

## HIGH SPEED INTERNET MODEM FAMILY

**CH2124** - **Send/Retrieve Email. 2 I/O Ports 2400bps.**  
**CH2160** - **Send/Retrieve Email. 2 I/O Ports, V.90.**

### FEATURES

- Replaces conventional modems using the world wide web for communication.
- Transparent internet operations of Point-to-Point Protocol (PPP), Password Authentication Protocol (PAP) and Challenge Authentication Protocol (CHAP) to connect to the Internet.
- Built-in TCP/IP and SMTP to send emails, TCP/IP and POP3 to retrieve and/or delete emails.
- On Demand and I/O pin event driven email transmission and retrieval.
- Send/Retrieve email.
- Retrieve select individual message.
- Programmable using serial interface.
- Remote programming using PSTN.
- Resident modem supports: V.90, V.34bis, V.34, V.22bis, V.22A/B V.23, V.21, Bell 212A and 103, (depending on model) and can be used in conventional modem mode.
- Error correcting: V.42 LAPM, MNP 2-4 and MNP10 (CH2160).
- Automatic baud rate adaptability utilizing speed sensing, flow control and data buffers.
- Serial interface, V.24 (EIA 232-E), 5 volts.
- NVRAM for stored modem (S-Registers) profiles.
- Cermetek @T<sup>®</sup> AT-like Commands.
- 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/Industry Canada CS-03 Part I approvable.
- Pin-for-Pin compatible family.
- +5 Volt operation.
- Small size: 1.35" x 1.97" x 0.55" (nominal).
- Low Cost 2400bps version (CH2124).
- Use with any Non-proprietary commercial or private ISP.
- Cermetek's **iModem Network** ISP has 1000s of local access numbers world wide.
- Failsafe back up 1-800 access number, auxiliary and alternative telephone numbers available.
- 1 year free trial subscription to **iModem Network** ISP provided with each iModem.
- iNetWizard<sup>®</sup> Windows based programming aid available free-of-charge.

### INTRODUCTION

Direct machine-to-machine interaction represents the next logical extension of the internet. Cermetek internet modem (iModem) products are designed to exploit the internet to facilitate the utilization of machine-to-machine interactions. Using email, information can easily be transferred between systems and can be transmitted/retrieved at will. Internet email provides low cost, near real time multi-path communication. Replacing conventional modems and long distance telephone lines with local access internet connections reduces fixed asset and maintenance costs, limits communication expenses and saves money.

### USER FRIENDLY INTERFACE LAYER

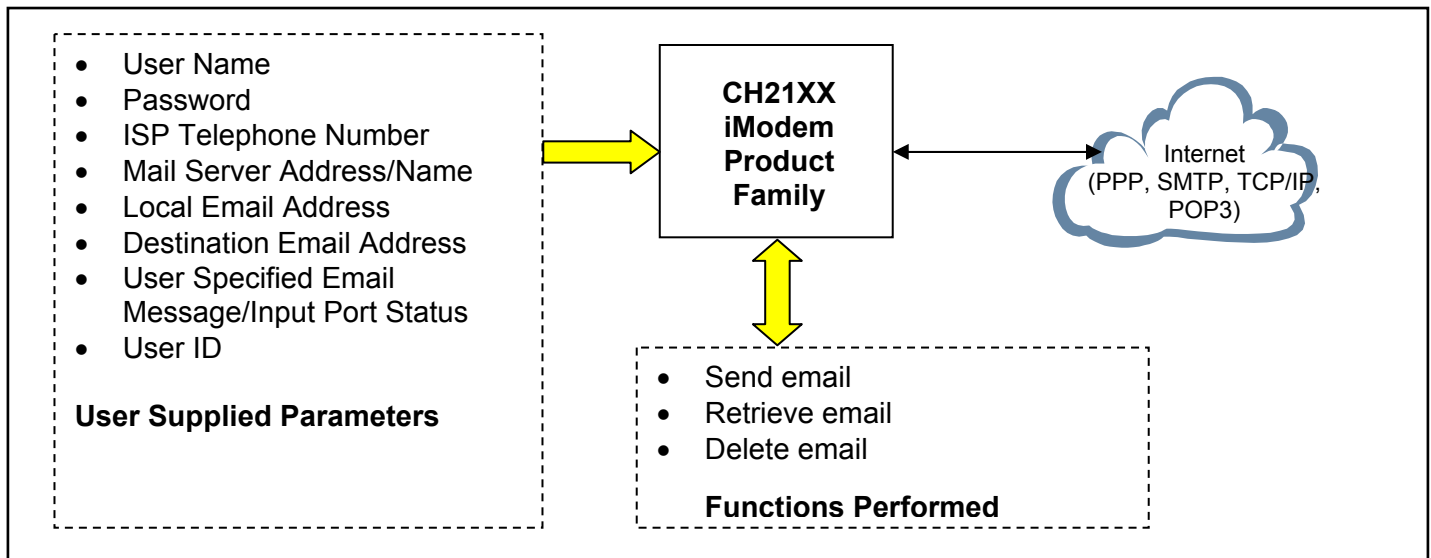
All Cermetek iModem products contain a user friendly interface layer that provides the user transparent access to the internet. This interface layer, consisting of various @T<sup>®</sup> macro commands, has the look and feel of conventional modem AT commands. With the @T<sup>®</sup> macro commands the user can direct the iModem to compose, edit/modify, send, retrieve and delete email messages. Internet and email activity status is reported via the iModem's V.24 (EIA 232-E) serial interface.

