2158/9 and CH2160 iModem® products contain 32K of extended memory and, therefore, can store limited emails for later re-transmission. However, to fully utilize the receive email capability, the RS232 interface should be operational.

The iModem®s full range of capabilities and features allows for three methods of internet control as briefly described below.

Fully Autonomous On Demand and Event Driven Control.

This is the simplest method of operational control. Application of a 10ms TTL low going pulse (i.e., $V < 0.6$) to the Send Email Control Pin

(Pin #6) will cause the iModem® to send an email using its internal default internet configuration profile. This profile is pre-programmed at the factory and can be modified by the user. No host processor intervention is required. The RS232 DTE serial interface is not required for fully autonomous on demand and event driven control.

Semi-Autonomous Control.

This method requires a minimal amount of host processor intervention and by necessity requires that the RS232 DTE serial interface be operational.

Semiautonomous control is a special case of full Host Supervised Control and relies on the pre-programmed default internet configuration profile contained within the iModem®. Initiation of the email activity occurs with the issuance of either the @TD iNet AT® Command (to Deliver email) or the @TG command (to receive email) by the host processor to the iModem®. PSTN dial-up, logon & authentication and email transmission are performed automatically by the iModem® in the same fashion as the on Demand control method described above.

Host Supervised Control.

This method is the most flexible, but requires the issuance of each of the necessary iNet® AT Commands in the required order from the host processor.

Although the RS232 DTE serial interface is required to be operational for this method of control, an additional feature of this method is the ability of the host to override the pre-programmed ISP and/or email address by simply including the applicable information on the same line of code as the iNet AT® Command.

Host supervised control is recommended for debug activities.

Regardless of the method of iModem® control employed, the iModem® will abort all email related activities if a low going TTL pulse is presented to the Send Email Control Pin (PIN #6) at any time during or after initiation of email send (@TD command) or email Receive (@TG Command).

DESCRIPTION OF FUNCTIONAL BLOCKS AND DISCUSSION OF BASIC OPERATIONS

Figure 1 contains a functional block drawing of the iModem®.

Each iModem® product consists of a mP controller with Network Protocols and Flash ROM, Extended RAM (CH2158/9 or CH2160 only), serial interface buffer, modulator/demodulator, modem controller with error correction and data compression, nonvolatile RAM and DAA.

The iModem® performs the following functions automatically:

1. Connects to ISP.
2. Authenticates user ID and logs onto internet.
3. Sends (or Receives) email to address specified using ISPs SMTP or POP3 Mail Server.
4. Terminates ISP session after all data is sent (or received).
5. Sends message accepted Pulse to Pin 4 after all the ISP Mail Server accepts the email.

Control of the internet capabilities of the iModem® can be either event driven, semiautonomous, or initiated and controlled by a system level host processor.

Further, the iModem® can function as a 56K V.90 modem when not connected to the internet.

mP Controller.

The mP controller is a Motorola GP32 type controller with resident internet protocol software and flash ROM. This controller interprets the iNet AT® commands issued by the external host processor or executes internal iNet AT® Command strings depending on the iModem® control method employed by the user.

Extended RAM.

Additional RAM is used as cache memory for the purpose of email flow control and to facilitate transmission and reception of large email files.

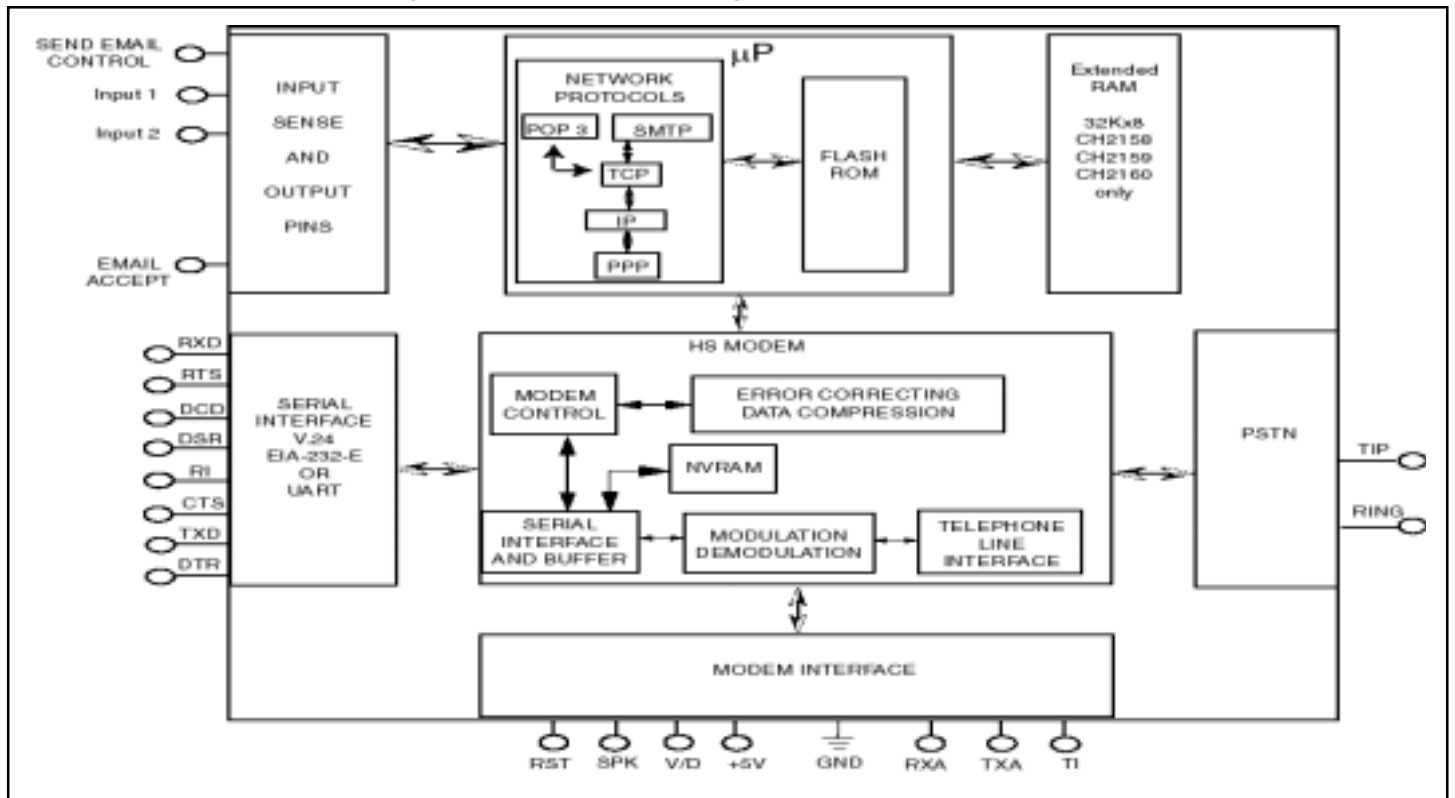
Modem Control.

The internal modem can be controlled with industry standard AT commands and is compatible with available industry communication software.

Serial Host Interface Buffer.

The iModem® utilizes a serial V.24 EIA 232-E 5V interface to control the modem and communicate with the mP.

Figure 1. Functional Block Diagram of iModem®



The modem communicates over the serial interface with the host processor (referred to as a DTE or Data Terminal Equipment) at a fixed speed regardless of the carrier line modulation speed (DCE) of the PSTN modem connection. This eliminates the need to have the DTE step up or step down in speed based on the incoming or outgoing PSTN communication data rate.

Non-Volatile RAM (NVRAM).

NVRAM can store two user-customized configurations. The AT&Wn command will store the active modem configuration in one of two NVRAM locations as selected by an n of 0 or 1.

The AT&Yn command selects one of the stored modem configurations to be automatically recalled and made active upon reset or power up. The ATZn command immediately recalls and activates a stored configuration. See Tables 7A and 7B for storable S-Registers and Commands. The NVRAM can save up to four telephone numbers, with up to 36 digits or modifiers in each telephone number. The AT&Zn=s command will store s, the telephone number dial string. The ATDS=n command will cause the modem to dial one of the four stored telephone numbers. The NVRAM storage location for the four telephone numbers is selected by an n of 0, 1, 2, or 3

Telephone Line Interface or DAA.

High performance modems are extremely sensitive to DAA (Data Access Arrangement) performance. The difference between a good modem and a fair one is in the DAA performance. The iModem® family includes a unique low distortion DAA designed for optimal performance over all PSTN line conditions thereby achieving the most reliable and best performance PSTN connections.

The iModem® family is designed to meet North American telephone standards as set by FCC Part 68 (USA) and CSA CS-03 Part I (Canada). The PSTN line interface is UL1950 and CSA C22-2 950 Listed (Third Edition) and is designed to meet 1500 VAC RMS isolation and provide 2122V peak surge protection. Consequently, the iModem® family of products satisfies U.S. and Canadian requirements, and will meet other international approval agency requirements that specify these levels of isolation.

Pins 1 and 2 function as both input and output connections to the PSTN. To maximize field reliability in hostile environments, for Canadian approval, for UL compliance, and also optionally for FCC Part 15 compliance, these two pins must be routed through an external network such as that described in Figure 6A and in Cermetek Application Note #126.

Each iModem® product comes with FCC Part 68 approval and is shipped from the factory with an FCC label indicating registration number and ringer equivalent. This label should be prominently displayed on the end product. With the exception of the U.S., most countries (including Canada) require submission of the final product or system containing the iModem® to the appropriate governing regulatory agency for approval.