The CH2124/60 products are the first generation internet enabled devices. These products excel at sending and retrieving modest amounts of data. Email messages of approximately 125 ASCII characters in length can be stored in internal Flash ROM for later transmission. Emails of larger length can be retrieved.

The CH2124/60 products are ideal for very low cost controller applications and in applications where limited data transfer is required.

### OVERVIEW OF THE CH21XX iMODEM

A conceptual representation of the iModem in an embedded environment is presented in Figure 1. As can be seen in this figure, the iModem requires the input of various internet parameters to function properly: user name, user ID, user password, ISP telephone number, ISP mail server address/name, local email address/name, destination email address and user specified email message/input port status.



**Figure 1. Conceptualized Block Diagram illustrating the Cermetek CH21XX iModem product family performing the embedded internet application function.**

Cermetek's iModem products provide the user with the ability to assign a unique unit name to each iModem thereby creating a customized identity for each system containing an iModem product.

Each iModem device stores the user-supplied parameters in internal memory. These parameters are retained when power is removed. The user supplied parameters are loaded into the iModem via the iModem's serial interface port utilizing either Cermetek's **iNetWizard**<sup>®</sup> telecommunications software package or, alternatively, one of a variety of commercially available terminal emulation software packages. **iNetWizard**<sup>®</sup> is available free of charge and runs on any standard PC operating Microsoft Windows.

**Internet Connectivity.** The CH21XX iModem uses the user supplied parameters to establish an internet connection and then send, retrieve and/or delete email. After completion of the required internet activities, the iModem terminates the internet connection.

**Send, Retrieve and Delete Email.** The CH2124/60 products send and retrieve email of modest length. The pre-stored message length is approximately 125 ASCII characters. Messages are stored in Flash ROM. Streaming email is not supported in the CH2124/60 iModem products.

Refer to Cermetek Application Note # 155, [@T<sup>®</sup> Command Set Description and Usage For CH2124/60 iModems](#), for more details.

**iModem Hardware Configuration.** Each CH2160 (CH2124) iModem contains a fully functional 56kbps (2400bps) modem and the hardware and firmware needed to provide the internet capability. Because of the unique architecture of Cermetek iModems, these iModems have the ability to operate as either an

internet email transceiver or as a high reliability analog modem. Additionally, the CH2124/60 products support user remote access which can be used to reprogram or reconfigure an iModem deployed in the field.

The iModem Family of products are pin compatible with the CH179X and CH2056 modem products. Referring to Figure 2, the CH21XX iModem Family consists of an industrial grade high speed modem module and a  $\mu$ P controller with associated internal logic. The  $\mu$ P controller and the logic provide all the functions required for internet communication via standard PSTN telephones lines. All CH21XX iModem products utilize TCP/IP, PPP, PAP, CHAP, SMTP and POP3 internet protocols.

#### **Remote Access.**

**Required External Connections.** The iModem requires an external RJ-11C jack for the PSTN line connection. An ITU-T V.24 serial interface is required when host processor control of the iModem is required in the specific application. All retrieved emails are presented to the host system for further processing and/or retention via the serial interface.

**Approvals.** The CH21XX iModem Family is FCC Part 68 approved, UL 1950 and CSA C22.2 950 (Third Edition) listed and Industry Canada CS-03 Part I registered.

**Physical Dimensions.** The modules are designed for PCB through-hole mounting and are 1.35" x 1.97" x 0.55" in size.

## iMODEM EVALUATION BOARD

Cermetek manufactures a companion evaluation board that is designed to simplify the hardware connections required to program the iModem as well as providing a reliable platform to assist with system level debugging. Contact Cermetek and ask for the CH21XX iModem Evaluation Board.

## iMODEM CONTROL METHODOLOGIES

The iModem receives @T<sup>®</sup> 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 POP, log on to the internet, authenticate and verify the user ID and password, and either sends or retrieves email depending on the command/status flag received. For CH2124/60 products, see Table 1 for a summary of available @T<sup>®</sup> commands.

The iModem Family offers a variety of internet communication features ranging from simple on demand event triggered email transmission to full send and retrieve email capability. User Control of the internet communication activity of the iModem device typically falls into one of the following basic control strategies:

1. Fully Autonomous or event driven pin control requiring no host processor intervention. A pre-stored message is sent on a pin transition (CH2124/60).
2. Semiautonomous control, requiring one command to be issued from the host processor. A pre-stored message is sent on command.
3. Complete host intervention and supervision requiring each command to be issued from the host. Message is constructed and sent in real time.

**Fully Autonomous On Demand Event Driven Control.** This is the simplest method of operational control. Application of a 50ms TTL Low going pulse or level to the Send Email Control pin (Pin # 6) will cause the CH2124/60 iModem to send an email using its internal internet configuration profile. This profile is pre-programmed at the factory and can be modified by the user as necessary. No host processor intervention is required. The DTE serial interface is not required for fully autonomous on demand or event driven control. The CH2124/60 iModem will abort email related activities and return to the idle state 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.