Typically this is accomplished by submitting the final end product to an independent test house or consultant for evaluation. The test/consultant then forwards the test results and applicable documents to the regulatory agency. Contact Cermetek for a list of suggested consultants.

Modulation/Demodulation/Error Correcting and Data Compression

These functions are provided by an industry standard modem ship set which has been adapted for use with the iModem® Family.

The Modulation/Demodulation scheme supports the industry modem standards listed below.

Bell 103	CCITT V.22
Bell 212A	CCITT V.22bis
	CCITT V.32
	CCITT V.32bis
	CCITT V.34
	CCITT V.34bis
	CCITT V.90

The iModem® supports V.42 LAMP, MNP 2-4, MNP 10 error correcting protocols and uses V.42bis data compression, allowing data transmission rates of up to a maximum of 230.4kbps. These high DTE data rates are supported by the iModem® serial interface via its auto baud capability. Note that the maximum speed attained is limited by the maximum speed available from the DTE and not by the iModem®.

When the iModem® is operating in the internet state, all iNet AT® Command communication between the iModem® and the host processor (DTE) is conducted over the RS232 serial interface at 57.6kbps. When the iModem® is operating in the modem state, communication with the DTE can be at any speed up to, and including, 230.4kbps.

The resident Modulator/Demodulator supports line equalization and forward error correction.

CONNECTING TO THE HOST UART

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

SUPPORTED FEATURES

Standard AT Command Set.

The iModem® supports the standard Hayes AT Command set with extensions and can operate with industry standard communication software. The AT commands are compatible with TR302.2/88-08006. Refer to Table 6A & 6B for the command set description.

iNet AT® Command Set.

Cermetek has created a set of iNet AT® command extensions for control of the internet communication function. These commands operate in the same fashion as the standard AT commands. Refer to Table 6C for the iNet AT® command extension set.

Serial Host Interface.

The iModem® operates in asynchronous mode and supports both the full RS-232C/V.24 serial interface and a 5V, RS232-like interface called V.24 (EIA-232-E). Signal levels are TTL rather than RS-232V level compatible, which allows direct connection of the iModem® to the host's UART without level translating circuitry. See Table 3 for a complete set of pin descriptions.

The iModem® is controlled by sending serial commands over TXD and by monitoring serial status messages returned on RXD. All other serial interface lines may be utilized for the convenience of a particular application but are not required by the iModem®. Unused outputs from the iModem® should be left unconnected. Unused inputs should be tied to the proper logic level. See Table 3.

When using the iModem® exclusively in an event driven application, the serial interface is not required.

Speaker Interface.

The SPK output reflects the receiver analog input and provides a signal test that can be used to monitor call progress. The SPK signal can drive a 300 ohm load directly. Typically, the SPK signal is input into an audio power amplifier and the amplifier, in turn, drives the speaker coil. The speaker is activated with the ATLn command, where n is 0, 1, 2, or 3.

Increasing numbers correspond to higher volume. Figure 3 indicates one method of driving an external 8 ohm speaker.

Zero Power Mode.

If an application calls for zero power during standby periods, the power may be switched off using external circuitry and then reapplied when the iModem®'s RI pin becomes active. The iModem® can thus be powered down to zero.

Referring to Figure 2, the controller activates the relay switch, supplying power (+5V) to the iModem®. In this configuration, the ring signal is used to "wake up" the iModem® when the iModem® is in the power down state.

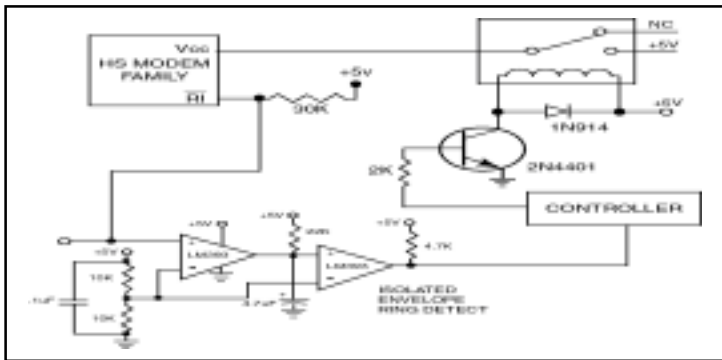
The pins of the iModem® will be in an undefined state when power is switched off. This must be taken into consideration to assure that no unwanted signals are presented to the iModem® during power down.

Power Supply.

The iModem® module is a complex set of sensitive sub-systems. During the course of normal operation, the iModem® decodes analog signals from the telephone line that are in millivolt range. Steps must be taken by the user to guarantee that power supply noise on all supply lines, including ground, does not exceed 25 mV peak to peak. If necessary, use dedicated power and ground planes. Failure to provide such operating conditions could cause the iModem® to malfunction or to function erratically.

The iModem® Family requires a single +5V ±5% supply. It is recommended that bypass capacitors be placed on the power supply as close to the iModem® supply input pins as practical. It is recommended that a 10 mF or greater tantalum capacitor in parallel with a 0.1mF ceramic capacitor be used. The user must also provide shielding from nearby sources of EMI, such as relays, motors and other power supplies.

Figure 3. Zero Power Operation



Automatic Speed/Format Sensing.

The iModem® supports both Command and Data modes of operation.

The iModem® can automatically determine the speed and format of the data sent from the DTE over the serial interface; and can sense the following broad range of speeds:

Table 1. Data Formats Recognized by iModem® Family.

Parity	Data Length (No. of Bits)	No. of Stop Bits	Character Length (No. of Bits)
None	7	2	10
Odd	7	1	10
Even	7	1	10
None	8	1	10
Odd	8	1	11*
Even	8	1	11*

*11 bit characters are sensed, but the parity bits are stripped off during data transmission in Normal and Error Correction modes.

300, 600, 1200, 2400, 4800, 7200, 9600, 12000, 14400, 16800, 19200, 21600, 24000, 26400, 28800, 38400, 57600, 115200 and 230400bps.

The data formats in Table 1 are recognized by the iModem® family of products.

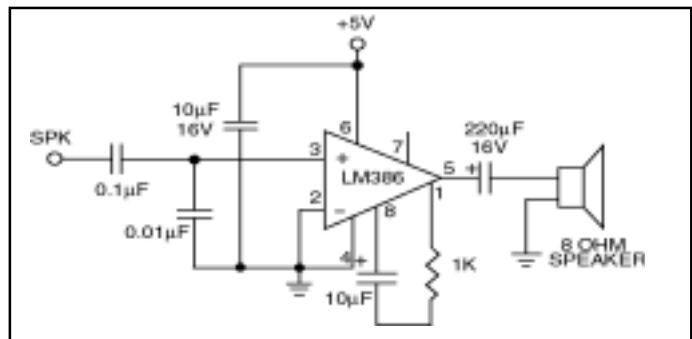
The iModem® can sense data with mark or space parity and configures itself as described in Table 2.

The iModem® is trained to a selected speed with an AT [CR] training sequence. Thus, the DTE to modem serial interface speed can be set independent of the DCE or line carrier connecting speed (with minor restrictions, see the AT + MS command). This allows greater flexibility when selecting DCE line carrier modulation speed thereby affording the user with optimum data throughput performance. To maximize effective modem data throughput speed, the DTE to modem serial interface speed should be set to the highest speed available without invoking the use of the iModem® built-in flow control. Although flow control facilitates communication with higher speed modes by the DTE, use of flow control causes an overall throughput data rate penalty.

Table 2. iModem® Auto Configuration Based on DTE Configuration.

DTE Configuration	iModem® Configuration
7 mark	7 none
7 space	8 none
8 mark	8 none
8 space	8 even.

Figure 4. Speaker Control Circuit.



Voice/Tone Injection Port.

The iModem® Family provides pin T1 to allow the user to share the PSTN line interface associated with the iModem® for voice and DTMF applications. Figure 5 contains a schematic indicating one possible configuration for voice/tone utilization.