**Semi-Autonomous Control.** This method requires a minimal amount of host processor intervention and requires that the DTE serial port be operational. Semi-autonomous control is a special case of full Host Supervised Control and relies on the preprogrammed default internet configuration profile contained within the iModem. Initiation of an email activity occurs with the issuance by the host processor to the iModem the appropriate @T<sup>®</sup> command to send/retrieve/delete email. PSTN dial-up, logon, authentication and email transmission, retrieval, and/or deletion are performed automatically by the iModem in the same fashion as for the Fully Autonomous On-Demand control method described above.

**Host Supervised Control.** This method is the most flexible, but requires issuance by the host processor of the necessary @T<sup>®</sup> commands in the required order from the host processor. When choosing an implementation scheme utilizing a host processor, the host controls the iModem by using Cermetek @T<sup>®</sup> commands. These commands are similar to the standard Hayes AT command set.

Although the DTE serial port 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 preprogrammed parameters (including the email message content) by simply entering the applicable information using the appropriate @T<sup>®</sup> Command.

**Delete Email.** The user may selectively delete any email message (by specifying the message number) or delete all messages cached on the POP3 server.

**Email and Internet Activity Status.** The CH2124/60 provides activity status messages on the iModem's serial port. These status messages consist of a series of ASCII characters. Some examples are: BAD MESSAGE NUMBER, CONNECT, HANGING UP, MESSAGE ACCEPTED, MESSAGE DELETED. For a more detailed discussion of CH2124/60 status messages, refer to Cermetek Application Note # 155, @T<sup>®</sup> Command Set Description and Usage For CH2124/60 iModems.

**Back-up and Alternative POP access Phone Numbers.** Cermetek iModem products allow usage of an alternative local access POP phone number or, if available, a 1-800 number, should the iModem fail to connect to the primary POP. The user can establish the number of attempts made to the primary POP before the back up POP is attempted.

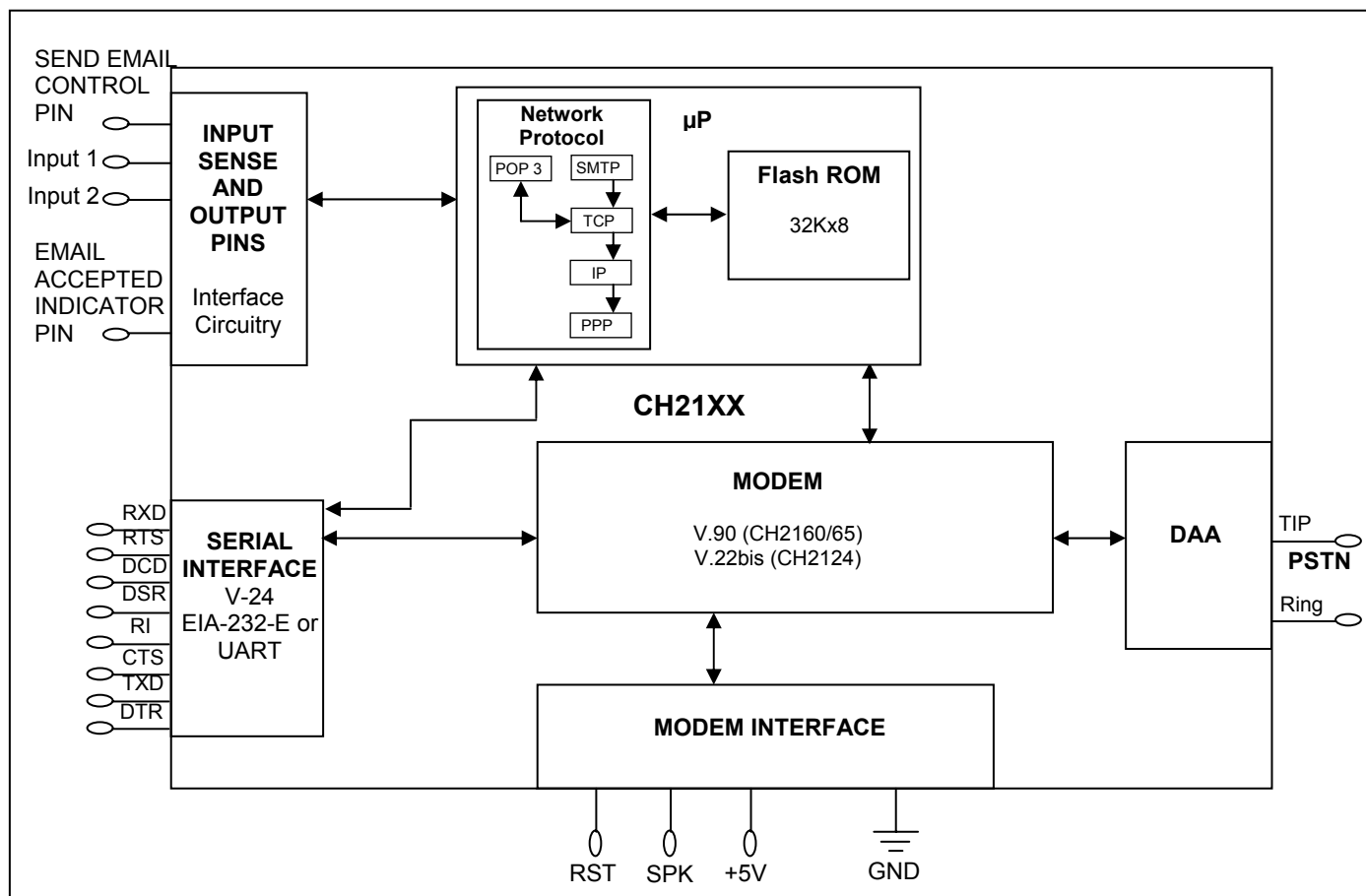


Figure 2. Functional Block Diagram of Cermetek CH2124/60 iModem Products.

## DESCRIPTION OF FUNCTIONAL BLOCKS AND DISCUSSION OF BASIC OPERATIONS

Each CH21XX iModem product consists of the following functional blocks:

1.  $\mu$ P controller with Network Protocols and Flash ROM.
2. Serial interface buffer.
3. Input/Output interface circuitry.
4. Internal modem (V.90 or V.22bis).
5. Modem interface circuitry.
6. DAA (Data Access Arrangement) PSTN interface.

Figure 2 contains a schematic drawing illustrating the interconnectivity of the various functional blocks comprising the CH21XX iModem products.

Each iModem performs the following internet connectivity functions automatically:

1. Dials local POP and Connects to ISP.
2. Authenticates user ID and logs onto the internet.
3. Sends (or Retrieves) email to (from) the server address/name specified using the ISP's SMTP (POP3) Mail Server.
4. Terminates ISP session after all data is sent (or retrieved).
5. The CH2124/60 sends an ASCII MESSAGE ACCEPTED activity response message and sends

a TTL LOW Pulse to Pin 8 indicating that the ISP Mail Server has accepted the email message.

Control of the internet capabilities of the iModem can be either event driven or initiated and controlled by a system level host processor. Refer to Table 3 for a complete set of pin descriptions.

When not utilized in the internet connectivity role, the iModem will function as a standard analog modem.

### KEY FEATURE

The user has complete control of the level of autonomy the iModem exercises in the user's application. This is a unique feature of Cermetek's iModem products.

**$\mu$ P Controller.** The  $\mu$ P controller performs the required internet operations by interpreting each specific **@T<sup>®</sup>** command and executing the appropriate internet commands. The necessary internet protocol firmware is resident in flash ROM. The **@T<sup>®</sup>** commands function as an extension to the industry standard Hayes AT command set.

**Internal Modem.** The internal modem is used to establish a data connection with the ISP. The CH2160 contains a V.90 internal modem while the CH2124 contains a V.22bis internal modem. The internal modem can be controlled with Hayes AT commands and is compatible with industry standard communication software. Refer to Cermetek publication, AT Commands and S-Registers, for a more detailed discussion of the Hayes AT commands supported by the iModem product family.

When operating in standard analog modem mode, the maximum Data Terminal Equipment (DTE)/Host system communication speed is established by the maximum speed available from the DTE/Host and is not limited by the iModem product.

#### IMPORTANT NOTICE

AS DELIVERED FROM THE FACTORY, all @T<sup>®</sup> command communication between the CH2160 (CH2124) iModem and the host processor is conducted over the serial interface at 57.6/19.2kbps (2400bps).

**CH21XX DTE Speed.** AS DELIVERED FROM THE FACTORY, the CH2160 iModem will only communicate with the DTE at 57.6kbps and the CH2124 at 2400bps. However, the user may modify the DTE speed with the appropriate @T<sup>®</sup> commands. Refer to Application Note # 155, @T<sup>®</sup> Command Set Description and Usage For CH2124/60. When the user changes the DTE communication speed to any speed other than the default value set of the factory, the user must ensure that the DTE supports the speed selected. Failure to do so could adversely affect communication with the iModem device or, worst-case, disable communication with the internal  $\mu$ P controller. Refer to Application Note # 158, Cermetek iModem Caveats and Definitions, for a more detailed discussion of this issue.

#### IMPORTANT NOTE

Cermetek recommends a minimum of 50ms inter-character delay when sending commands to the CH2124/60 iModem. Failure to do so could result in unpredictable performance.

Refer to Cermetek's High Speed Modem and FAX Family product data sheet for a complete Description of the internal modem's capabilities and functions.

**Serial Host Interface Buffer.** The iModem utilizes a serial V.24 EIA 232-E 5V interface to communicate with the internal modem and to communicate with the internal  $\mu$ P.

**Telephone Line Interface or DAA.** 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 CH21XX iModem family is designed to meet North American telephone standards as set by FCC Part 68 (USA) and Industry Canada CS-03 Part I (Canada). Each iModem product is shipped from the factory with an FCC label indicating the FCC registration number and ringer equivalent. The PSTN line interface is UL1950 and CSA listed. 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.

#### IMPORTANT NOTICE

If the user wants to change the DTE/Host communication speed to any speed other than the factory set speed of 57.6kbps for the CH2160 or 2400bps for the CH2124, the user must first change the DTE speed of the iModem using the appropriate all @T<sup>®</sup> commands before changing the DTE/Host speed. Refer to Application Note # 158, Cermetek iModem Caveats and Definitions, for a more detailed discussion of this issue.