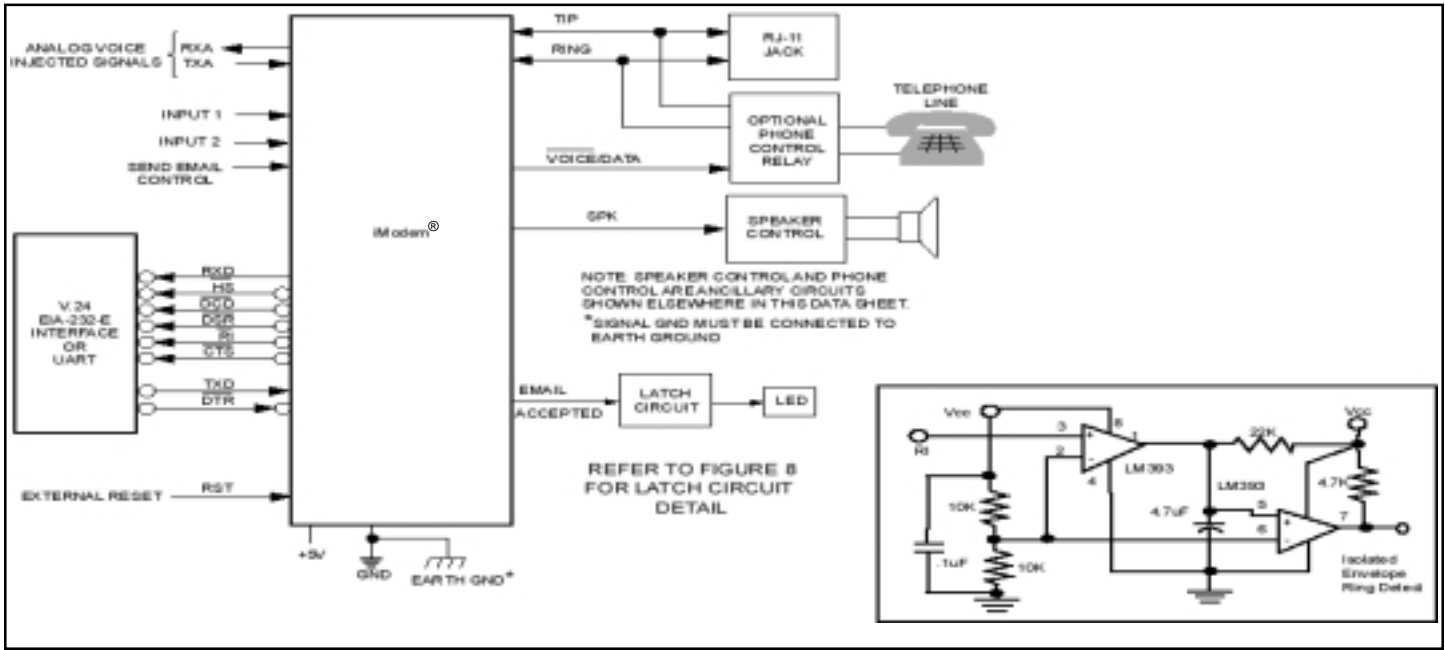
All iModem® products are designed with pin T1 coupled directly to the internal DAA. When using the iModem® in data mode, T1 should float and be disconnected from any potential signal because any signal on T1 during data operation will affect the iModem® output. If T1 is being asserted from another application, use a relay or zero impedance switch to disconnect T1 when in data mode.

Referring to Figure 5, use the variable resistor (POT) to set required speaker volume.

To maintain FCC compliance, frequencies transmitted while in voice mode should be between 300Hz and 3000Hz.

When voice and data are both being used, and the RXA and TXA pins are active, it is typical for voice communication to precede data communication. In this case, the following commands should be used to configure the iModem® to allow for full utilization of the Voice/Tone injection feature.

Figure 5. iModem® Family Application Diagram



These commands disable auto-answer and eliminate hang-up due to lack of carrier signal.

1. Enter: **ATS0=0 [CR]**
2. Enter: **ATS7=255 [CR]**
3. Enter: **ATS10=255 [CR]**

The following command sequences illustrate implementation of common voice/tone port applications.

1. To answer a voice call:
 - (a) Enter: **ATH1 [CR]**
 - (b) Switch local voice source into RXA and TXA
 - (c) Begin voice conversation.
2. To switch to data mode, switch local voice source from RXA and TXA:
 - (a) At the Originate Modem, enter: **ATX1 [CR]**
 - (b) At the Answer modem, enter: **ATA [CR]**
3. To disconnect (hang-up) a voice call or data call:
 - (a) Return to control mode by Entering: **+++**
 - (b) Enter: **ATH [CR]**
4. To place a voice call using the HS Modem DTMF facilities:
 - (a) Enter: **ATDT(Tele)#:[CR]**
 - (b) Then switch to local voice source

iModem® STATES

The iModem can be in either the Internet State or the Modem State. Because the iModem® has the unique ability to operate as either a high speed V.90 Modem or as an internet email transceiver, the commands sent on TXD (or the status of the Send Email Control Pin) determine operation.

iModem® Internet State.

The iModem® can be controlled by providing status flags on the Send Email Control Pin (pin #6) or by sending ASCII commands via the serial interface. Use of Pin #6 forces Internet email transmission operation. Upon successful transmission of an EMAIL, the iModem® sends a momentary 100ms Low going TTL output pulse on the Email Accepted Pin (Pin #8) indicating the email has been received by the ISP Mail Server. If desired, a simple latch circuit (see example in Figure 8) can be used to illuminate an LED to indicate Email Accepted.

This message indicates command completion status. Refer to Tables 5A, 5B and 5C for a complete list of status messages.

iModem® Modem State.

When in the Modem State, the iModem® can be in either command mode or data mode. When the modem is idle, it is in command mode by default and will recognize commands. When data transmission is in progress, the iModem® is in the data mode state and will not recognize commands. To force the iModem® to recognize commands, the host must send an "escape sequence" to the iModem® forcing it out of data mode and into 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 another guard time. 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, respectively.

The iModem® will stay off-hook with its carrier on after the escape sequence is received and it returns an OK status message when it is ready to accept commands. The HS Modem can be put into data mode by issuing the command **ATO [CR]**.

THE COMMAND FORMAT

Typical commands consist of three elements:

1. The attention sequence,
2. The commands themselves and
3. A terminating carriage return.

WARNING: the iModem® family of products has been FCC Part 68 approved as data/FAX modems. Utilization of the Voice/Tone Port requires further registration. The FCC requires that the entire system, including the HS Modem and the handset or DTMF transceiver, adhere to Part 68 rules.

AT [commands] [CR].

Where: **[AT]** represents attention sequence.

[commands] represents command strings.

[CR] represents carriage return (ASCII 13 or HEX 0D).

When entering commands to the modem, the backspace character-control-H (ASCII 8 or HEX 08) 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 the letters AT.

By way of example, the command below instructs the iModem® to configure itself to not echo characters when in command mode (E0) and then put itself in answer mode (A).

Enter: **ATE0A[CR]**

Standard AT Command Set.

The Hayes AT command set is divided into four types of commands: dial modifiers, basic commands, ampersand and percent commands. Refer to the complete list in Tables 6A and 6B.

INITIALIZING THE iModem®

Before commands may be sent to the iModem®, the iModem® must be initialized. This consists of two events:

1. Modem Reset. This is accomplished by applying a hardware reset pulse to pin RST or by switching the power off and then back on.
2. Initial Modem Training. The modem must be trained to the host DTE speed and parity (odd, even, mark, space or none). These activities are briefly described below.

Reset.

Upon applying power to the iModem®, the iModem® automatically generates an internal reset pulse. The user can also reset the modem externally by applying a high-going reset pulse to the RST pin for at least 10ms after the +5V power supply has been stabilized. Delay sending commands to iModem® for 900ms after reset has been initiated to allow the iModem® time to properly reconfigure.

On power up, or when reset is initiated either by command ATZ or by the RST pin, the iModem® will reconfigure to its default state with the line carrier modulation DCE speed set to 56 kbps.

If desired, any speed, error correction, or data compression method available on the iModem® can be locked in, using the AT\Nn and/or AT+MS commands.

Training the iModem®.

The iModem® must be trained to match the host DTE speed and parity so that it is able to recognize serial asynchronous commands sent to it by the DTE.

The DTE must retrain the iModem® each time a reset pulse is applied on RST or after a RESET serial command has been issued.

iModem® Training Command Sequence.

The iModem® is trained by sending it the following sequence:

Enter: **AT[CR]**

Where: **A** and **T** may be either upper or lower case but must be the same case.

[CR] represents carriage return.

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

Result: **0[CR]** (Abbreviated form)

Result: **[CR][LF][OK][CR][LF]** (English form)

Where: **[CR]** represents carriage return (ASCII 13 or HEX 0D)

[LF] represents line feed (ASCII 10 or HEX 0A)

The iModem® is now in idle, the DTE speed is set to a default speed of 57.6kbs mode and the iModem® is ready to accept commands.

As an alternate attention sequence "A/" may be sent which behaves much like the AT sequence except that it causes the previously entered command specified with an AT prefix to be executed. When given, it must be in the upper case ASCII. No carriage return is needed.

STATUS MESSAGES AND RESULT CODES

A result code is issued by the iModem® to the DTE for all commands executed by the iModem®, except dialing and internet commands. Further, various activities on the PSTN are also signaled to the DTE by the iModem®.

All result codes have either a terse, short form version (which is identified by a number followed by a [CR]) or a verbose long form English-like message version (which is preceded and terminated with a [CR] and line feed).

The user may suppress certain subsets of the non-extended result codes. This is accomplished by selecting subsets of the result code set using the ATXn command, where n=0, 1, 2, 3. Optionally, the user may specify an extended set of result codes (codes above 35) by setting Register S95. See the detailed description of result codes in Table 5A, Table 5B and Table 5C.

All AT commands, other than dialing commands, will be responded to with either an OK (short form result code 0) if the command is valid or accepted, or with an ERROR (result code 4) if the command is not recognized. The detail contained in the error result code signaled to the DTE depends on the level of message suppression employed by the user. As can be seen from Tables 5A, 5B and 5C, specifying X4 allows the iModem® to utilize the entire range of non-extended messages, whereas X0 suppresses all but the very basic result codes. Most of the result codes allowed under X1, X2 and X3 are considered call progress status codes and, in practice, are suppressed except for the case of debugging activities. It is recommended that the non-extended result codes be used in all cases.

It should be noted that the default connect result codes 9-20 indicate DTE connection speed, not Carrier Line DCE speed. Hence, the iModem® will connect at a maximum speed of 57.6kbps (result code 18) unless the DTE is forced to a higher speed by selection of data compression. In this case, the maximum DTE to iModem® speed is 230.4kbps (result code 20).

Extensions to the basic result code set can be specified by Register S95, which allows for the use of result codes 40 - 64, 165 - 194.

Note: To obtain a detailed status report for a given modem communication configuration, use the AT/V1 command. Executing this command at setup will cause the iModem® to connect and return a message on line consisting of <DTE speed> <modulation> <error protocol> <line speed of connection>.