**Table 1. Summary of CH2124/60 Allowed @T® Commands.**

Command	Notes	Description
@T[A1][=n]	1,2,3,4	Enter destination email address, <b>n</b> . Maximum length is 34 ASCII characters.
@T[D][ ]	1,2,7,12	Dialup ISP and send pre-configured Input Port Status email. Message type sent is specified by @TJn command or by <b>K8</b> parameter for firmware versions 1.262 or greater.
@T[DG][n]	1,2,12	Dial preprogrammed ISP and Retrieve mail message from preprogrammed email address. Message number must be specified, <b>n=1 to 99</b> .
@T[DK][n]	1,2,12	Dial preprogrammed ISP and Delete mail message <b>n</b> . <b>n=aa</b> Where <b>aa</b> is the message number. <b>n=aa-bb</b> will delete message number <b>aa</b> through <b>bb</b> (inclusive). <b>n=*</b> will delete all messages.
@T[DM1][ ]	1,2,3,4, 7,12	Dialup ISP and send user defined email message regardless of message type specified by @TJn command.
@T[E1][=n]	1,2,3,4	Enter local or "FROM:" email address, <b>n</b> .
@T[H][ ]	1,2	Directs remotely accessed iModem connected via Remote Dial-up Access to terminate access session and hang-up.
@T[J][0]	1,2,7,12	Establish email message type to be sent when iModem SEND pin is activated or the @TD command issued. <b>J0</b> will select the Input Port Status message or by <b>K8</b> parameter for firmware versions 1.262 or greater.
@T[J][1]	1,2,7,12	Establish email message type to be sent when iModem SEND pin is activated or the @TD command issued. <b>J1</b> will select the User Defined message or by <b>K8</b> parameter for firmware versions 1.262 or greater.
@T[K0][=n]	1,2,6	Select PAP Authentication Protocol: <b>n=01</b> allows PAP only. (DEFAULT) <b>n=7D</b> allows CHAP or PAP. (CHAP NOT SUPPORTED)
@T[K1][=n]	1,2,6	Set the number of dial-up attempts. Auto re-dial enabled for <b>K1&gt;01</b> . Specified in HEX. <b>n=01</b> allows initial dial-up attempt only (default). <b>n=0E</b> allows 15 dial-up attempts (maximum per FCC).
@T[K2][=n]	1,2,6	Set the number of minutes, <b>n</b> , between auto-redials. Specified in HEX. <b>n=01</b> 1 minute between re-dial attempts (default). <b>n=FF</b> 255 minutes between re-dial attempts (maximum).
@T[K3][=n]	1,2,6,10	Set the number of MESSAGE ACCEPTEDs required to exit auto-re-dial mode. Specified in HEX. <b>n=01</b> 1 MESSAGE ACCEPTEDs to exit auto re-dial (default). <b>n=FF</b> 255 "accepted message" to exit auto re-dial (maximum).
@T[K4][=n]	1,2,6,8	Select login method for User Defined message. <b>K4</b> affects the currently ACTIVE ISP CONFIGURATION profile only: <b>n=01</b> PPP login only. PPP protocol used for email data packets. <b>n=02</b> Enables ASCII Text Login. PPP protocol used for email data packets. Message sent using TCP/IP. <b>n=03</b> Unix Shell login. No PPP protocol.
@T[K8][=n]	1,2,6	Select Email Message type to be sent when SEND PIN is set TTL low. Replaces @TJ0 and @TJ1 for firmware revisions 1.262 and greater: <b>n=30</b> Send Input Port Status message. <b>n=31</b> Send User Defined message. (Default)

**Table 1. Summary of CH2124/60 Allowed @T® Commands (Continued).**

Command	Notes	Description
@T[K10][=n]	1,2,6,9	Select DTE Baud rate: <b>n=01</b> Select DTE baud rate <b>115200</b> . <b>n=02</b> Select DTE baud rate <b>57600</b> . (Default CH2160) <b>n=11</b> Select DTE baud rate <b>38400</b> . <b>n=12</b> Disabled. <b>n=13</b> Select DTE baud rate <b>9600</b> . <b>n=14</b> Select DTE baud rate <b>4800</b> . <b>n=15</b> Select DTE baud rate <b>2400</b> . (Default CH2124) <b>n=16</b> Disabled.
@T[K11][=n]	1,2,6,9,14	Enable/Disable Remote Dial-up Access. For <b>n</b> greater than 00, Remote Dial-up Access is enabled and <b>n</b> specifies the number of rings required before iModem will answer the incoming call. Specified in HEX. <b>n=00</b> Disable Remote Dial-up Access. <b>n=02</b> Enable Remote Dial-up Access to answer after 2 ring (minimum allowed) (Default) <b>n=FF</b> Enable Remote Dial-up Access to answer after 255 rings (maximum allowed).
@T[LM][=n]	1,2	Enter POP3 Login name, <b>n</b> .
@T[L1][=n]	1,2	Enter ISP Login name, <b>n</b> .
@T[M1][=n]	1,2	Enter user defined email message, <b>n</b> . End with <CR><LF>.<CR><LF>. The mail message must be entered after all other ISP parameters have been set. Additionally, any carriage return <CR> (HEX 0D) included in the message is interpreted as a carriage return <CR> line feed <LF> (HEX 0D 0A). This is for compatibility with commercial terminal emulation programs. The message length is currently limited to 125 ASCII characters. Blanks or spaces are allowed and count as 1 character per each occurrence. The entered message is stored in message memory location <b>M1</b> .
@T[N1][=n]	1,2	Enter local access phone number for ISP, <b>n</b> .
@T[OP1][=n]	1,2	Enter POP3 server IP HEXIDECIMAL address, <b>n</b> .
@T[OS1][=n]	1,2	Enter SMTP server IP HEXIDECIMAL address, <b>n</b> .
@T[PW][=n]	1,2	Enter Dialup Password. Maximum length is 15 alphanumeric ASCII characters.
@T[PM][=n]	1,2	Enter POP3 Password. Maximum length is 16 alphanumeric ASCII characters.
@T[P1][=n]	1,2	Enter password for ISP, <b>n</b> . Blanks or spaces are not allowed.
@T[Q][=n]	1,2,3,4	Terminate iModem mode of remotely accessed iModem during Remote Dial-up Access session. Switch to standard analog modem mode while maintaining current Remote Dial-up Access session.
@T[S1][=n]	1,2,3,4	Enter email subject line, <b>n</b> . The subject line length is currently limited to 16 ASCII characters. Blanks or spaces are allowed and count as 1 character per each occurrence. The same subject line is used for both the <b>Input Port Status</b> message and the <b>User Defined</b> message.
@T[U1][=n]	1,2	Enter iModem Device Name. No special characters allowed (i.e., %, *). Maximum length is 16 alpha-numeric ASCII characters.
@T[Z][ ]	1,2,11	Restores factory set profile (i.e., phone number, username, password, SMTP mail server address, iModem local email address subject and message body).
@T[Z][n]	1,2,11	Set current ACTIVE ISP profile (i.e., phone number, username, password, SMTP mail server address, iModem local email address subject and message body) from factory set profiles. <b>n=0</b> Restore factory set ISP profile. Same as @TZ.

**Table 1. Summary of CH2124/60 Allowed @T<sup>®</sup> Commands (Continued).**  
**Notes For Table 1.**

1. Use the exact syntax as indicated in Table 1 above.
2. Each command line has the following format:  
**@T[command][=data field]<CR><LF>**  
Any information listed in bold is a required portion of the command string. Brackets [] not in bold are intended to serve as delimiters only and are not part of the required command string. All embedded spaces are ignored except in the data field.
3. For the case of the User Defined email message (i.e., message sent using the **@TDM1** command), the **@TM1** must be the last ISP parameter modification command executed prior to executing the **@TDM1** the command. This means the **@TM1** command must be executed after the **@TA1**, **@TE1**, **@TS1** and **@TU1** commands. This programming sequence is necessary because the **@TM1** command forces the iModem to compose the entire message and store the complete message (including headers) into flash memory prior to initiating ISP dialup. Failure to do this will cause unpredictable results.
4. For the case of the Input Port Status email message (i.e., message sent using the **@TD** command). When the message type selection is **@TJ0** (or **@TK8=30**, as appropriate), the **@TM1** command execution requirements of Note 3 above DO NOT apply.
5. Parameter must be specified as one ASCII alphanumeric character.
6. Parameter must be specified as two alphanumeric characters. Use a leading 0, if necessary.
7. Effective with iModem Firmware Revisions 1.262 or greater, the **@TJ0** and **@TJ1** commands have been replaced with **K8** parameter modifiable with the **@TK8** command.
8. Dial-up Unix Shell account access is NOT currently supported on the **iModem Network** ISP.
9. Although the **@TK10** command allows the DTE communication speed of the CH2160 iModem devices to be changed, the user must ensure that the DTE communication speed selected is actually supported by the DTE. Failure to do so could inadvertently disable communication with the iModem device.
10. If the maximum number of MESSAGE ACCEPTEDs is set to a value greater than the number of auto re-dial attempts, the iModem will auto re-dial the number of re-dial attempts specified by the auto re-dial parameter (**K1**). Under no circumstances will auto re-dial exceed the number of re-dial attempts specified by parameter **K1**.
11. The **@TM1** command must be executed after the **@TZ**, **@TZ0** and **@TZ1** commands. This is required to "rebuild" the email message including headers. Failure execute the **@TM1** command will cause errors in the header creating leading to unpredictable email transmission results.
12. NOT supported during Remote Dial-up Access session.
13. If **TK5=02** and **TK1=01**, the email message will be sent using the Back Channel feature on the first dial attempt.
14. Must set **K11=00** to allow the CH2124/60 product to answer as a remote modem. This disables the Remote Dial-up Access feature.



Table 2. Summary of CH2124/60 iModem @T<sup>®</sup> Result Messages.