AT COMMAND APPLICATIONS WHEN OPERATING THE iModem® IN THE INTERNET STATE

Each iModem® is delivered with a pre-programmed ISP account ID and password, local Sunnyvale, CA, dial-up ISP access phone number and a default pre-programmed email subject title for use on an interim basis.

Sending Emails.

If an email is to be sent utilizing the Cermetek pre-programmed internet configuration profile (i.e., the pre-programmed ISP account ID and password, and the pre-programmed destination email address), issuing the **@TD** command is all that is needed to send an email.

Example: Initiate dial-up and complete email transmission using the pre-programmed internet configuration profile.

Enter: **@TD**

The default email subject title is:

Cermetek Microelectronics iModem Email

Further, Input #1 and Input #2 status will also be transmitted. For CH2156, CH2158/9 and CH2160, the default send email will be of the form:

Remote Product Message
Input 1 High (or low)
Input 2 High (or low)

For CH2157, which contains an onboard temperature sensor, the default send email is of the form:

Remote Product Message
Temperature xx (Reported in Fahrenheit)
Input High (or low)

To change the default internet configuration profile, refer to the PROGRAMMING THE iMODEM® section of this data sheet.

Fully Autonomous Control.

If email is to be sent by activating the SEND EMAIL CONTROL PIN (PIN#6), the iModem® will utilize the pre-programmed internet configuration profile.

The iModem® is designed to allow the user to personalize the default internet configuration profile by either using the PSTN to dial up the iModem® or by using the RS232 host serial interface. Once reconfigured, simply activating the SEND EMAIL CONTROL PIN will automatically cause an email to be transmitted.

In a typical fully autonomous application, the user installs "as received" the iModem® in the desired remote environment and connects only the incoming PSTN to the systems jack.

Once the PSTN is connected, the user accesses the iModem® and then re-configures the iModem® in situ. Upon completion of the re-configuration activity, the iModem® can now be directed to send emails from the remote environment by activating the SEND EMAIL CONTROL pin.

Semi-Autonomous and Complete Host Intervention Control.

This method of control requires all commands to be issued in serial fashion. The first example assumes that the pre-programmed ISP and email address is to be used.

A common host control application involves using the iModem® pre-programmed internet configuration profile except for the local access ISP phone number.

Example: Initiate dialup using a local ISP access phone number different from the pre-programmed number. Then complete email transmission using the pre-programmed ISP account, ID password and email destination address.

Enter: @TN1234567 New Phone Number
Enter: @TD Initiate dialup and send email

In a slightly more complex example, the host controller overrides both the ISP access phone number and the destination email address. The email is then sent using the @TD command.

Example: Send email Overriding the pre-programmed ISP local access phone number and default pre-programmed destination email address. For all other parameters, use pre-programmed information internet configuration profile.

Enter: @TNaaaaaaa Where aaaaaaa is the ISP local access phone number
Enter: @TObbbbbbb Where bbbbbbb is the email destination address
Enter: @TD Dial-up ISP and send email.

Example: Over ride default pre-programmed ISP account ID & Password, email destination address, local access phone number, send email.

Enter: @TLaaaaaa Where aaaaaa is ISP account ID
Enter: @TPbbbbbbb Where bbbbbbb is ISP account Password
Enter: @TOcccc Where cccc is ISP mail server address
Enter: @TNdddddd Where ddddd is the local ISP access phone number

Enter: @TSeeeeeee Where eeeeeee is the email subject (limited to 15 ASCII characters)

Enter: @TD Dial up ISP and complete email transmission using above data for email accounts.

iNet AT® commands must be sent from the Host controller at 57600bps, N81 (no parity, 8 databits, 1 stop bit).

Note that the ISP Mail Server Address must be specified in Hexadecimal. Refer to Cermetek Application Note #147, "Procedure to convert user account address to Hexadecimal".

Changing the Default Internet Configuration Profile.

When various iNet AT® commands that modify internet configuration parameters are issued to the iModem®, the changes invoked by these commands are only temporary. Once power to the iModem® is removed, the changes are lost. The default configuration profile will not be lost when power is removed from the iModem®.

AT COMMAND APPLICATIONS WHEN OPERATING THE iModem® IN THE MODEM STATE.

In the last example, the entire pre-programmed internet configuration profile is overridden.

Dialing A Phone Number.

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 iModem® dials the telephone number "123-4567" and then waits for a carrier from the distant modem. If no carrier is detected within a given time (the default time is 30 seconds), the iModem® automatically releases the line and sends a NO CARRIER result code.

Table 3. iModem® Family Pin Descriptions

PIN	NAME	I/O	FUNCTION
1	RING	I/O	Directly connects to the telephone line's Ring lead through a user supplied RJ-11C jack
2	TIP	I/O	Directly connects to the telephone line's Tip lead through a user supplied RJ-11C jack
3	T1	I/O	ANALOG VOICE INJECTED. Input (see Figure 5). 2.2V P-P max. Let float if not used.
4	$\overline{\text{SENT}}$	O	Output. Used to illuminate LED to indicated email message accepted. Low pulse indicates email message accepted by ISP. See Figure 8 for circuit that uses $\overline{\text{SENT}}$ to illuminate status indication LED.
5	SPK	O	SPEAKER. Audio output for speaker. See speaker control diagram.
6	$\overline{\text{SEND}}$	I	Input. Low pulse sends email. Modem will go offhook, dial up ISP, send email and hang up. Send should be tied high when not used.
7	IN 1	I	Input. TTL High or Low input pin. The logic level of this input pin is reported in the email message.
8	IN 2	I	Input. TTL High or Low input pin. The logic level of this input pin is reported in the email message.
9	NC	-	No Connection.
10	TXD	I	TRANSMIT DATA. Serial transmit data input. Marking, or a binary 1 condition, is transmitted when a HIGH is asserted.
11	RXD	O	RECEIVE DATA. Serial Receive data output. Received marking or a binary 1 condition is indicated by a HIGH.
12	NC	-	No connection.
13	$\overline{\text{DTR}}$	I	DATA TERMINAL READY INPUT. Active LOW. Switching off DTR can either return modem to command state, disconnect phone call, or reset modem. DTR should be set LOW when not used.
14	$\overline{\text{DSR}}$	O	DATA SET READY. LOW indicates handshaking with a remote modem is in progress, and/or the data carrier of a remote modem has been detected.
15	$\overline{\text{RI}}$	O	RING INDICATION. This signal follows the frequency of the ringing signal and is normally about 20 to 40 Hz for 2 second on with 4 seconds off.
16	$\overline{\text{CTS}}$	O	CLEAR-TO SEND. Output always LOW. Reserved for flow controls with FAX option. Not active, and must be tied low when internet communication activated.
17	$\overline{\text{DCD}}$	O	DATA CARRIER DETECT. LOW indicates a data carrier from a remote modem has been detected.
18	NC	-	Formerly HS INDICATION. Effective 31 March 2000, the HS indication function will no longer be supported. This pin should be NO CONNECT in all applications.
19	VCC	-	POWER SUPPLY. 5 Volts \pm 5% Note: Noise should be less than 25mV peak to peak.
20	GND	-	GROUND. Note: Noise should be less than 25mV peak to peak
21	RST	I	RESET. Active HIGH. This input must be asserted HIGH for at least 10 ms to reset the modem. RESET is then returned to LOW for normal operation. If no system reset is available, let this pin float to enable internal reset.
22	$\overline{\text{RTS}}$	I	REQUEST TO SEND. Active Low. Used for flow control. Sould be tied Low if not used. Should be tied Low when using $\overline{\text{SEND}}$ pin and when using @T commands.

If a carrier is detected, the iModem® 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 iModem® to pick up the telephone line without dialing a number.

Table 4. Pin Comparison of CH179X, HS Modem and CH21XX iModem® Family

PIN	iModem CH21XX FAMILY	CH179X and HS Modem FAMILY
1	RING	RING
2	TIP	TP
3	TI	T1
4	NC	$\overline{\text{SENT}}$
5	SPK	SPK
6	NC	$\overline{\text{SEND}}$
7	NC	IN 1
8	OPEN*	IN 2
9	NC	NC
10	TXD	TXD
11	RXD	RXD
12	NC	NC
13	$\overline{\text{DTR}}$	$\overline{\text{DTR}}$
14	$\overline{\text{DSR}}$	$\overline{\text{DSR}}$
15	$\overline{\text{RI}}$	$\overline{\text{RI}}$
16	$\overline{\text{CTS}}$	$\overline{\text{CTS}}$
17	$\overline{\text{DCD}}$	$\overline{\text{DCD}}$
18	NC	NC
19	V _{cc}	V _{cc}
20	GND	GND
21	RST	RST
22	$\overline{\text{RTS}}$	$\overline{\text{RTS}}$

Pause During Dialing.

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 iModem® to pause for a specific length of time. The factory default pause time is 2 seconds.

Example: Dial 9, pause, dial number.
Enter: **ATDT9, T1234567**

Multiple commas may be used for a greater delay time.

Touch Tone and Pause Dialing

The iModem® can use DTMF (touch-tones) "T", or dial pulses "P" 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 T.

Example: Pulse dial 9, pause, touch-tone dial number
Enter: **ATDP9, T1234567**

Redial Last Number.

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

Example: Touch-tone dial 9, pause, dial number, return for command.
Enter: **ATDP9, T1234567;**

Return to Command State.

The iModem® can be forced to reenter the command state after dialing (without hanging up) by ending the dial command with a semi-colon. This is useful when using the modem as an auto dialer.

Automatic Answering.

S0=0* DO NOT ANSWER TELEPHONE
S0=1-254 ANSWER ON RING 1 TO RING 254
S0=255 ANSWER ON RING 255

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

PROGRAMING THE iModem®

Cemetek's iModem® requires an ISP (Internet Service Provider) address, ISP account password, local PSTN dial up phone number and valid email address to send and receive emails.

The required information can be modified by including it on the appropriate iNet AT® Command line at the time the commands are issued from the host processor.

Commands can be issued to the iModem® using any number of commercially available terminal emulation programs - such as PROCOM or HYPER TERMINAL. As an added service to our customers, each iModem® is shipped from the factory with a default ISP account and password for interim use. The default PSTN dial up phone # is local to Sunnyvale, CA.

Table 5A Summary of Non-Extended Result Codes.

Result Code Form		n in ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
0	OK	x	x	x	x	x
1	CONNECT	x	x	x	x	x
2	RING	x	x	x	x	x
3	NO CARRIER	x	x	x	x	x
4	ERROR	x	x	x	x	x
5	CONNECT 1200	1	x	x	x	x
6	NO DIAL TONE	3	3	x	x	x
7	BUSY	3	3	3	x	x
8	NO ANSWER	x	x	x	x	x
9	CONNECT 0600	1	x	x	x	x
10	CONNECT 2400	1	x	x	x	x
11	CONNECT 4800	1	x	x	x	x
12	CONNECT 9600	1	x	x	x	x
13	CONNECT 7200	1	x	x	x	x
14	CONNECT 12000	1	x	x	x	x
15	CONNECT 14400	1	x	x	x	x
16	CONNECT 19200	1	x	x	x	x
17	CONNECT 38400	1	x	x	x	x
18	CONNECT 57600	1	x	x	x	x
19	CONNECT 115200	1	x	x	x	x
22	CONNECT 75TX/1200RX	1	x	x	x	x
23	CONNECT 1200TX/75RX	1	x	x	x	x
24	DELAYED	4	4	4	4	x
32	BLACKLISTED	4	4	4	4	x
33	FAX	x	x	x	x	x
35	DATA	x	x	x	x	x

Table 5B Extended Result Codes.

Result Code Form		n in ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
40	CARRIER 300	x	x	x	x	x
44	CARRIER 1200/75	x	x	x	x	x
45	CARRIER 75/1200	x	x	x	x	x
46	CARRIER 1200	x	x	x	x	x
47	CARRIER 2400	x	x	x	x	x
48	CARRIER 4800	x	x	x	x	x
49	CARRIER 7200	x	x	x	x	x
50	CARRIER 9600	x	x	x	x	x
51	CARRIER 12000	x	x	x	x	x
52	CARRIER 14400	x	x	x	x	x
53	CARRIER 16800	x	x	x	x	x
54	CARRIER 19200	x	x	x	x	x
55	CARRIER 21600	x	x	x	x	x
56	CARRIER 24000	x	x	x	x	x
57	CARRIER 26400	x	x	x	x	x
58	CARRIER 28800	x	x	x	x	x
59	CONNECT 16800	1	x	x	x	x
61	CONNECT 21600	1	x	x	x	x
62	CONNECT 24000	1	x	x	x	x
63	CONNECT 26400	1	x	x	x	x
64	CONNECT 28800	1	x	x	x	x
66	COMPRESSION: CLASS 5	x	x	x	x	x
67	COMPRESSION: V.42bis	x	x	x	x	x
69	COMPRESSION: NONE	x	x	x	x	x
76	PROTOCOL: NONE	x	x	x	x	x
77	PROTOCOL: LAPM	x	x	x	x	x
80	PROTOCOL: ALT	x	x	x	x	x
84	CONNECT 33600	x	x	x	x	x
91	CONNECT 31200	x	x	x	x	x

Note: 1. An "x" in a column indicates that the message (either the long form if verbose, or the value only for short form) will be generated when that particular value of "n" (shown at the top of the column) has been selected by the use of ATXn. A numeral indicates which less explicit message (verbose or short form) will be output for that X option.

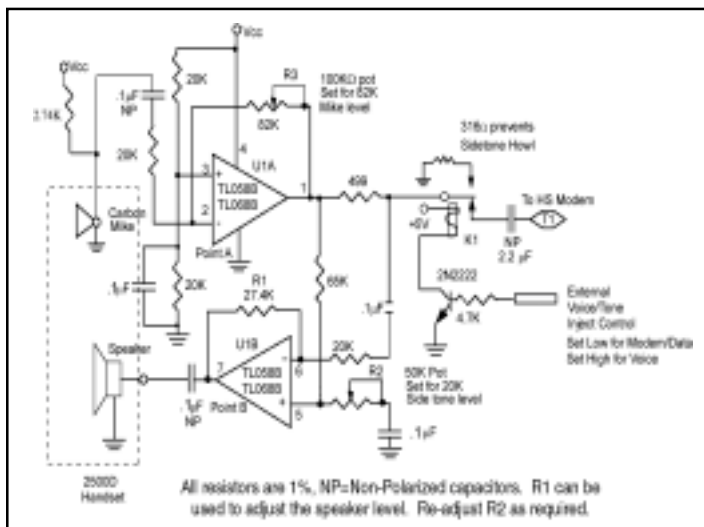
Table 5C. Extended Result Codes.

Result Code Form		n in ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
165	CONNECT 32000	x	x	x	x	x
166	CONNECT 34000	x	x	x	x	x
167	CONNECT 36000	x	x	x	x	x
168	CONNECT 38000	x	x	x	x	x
169	CONNECT 40000	x	x	x	x	x
170	CONNECT 42000	x	x	x	x	x
171	CONNECT 44000	x	x	x	x	x
172	CONNECT 46000	x	x	x	x	x
173	CONNECT 48000	x	x	x	x	x
174	CONNECT 50000	x	x	x	x	x
175	CONNECT 52000	x	x	x	x	x
176	CONNECT 54000	x	x	x	x	x
177	CONNECT 56000	x	x	x	x	x
178	CONNECT 56000	x	x	x	x	x
179	CONNECT 230400	x	x	x	x	x

Table 5C. Extended Result Codes.

Result Code Form		n in ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
180	CONNECT 28000	x	x	x	x	x
181	CONNECT 29333	1	x	x	x	x
182	CONNECT 30667	1	x	x	x	x
183	CONNECT 33333	1	x	x	x	x
184	CONNECT 34667	1	x	x	x	x
185	CONNECT 37333	1	x	x	x	x
186	CONNECT 38667	x	x	x	x	x
187	CONNECT 41333	x	x	x	x	x
188	CONNECT 42667	x	x	x	x	x
189	CONNECT 45333	x	x	x	x	x
190	CONNECT 46667	x	x	x	x	x
191	CONNECT 49333	x	x	x	x	x
192	CONNECT 50677	x	x	x	x	x
193	CONNECT 53333	x	x	x	x	x
194	CONNECT 54677	x	x	x	x	x

Figure 6. Schematic Illustrating Implementation of Voice Injection Feature.



PHONE LINE CONNECTION GUIDELINES

1. The iModem® must be mounted in the final assembly such 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 iModem® to the telephone line interface must be provided in wiring that carries no other circuitry other than that specifically allowed in the FCC rules (such as A and A1 leads).
3. Connection to phone line should be made through an RJ-11C jack.
4. PCB traces from the modem's RING and TIP pins to the RJ-11C jack must be 0.1 inch spacing or greater to one another and 0.2 inch spacing or greater to all other traces. The traces should have a nominal width of 0.020 inches or greater.
5. The RING and TIP PCB traces should be as short as possible and oriented to prevent coupling other high speed or high frequency signals present on the host circuit PCB.
6. No additional circuitry other than that shown in Figure 7 may be connected between the modem module and the RJ-11C Jack. Doing so will invalidate the FCC approval.
7. The iModem®, the RJ-11 Jack, the interfacing circuitry and all PCB traces in between, must be contained on a PCB with a 94 V-0 flammability rating.
8. The supplied FCC registration label must be applied visibly on the outside of the product.
9. The product's User Manual must provide the user with instructions for connection and use as recommended in the FCC Registration Section below.

CANADIAN APPROVALS

The iModem® family is approveable for use by DOT to CSA CS-03 Part I. However, per Canadian procedures, approval can only be granted after the iModem® has been installed into the end product. Typically, Canadian approval is obtained by submitting the final end product to an independent test house or consultant for evaluation. The test house/consultant then forwards the test results and applicable documents to the regulatory agency. Cermetek offers a list of consultants to assist with this process.

iModem® HANDLING AND ASSEMBLY RECOMMENDATIONS

The iModem® contains static-sensitive components and should only be handled by personnel and in areas that are properly protected against static discharge.

There are two mounting techniques that are recommended for physically connecting the iModem® to a PCB:

1. Direct soldering
2. Sockets.

Direct Soldering.

The iModem® may be wave soldered onto a circuit card. All iModem® products are hermetically sealed and will not be harmed by industry standard wave soldering processes.

Socketing.

The socketing approach to mounting eliminates cleaning and desoldering concerns. When the socket is used, it must make a solid connection to all pins. Failure to do so will cause unreliable or intermittent operation. Also, steps should be taken to assure that the module remains tightly seated in the socket after the end product is shipped. Cermetek recommends socket CES-150-01-T-S by Samtec, 50 pin strip socket.

FCC REGISTRATION

All products in the iModem® family are registered with the FCC under Part 68. To maintain the validity of the registration, you must serve notice to the end user of the product of several restrictions the FCC places on the modem and its use.