Result Message	Explanation of Result Message
<b>BAD MESSAGE NUMBER</b>	1. Occurs during retrieval (@TGn command) or during deletion (@TDKn command) when message number specified does not exist on POP3 server.
<b>CHAP ERROR</b>	1. Occurs when CHAP protocol error occurs during login. (Not Supported).
<b>CONNECT</b>	1. Successful dialup and ISP connection.
<b>ERROR</b>	1. Occurs when errors in data field are encountered.
<b>HANGING UP</b>	1. Occurs after PSTN line release.
<b>MAILBOX BUSY</b>	1. Occurs when POP3 server connection is in use by another device logged in using the same User ID. 2. Occurs when POP3 server connection was not properly terminated and user attempts to reconnect within 12 minutes of previous connection. 3. Occurs when POP3 server detects error in specified POP3 Login and/or Password.
<b>MESSAGE ACCEPTED</b>	1. Occurs after successful email transmission and after receipt of MESSAGE ACCEPT status from ISP SMTP mail server.
<b>MESSAGE DELETED</b>	1. Occurs after successful deletion of specified message number(s).
<b>NO CONNECT</b>	1. Occurs when PSTN line is released after unsuccessful dialup and/or unsuccessful ISP negotiation and/or unsuccessful SMTP server negotiation.
<b>NO DIALTONE</b>	1. Occurs after unsuccessful dialup and iModem determines that cause of unsuccessful dialup is lack of dial tone.
<b>NOT IN IMODEM MODE</b>	1. Occurs when verbose result message responses are disabled. When in this state, @T commands will not be executed.
<b>OK</b>	1. Successful execution of @T commands except @TD and @TDM1.
<b>PASSWORD ERROR</b>	1. Occurs when error in specified password is detected.
<b>PASSWORD OK</b>	1. Occurs after successful logon to specified ISP account.
<b>POP3 REQUESTS TERMINATION</b>	1. Occurs when the POP3 server determines that the user is already connected to the POP3 server. POP3 requests that the user terminate attempted POP3 connection.
<b>RETRIEVAL COMPLETE</b>	1. Occurs after successful retrieval of specified POP3 message number.
<b>SERVER CLOSED</b>	1. Occurs when POP3 server connection is terminated.
<b>BUSY</b>	1. Occurs when called POP is busy.

**Table 3. Summary of Query Commands**

<b>Command</b>	<b>Description/Function</b>
<b>Commands To Query iModem Parameters</b>	
@TA1?	Display destination address.
@TE1?	Display "FROM" address.
@TK?	Display all K parameters.
@TL1?	Display user name.
@TM1?	Display User Defined email message.
@TN1?	Display local access POP phone number.
@TOP1?	Display POP3 server IP address.
@TOS1?	Display SMTP server IP address.
@TPW?	Display Dial-up password.
@TPM?	Display POP3 password.
@TP1?	Display ISP password.
@TS1?	Display email subject.
@TU1?	Display email recipient "TO" name.
<b>Commands To Interrogate iModem</b>	
<b>Command</b>	<b>Function</b>
@TI	Display iModem product type and firmware revision.
@TV	Displays ISP configuration profile and User Defined email message.
@TV0	Displays ISP configuration profile and User Defined email message.
@TV1	Displays Input Port Status message.

Pins 1 and 2 function as both input and output connections to the PSTN. To maximize field reliability in hostile environments, to ensure UL compliance, and also optionally for FCC part 15 compliance, these two pins may be routed through an external network such as that briefly described in figure 3 or as described in more detail in Cermetek Application Note # 126, Supplemental PSTN Line Protection.

## 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.

The circuitry from the iModem to the telephone 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).

2. Connection to the PSTN line should be made through an RJ-11C jack.
3. PCB traces from the iModem'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.
4. The RING and TIP PCB traces should be as short as possible and oriented to prevent coupling with other high speed or high frequency signals present on the host circuit PCB.
5. No additional circuitry other than that shown in Figure 3 may be connected between the iModem module and the RJ-11C jack. Doing so will invalidate the conveyed FCC approval.
6. The iModem, the RJ-11C jack, the interfacing circuitry and all PCB traces must be contained on a PCB with a 94 V-0 flammability rating.
7. The supplied FCC registration label must be applied visibly on the outside of the product.
8. 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 approvable for use by DOT to Industry Canada 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 sealed and will not be harmed by industry standard wave soldering processes.

**Socketing.** The socket 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 the 50 pin strip socket CES-150-01-T-S by Samtec. Refer to Application Note# 130, Summary of Recommend Supplies, for a list of supplies and associated contact information.

## FCC REGISTRATION

All CH21XX iModem products are registered with the FCC under Part 68. To maintain the validity of the registration, notice of the restrictions the FCC places on the iModem and its use must be served to the end user of the product containing the iModem.

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 for 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 an iModem device.

**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 the best service it can. In order to do this, it may occasionally be necessary for the telephone company to make changes to their equipment, operations or procedures. If these changes might affect service provided to the users or the operation of the user's equipment, the telephone company will give the user notice, in writing, to allow the users to make any changes necessary to maintain uninterrupted service.

In certain circumstances, it may be necessary for the telephone company to request information from the users concerning the equipment which the user has connected to the 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. The sum of all of the REN's on the user's 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 useable on a given line. Consult your telephone provider.

**If Problems Arise:** If any of the user's telephone equipment is not operating properly, the user should immediately remove it from the user 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 the user in advance of this disconnection. If advance notice is not feasible, the user will be notified as soon as possible.

When the user is notified, the user will be given the opportunity to correct the problem and informed of their right to file a complaint with the FCC. Contact the local telephone service provider if any questions arise concerning the telephone service.

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 or (insert your company name). For information contact: (insert your company address).