In addition to restriction notification, the FCC requires that Cermetek make all repairs to all products in the iModem® family. If repairs are necessary after installation of the iModem® and the end product has been delivered to the end user, the end product must be returned to the end product supplier where the iModem® can be removed and then forwarded to Cermetek repair. The following notice is recommended and should be included in the end product's user manual.

FOR YOUR USER'S MANUAL

The part 68 rules require the following (or equivalent) be provided to the end user of the equipment containing a DAA:

Type of Service: The (insert end 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 RJ45S). Connection to telephone-company-provided coin service (central office implemented systems) is prohibited. Connection to party lines service is subject to state tariffs.

Changes in Attestation Procedure for Plugs and Jacks:

(Name of applicant) attests that the network interface plugs or jacks used on this equipment comply with and will continue to comply with the mechanical requirements specified in Part 68, Sub-part F, specifically the dimensions, tolerances and metallic plating requirements. The compliance of these connectors will be assured by purchase specifications and incoming inspection. Documentation of such specifications and/or inspections will be provided by the FCC within 30 days of their request for the same.

Telephone Company Procedure: 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 effect 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.

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); both of these items are listed on the equipment label.

Table 6A. Summary of Basic AT Commands.

COMMAND	FUNCTION	COMMAND	FUNCTION
A/	Re-execute command	X0	Report basic call progress result codes, i.e. OK, CONNECT< RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER and ERROR
A	Go off-hook and attempt to answer call	X1	Report basic call progress result codes, i.e. OK, CONNECT< RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER and ERROR
B0	Select V.22 connection at 1200bps	X2	Report basic call progress result codes, i.e. OK, CONNECT< RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER and ERROR
B1	Select Bell 212A connection at 1200bps	X3	Report basic call progress result codes, i.e. OK, CONNECT< RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER and ERROR
C1	Return OK message	X4	Report basic call progress result codes, i.e. OK, CONNECT< RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER and ERROR
Dn	Dial modifier	Y0	Disable long space disconnect before on-hook
	P Pulse Dial	Y1	Enable long space disconnect before on-hook
	T Touch Tone Dial	Z0	Restore stored profile 0 after warm reset
	W Wait for Dial Tone	Z1	Restore stored profile 1 after warm reset
	; Return to Idle State		Force RLSD active regardless of the carrier state
	@ Wait for Quiet Answer	&C0	Allow RLSD to follow the carrier state
	! Command	&C1	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q7
	, Flash Hook	&D0	The modem ignores DTR Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6
	0-9/ABCD Dial Digits/ Characters & wait for credit card dial tone	&D1	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6
	Ù Toggles calling tone	&D2	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6
	L Redial last number	&D3	The modem performs soft reset.
	* Star digit - tone dialing		
	S=n Dial the number and store in directory. N 0 to 3.		
E0	Turn off command echo		
E1	Turn on command echo		
H0	Initiate a hang-up sequence		
H1	If on-hook, go off-hook and enter command mode		
L0	Set low speaker volume		
L1	Set low speaker volume		
L2	Set medium speaker volume		
L3	Set high speaker volume		
M0	Turn Speaker off		
M1	Turn speaker on during hand shaking and turn speaker off while receiving carrier		
M2	Turn speaker on during hand shaking and while receiving carrier		
M3	Turn speaker off during dialing and receiving carrier and turn speaker on during answering		
N0	Turn off auto-mode detection		
N1	Turn on auto-mode detection		
O0	Go on-line		
O1	Go on-line and initiate a retrain sequence		
Q0	Allow result codes to DTE		
Q1	Inhibit result codes to DTE		
Sn	Select S-Register as default		
Sn?	Return the value of S-Register n		
Sn=v	Set default S-Register to value v		
V0	Report short form (terse) result codes		
V1	Report long form (verbose) result codes		
W0	Report DTE speed in EC model		
W1	Report line speed, EC protocol and DTE speed		
W2	Report DCE speed in EC mode		

Table 6B. Summary of Basic AT Commands (continued).

COMMAND	FUNCTION	COMMAND	FUNCTION
&F0	Restore factory configuration 0	&P3	Set 20 pps pulse dial with 33%/ 67% make/ break
&F1	Restore factory configuration 1	&Q0	Select direct asynchronous mode
&G0	Disable guard tone	&Q5	Modem negotiates an error corrected link
&G1	Disable guard tone	&Q6	Select asynchronous operation in normal mode
&G2	Enable 1800 Hz guard tone	&T0	Terminate any test in progress
&K0	Disable DTE/ DCE flow control	&T1	Initiate local analog loopback
&K3	Enable RTS/ CTS DTE/DCE flow control	&T2	Return ERROR result code
&K4	Enable XON/XOFF DTE/DCE flow control	&T3	Initiate local digital loopback
&K5	Enable transparent XON/XOFF flow control	&T4	Allow remote digital loopback
&K6	Enable both RTS/CTS and XON/XOFF flow control	&T5	Disallow remote digital loopback request
Kn	CONTROLS BREAK HANDLING DURING THREE STATES When modem receives a break from THE DTE:	&T6	Request an RDL without self-test
\K0,2,4	Enter on-line command mode, no break sent to the remote modem	&T7	Request an RDL with self-test
\K1	Clear buffers and send break to remote modem	&T8	Initiate local analog loop with self-test
\K3	Send break to remote modem immediately	&V	Display current configurations
\K5	Send break to remote modem in sequence with transmitted data	&W0	Store the active profile in NVRAM profile 0
	When modem receives \b in on-line command state:	&W1	Store the active profile in NVRAM profile 1
\K0,1	Clear buffers and send break to remote modem	&Y0	Recall stored profile 0 upon power up
\K2,3	Send break to remote modem	&Y1	Recall stored profile 1 upon power up
\K4,5	Send break to remote modem in sequence with transmitted data	&Zn=x	Store dial string x (to 34) to location n (0-3)
	When modem receives break from remote modem:	%E0	Disable line quality monitor and auto retrain
\K0,1	Clear data buffers and send break to DTE	%E1	Enable line quality monitor and auto retrain
\K2,3	Send a break immediately to DTE	%E2	Enable line quality monitor and fallback
\K4,5	Send a break with received data to DTE		
\N0	Select normal speed buffered mode	MNP10 COMMANDS	
\N1	Select direct mode	-K0	Disable MNP 10 extended services
\N2	Select reliable link mode	-K1	Disable MNP 10 extended services
\N3	Select auto reliable mode	-K2	Disable MNP 10 extended services
\N4	Force LAPM mode		
\N5	Force MNP mode	FAX CLASS 1	
\V0	Connect messages are controlled by the command settings X, W, and S95	+FCLASS=n	Service Class
\V1	Connect messages are displayed in the single line format	+FAE=n	Data/fax auto answer
+MS	Select modulation	+FRH=n	Receive data with HDLC framing
	ERROR CORRECTING COMMANDS	+FRM=n	Receive data
%C0	Disable data compression	+FRS=n	Receive silence
%C1	Enable MNP 5 data compression	+FTH=n	Transmit data with HDLC framing
%C2	Enable MNP 5 data compression	+FTM=n	Transmit data
%C3	Enable both V.42.bis and MNP5 compression	+FTS=n	Stop transmission and wait
\A0	Set maximum block size in MNP to 64		
\A1	Set maximum block size in MNP to 128	iNet AT® Commands	
\A2	Set maximum block size in MNP to 192	@TAn	Enter remote receiver email address
\A3	Set maximum block size in MNP to 256	@TC	Save current internet configuration profile
\Bn	Send break of n x 100 ms	@TD	Dial pre-programmed ISP and send email to pre-programmed email address
&M0	Select direct asynchronous mode	@TEn	Enter local modem email address
&P0	Set 10 pps pulse dial with 39%/61% make/ break	@TI	View revision of firmware
&P1	Set 10 pps pulse dial with 33%/67% make/ break	@TLn	Enter username for ISP where n is username
&P2	Set 20 pps pulse dial with 39%/61% make/ break	@TNn	Enter local access phone number for ISP
		@TMn	Enter email message. End with <CR>.<CR>
		@TPn	Enter password for ISP
		@TON	Enter ISP mail server IP address
		@TS	Enter email subject
		@TV	View imodem profile
		@TG	Dial Pre-programmed ISP and Receive email from pre-programmed email address.

Note: All @T Commands sent from the host (DCE) must be sent at 57600bps, N81 (no parity, 8 data bits and 1 stop bit).

Table 7. S-Registers Summary.

Register	Function	Range	Units	Saved	Default
S0	Rings to Auto-Answer	0-255	Rings	*	0
S1	Ring Counter	0-255	Rings		0
S2	Escape Character	0-255	ASCII	*	43
S3	Carriage Return Character	0-127	ASCII		13
S4	Line Feed Character	0-127	ASCII		10
S5	Backspace Character	0-255	ASCII		8
S6	Wait Time for Dial Tone	2-255	seconds		2
S7	Wait Time for Carrier	1-255	seconds		50
S8	Pause Time for Dial Delay Modifier	0-255	seconds	*	2
S9	Carrier Detect Response Time	1-255	0.1 seconds	*	6
S10	Carrier Loss Disconnect Time	1-255	0.1seconds	*	14
S11	DTMF Tone Duration	50-255	0.001sec	*	95
S12	Escape Prompt Delay	0-255	0.02sec	*	50
S13	Reserved	---	---	---	---
S14	General Bit Mapped Options Status	---	---	---	138 (8Ah)
S15	Reserved	---	---	---	---
S16	Test Mode Bit Mapped Options Status (&T)	---	---	---	0
S17	Reserved	---	---	---	---
S18	Test Timer	0-255	seconds	*	0
S21	V.24/General Bit Mapped Options Status	---	---	---	52 (34h)
S22	Speaker/Results Bit Mapped Options Status	---	---	---	117 (75h)
S23	General Bit Mapped Options Status	---	---	---	62 (3Dh)
S24	Reserved	---	---	---	---
S25	Delay to DTR Off	0-255	seconds or 0.01 second	---	5
S26	RTS-to-CTS Delay	0-255	0.01second	---	1
S27	General Bit Mapped Options Status	---	---	---	73 (49h)
S28	General Bit Mapped Options Status	---	---	---	0
S30	Disconnect Inactivity Timer	0-255	10 seconds	---	0
S31	General Bit Mapped Options Status	---	---	---	94 (C2h)
S32	XON Character	0-255	ASC11	---	17 (11h)
S33	XOFF Character	0-255	ASC11		19 (13h)
S34-S35	Reserved	---	---		---
S36	LAPM Failure control	---	---	*	7
S37	Line Connection Speed	---	---	*	0
S38	Delay before Forced Hang up	0-255	seconds		20
S39	Flow Control bit Mapped Options Status	---	---	*	3
S40	General Bit Mapped Options Status	---	---	*	104 (68h)
S41	General Bit Mapped Options Status	---	---	*	195 (C3h)
S42-S45	Reserved	---	---		---
S46	Data Compression Control	---	---	*	138
S48	V.42 Negotiation Control	---	---	*	7
S82	LAPM Break Control	---	---		128 (40h)
S86	Call Failure Reason Code	0-255	---		---
S95	Result Code Messages Control	---	---	*	0

Telephone Company Procedure (continued):

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. Consult your telephone provider.

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. Contact your local telephone service provider if you have any questions about your phone line.

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).

DEFAULT STATUS, PERFORMANCE AND SPECS

Prior to delivery, Cermetek installs into each iModem® the following the Default Configuration Profile:

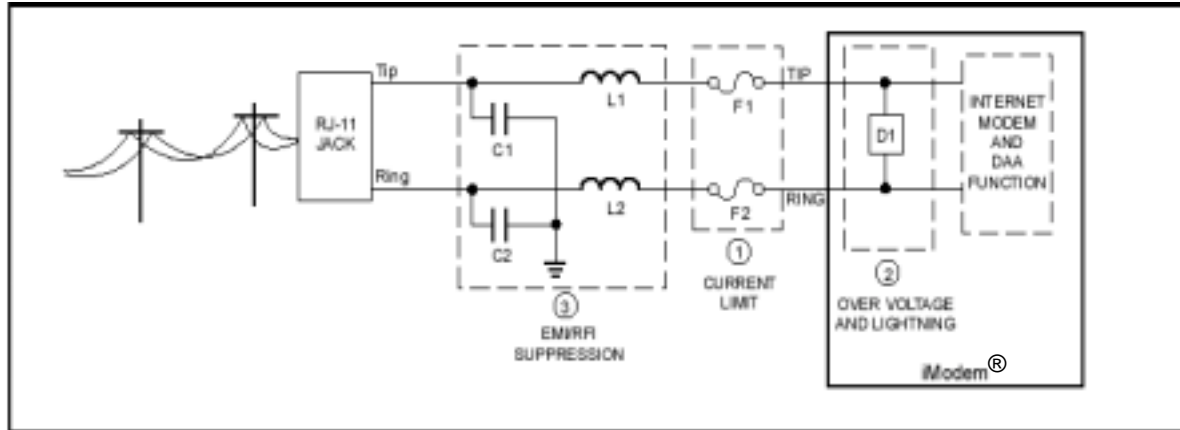
Default Connect Speeds is 56,000bps
Serial port data rate auto baud enabled
Bell 212A operation at 1200bps
Parity - none
Auto answer disabled
Command echo ON
All result codes enabled – except \REL codes
Wait for dial tone before dialing – 2 seconds
Dials with touch-tone (T)
Detects busy signal (ATX4)
Full word result codes - non-extended
Pulse dial make/break ratio = 39/61- 10 pps
Test timer set to 0 seconds, test modes disabled
Inactivity timer set to 0 minutes
CTS always active
DSR is ignored
DCD is ignored
RTS to CTS delay - .01 seconds
DTR always active - hangs up after transition
Long space disconnect disabled
Speaker enabled but off when receiving carrier
Speaker volume set to low
Local modem will not grant RDL request from remote modem
Guard tones disabled
Minimum DTR pulse width = .05 seconds
Ring count – 00
Escape code character = 43 (+)
Flash to on hook = 70 ms
Auto speed detection enabled
DTE connect speed, connect messages
Back space character = 08 (BS) Carriage return character = 13 (CR)
Line feed character = 10 (LF)
Duration of wait for dial tone = 2 seconds
Duration of wait for carrier after dialing = 50 seconds
Carrier detect response time = 0.6 seconds
Connection detected at DTE – Highest speed 38,400bps

DEFAULT STATUS, PERFORMANCE AND SPECS (continued)

Auto retrain enabled - 30 seconds attempt
MNP error correction mode can be negotiated (&Q5)
MNP - non-extended service selected
MNP error correction block size is 128 characters selected
Data compression -negotiation enabled
Transmit break length is 0.3 seconds
All breaks are transmitted in sequence with data
Serial port flow control enabled = RTS/CTS
XON/XOFF flow control characters selected

Note: Upon power-up the iModem® will recall user profile 0 which may override some of the above Factory Defaults. If desired the user may, at their option, save the factory defaults in user profile 0.

Figure 7. PSTN Line Interface for all iNet Appliance Products



1. **Current Limiting PSTN Protection Line Device.**

Current limiting is mandatory to meet UL safety requirements. To maintain conveyed FCC Part 68 approval, the current limiting devices identified as F1 and F2 in dashed box #1 must also survive FCC Part 68 surge tests. Use one of the external component schemes defined below in section 1A-1C to maintain compliance. Reference Cermetek Application Note # 126 for a more detailed discussion.

- A. A Raychem Polyfuse TR 600-150 (rated at 0.15 amps) is preferred because this device resets automatically upon removal of the current flow. Non-resetable devices such as Littelfuse, type 220003, WICKMANN 19397-038 or TECCOR F1250T are also acceptable.
- B. Resistors (10Ω carbon film or 1/8 watt minimum) may be used in Canada as Canada has no requirement that PSTN equipment be operational after a Type B surge test.
- C. Although CSA CS-03 Part 1 (Canada) follows the requirements of FCC Part 68 (USA), Cermetek recommends contacting DOT (Canada) and/or a certified independent lab to verify compliance. For Canada, use either 10Ω resistors (carbon film or SMD parts 1/8 watt minimum) as described in paragraph B, above, or non-resetable fuses or resetable Polyfuses as described in paragraph A above.

2. **Over Voltage and Lightning Protection.**

Surge Protection is provided by internal circuitry contained within the iModem[®]. No additional external components are required to maintain conveyed FCC Part 68 approval. Refer to Cermetek Application Note #126 for a more detailed discussion.

3. **EMIRFI Suppression.**

No external EMIRFI noise suppression circuitry is required to maintain conveyed FCC Part 68 approval. However, additional suppression, if required for other reasons, may be added as described below in sections 3A-3B without adversely effecting the FCC Part 68 approval.

- A. To provide adequate EMIRFI suppression, the capacitor/inductor network contained in dashed box #3 in Figure 1 should be located as close to the RJ11 Jack as possible. Further, this network should be provided with an excellent ground path to the chassis.
- B. Capacitors C1 and C2 should not exceed 0.005 μf. They must have a rating of 1.5 KV and typically are .001 μf +/- 20%. Recommended devices for inductors L1 and L2 are Fair-Rite 2643666611 or 2943666661 or equivalent. For UL applications, choose capacitors and inductors that are UL 1950 listed. The actual values of the components used may vary depending on the end product design.

Table 8. iModem® Electrical Specifications.

Symbol	Characteristic	Min.	Typ.	Max.	Units
V _{cc}	Positive Supply voltage	4.5	5.0	5.5	V
I _{cc} Off Hook (CH1794)	Nominal Operating Current @ V _{cc} =5.5V when modem is Off Hook		115.0		mA
I _{cc} Off Hook (CH1798/99)	Nominal Operating Current @ V _{cc} =5.5V when momem is Off Hook		185.0		mA
V _{IH}	High Level Input Voltage*	2.0			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		0.5		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 _{IN}	Input Leakage Current (TXD, DTR, RTS, IN1, IN2, SEND)			100	uA
I _{OH}	Input Current (RST)			500	uA
C _P	Capacitive Load (TXD, DTR, RTS) Capacitive Load (RTS)			10 8	pF pF

Table 9. iModem® Electrical Specification

Parameter	Minimum	Typical	Maximum	Units	Comments
Off Hook Impedance	20			MOhm	
Trans Hybrid Loss		25		dB	600 Ohm, RXA, TXA
Ring Voltage Loop	110V		250V	V _{pp}	On 48VDC line voltage for sustained periods
Line Loop Current - (Off-Hook)		20	100	mA	Does not apply to CH1799LL
Return Loss @ 1000 Hz		15		dB	600 Ohm
Ring Frequencies		40		Hz	
Receiver Insertion Gain	-0.5	0.0	+0.5	dB	
Transmit Power		-9.5		dBm	600 Ohm - Data Mode
First Character After Reset	0.5	1.0		sec	Delay
Inter Character Delay	20	50		msec	Between all command characters
Command Delay	100	200		msec	Between all AT commands
Minimum Reset Pulse Duration	10			msec	If user supplied

Table 10. Analog Characteristics.

Name	Type	Characteristics	Value
SPK	O(DF)	Minimum Load	300ohm
		Maximum Capacitive Load	0.01m
		Output Impedance	10ohm
		Output Voltage	2.5 ± 1.6V
		D.C. Offset	<20mV

Table 11. Summary iModem® Family of Products

Model	Summary of Features	Operating Temperature
CH2156	2 Sense Pins, Email Send Control Pin, Send port status emails Full Function, V.90, FCC Part 68 Approved, UL1950 listed modem	0° C to 70° C
CH2157	1 Input Sense Pin, 1 Temperature Sense Pin, Email Send Control Pin Send port status emails Full Function, V.90, FCC Part 68 Approved, UL1950 listed modem	0° C to 70° C
CH2158	2 Input Sense Pins, Serial RAM, Email Send Control Pin Send Email only Full Function, V.90, FCC Part 68 Approved, UL1950 listed modem	0° C to 70° C
CH2159	2 Input Sense Pins, Email Send Control Pin , Send emails with attachment files. Full Function, V.90, FCC Part 68 Approved, UL1950 listed modem	0° C to 70° C
CH2160	2 Input Sense Pins, Send and Receive Email. Email Send Control Pin Full Function, V.90, FCC Part 68 Approved, UL1950 listed modem	0° C to 70° C

Figure 8. Example Circuit for illumination of Email Accepted LED.

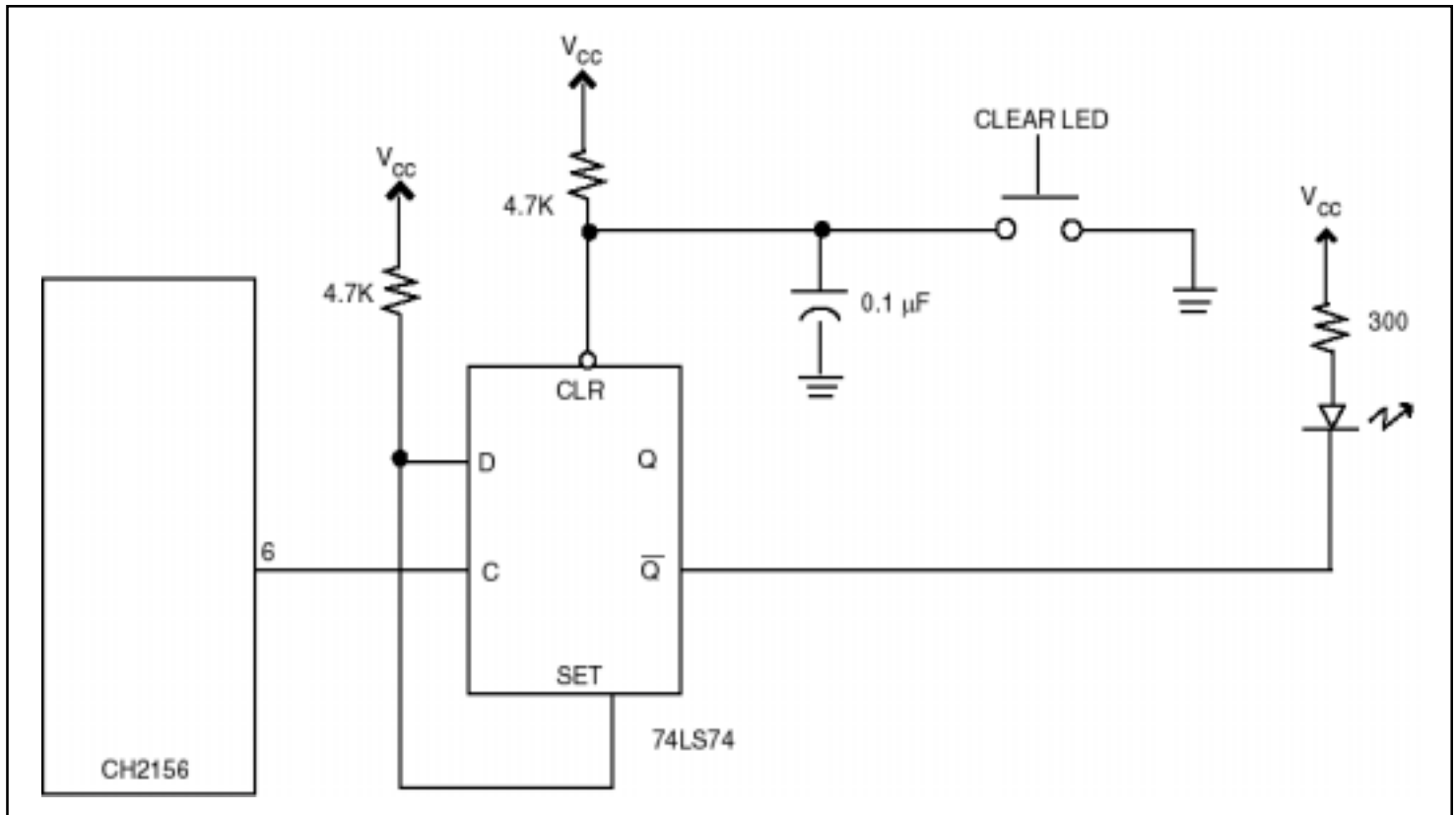
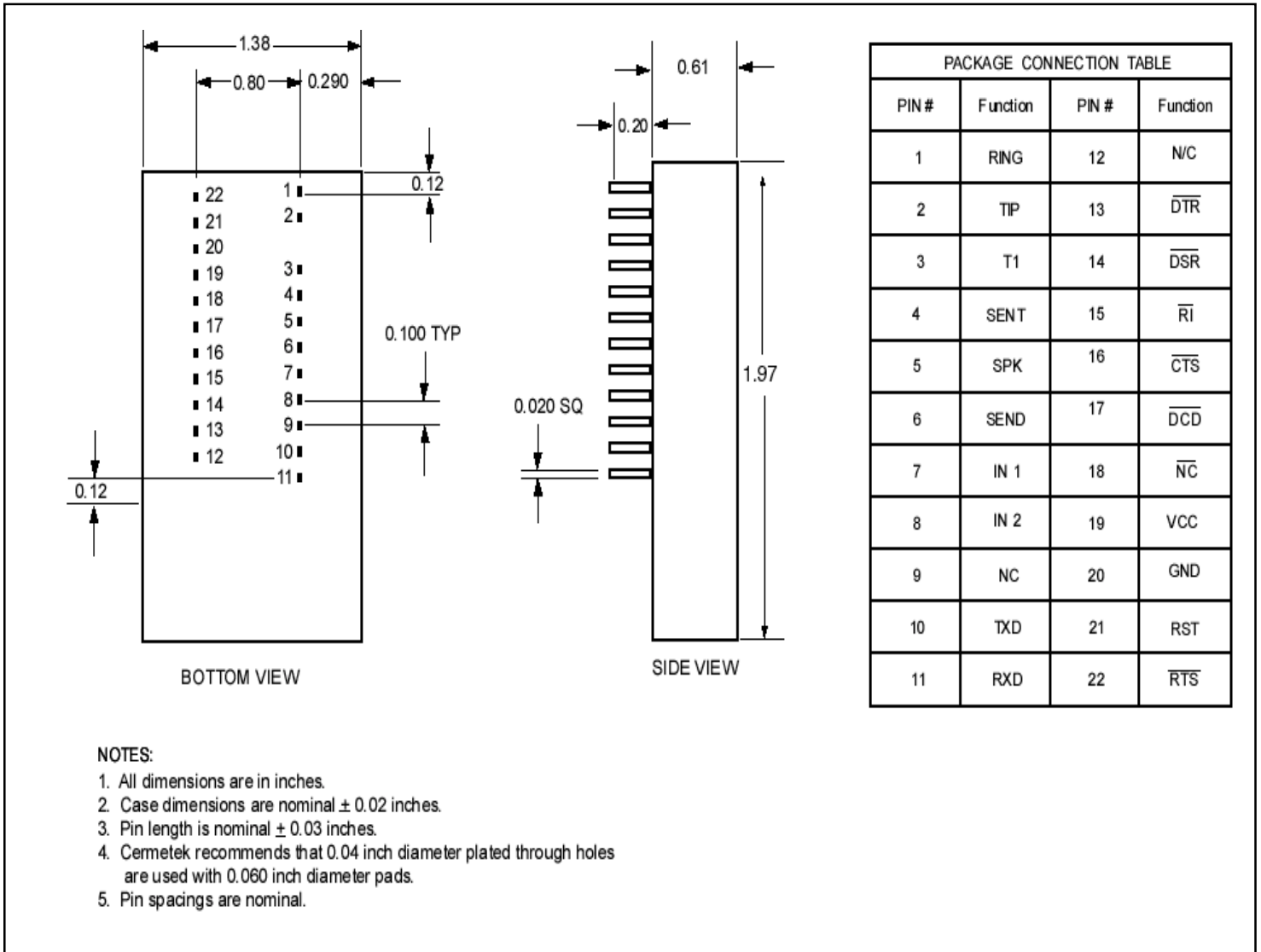


Figure 9. Physical Dimensions and Pin Functions



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406 TASMAN DRIVE · SUNNYVALE, CALIFORNIA 94089 · TEL: (408) 752-5000 FAX: (408) 752-5004

E-mail: cermstaf@cermetek.com

website: www.cermetek.com

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