**Table 3. iModem Family Pin Description.**

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	NC	---	NO CONECTION
4	NC	---	NO CONECTION
5	SPK	O	SPEAKER. Audio output for speaker. See speaker control diagram.
6	SEND	I	SEND EMAIL. Active Low. A low pulse will send an email. The modem will go off hook, dialup an ISP, send the email and hang up. The SEND pin must be tied high when not in use. Pulse should be 50msec minimum.
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	SENT	O	EMAIL SENT. Active Low. A low pulse is output on this pin to indicate that an email sent by the iModem has been accepted by its ISP. The pulse is low for 50ms minimum. See figure 8.
9	IN 2	I	Input. TTL High or Low input pin. The logic level of this input pin is reported in the email message.
10	TXD	I	TRANSMIT DATA. Serial transmit data input. Marking, or a binary 1 condition is indicated by a HIGH.
11	RXD	O	RECEIVE DATA. Serial Receive data output. Received marking or a binary 1 condition is indicated by a HIGH.
12	NC	---	NO CONECTION
13	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 in use.
14	DSR	O	DATA SET READY. LOW indicates handshaking with a remote modem in progress, and/or the data carrier of a remote modem has been detected.
15	RI	O	RING INDICATION. This signal follows the frequency of the ringing signal and is normally about 20 to 40 Hz for 2 seconds on with 4 second off.
16	CTS	O	CLEAR-TO-SEND. Output always LOW. Reserved for flow controls with FAX option. Not active, let float.
17	DCD	O	DATA CARRIER DETECT. LOW indicates a data carrier from a remote modem has been detected. Must enable with <b>AT&amp;C1</b> Hayes command.
18	NC	---	NO CONECTION
19	VCC	---	DC SUPPLY. 5V $\pm$ 5% required.
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 10ms 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	RTS	I	REQUEST TO SEND. Active Low. Used for flow control. Should be tied Low when using SEND pin and when using <b>@T</b> commands for CH2160 only. DO NOT CONNECT for CH2124.

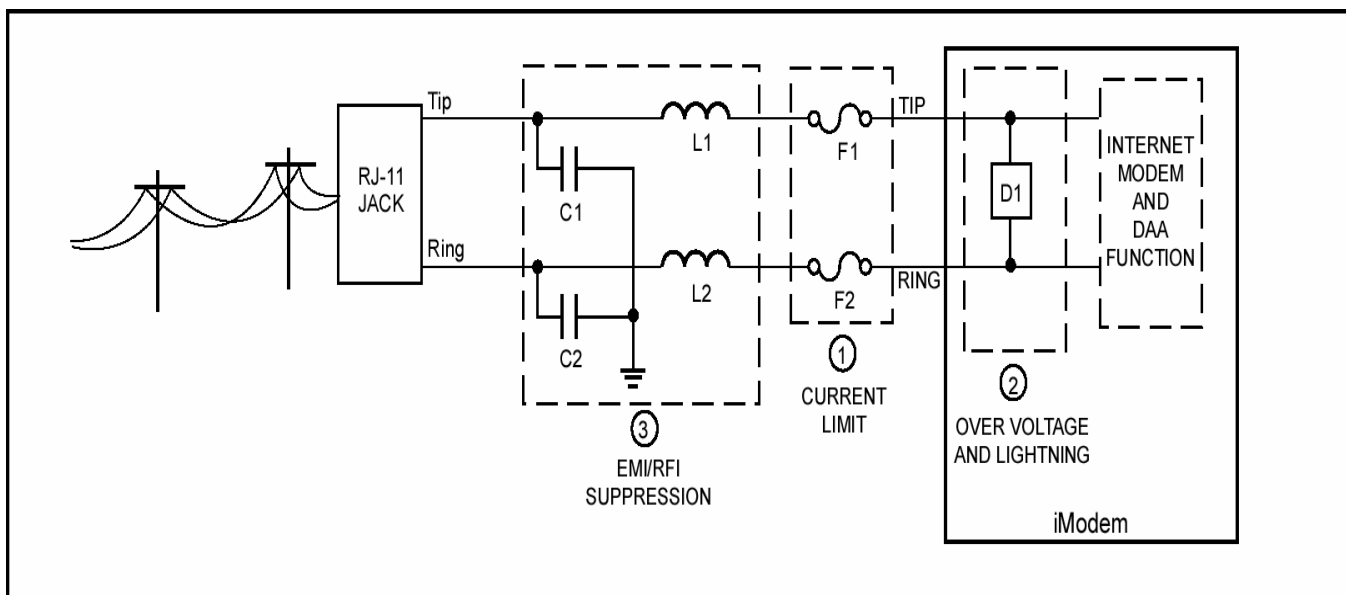


Figure 3. PSTN Line Interface for all iNet Appliance Products.

### 1. Currently Limiting PSTN Protection Line Device.

Currently limiting devices are mandatory to meet UL safety standards. To maintain conveyed FCC Part 68 approval, the current limiting components identified as F1 and F2 in dashed Box #1 must also survive FCC Part 68 surge testing. Refer to Cermetek Application Note #126, [Supplemental PSTN Line Protection](#), for more details. Refer to Application Note # 130, [Summary of Recommended Suppliers](#), for a list of suppliers and associated part numbers.

- A. A PTC (rated at 0.15 amps) is preferred because it resets automatically upon removal of the current flow. Fuse devices are also acceptable. Refer to Application Note #130 for a complete list of recommended vendors and associated part numbers.
- B. Resistors (10 $\Omega$  carbon film or 1/8 watt minimum) may be used in Canada, as Canada has no requirements 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 10 $\Omega$  resistors (carbon film or SMD parts 1/8 watt minimum) as described in paragraph B above.

### 2. Over Voltage and Lightning Protection.

- A. Surge Protection is provided by internal circuitry (see Figure 3). No additional external components are required to maintain conveyed FCC Part 68 approval.
- B. In most environments, 2 terminal surge suppressors are adequate. For severe environments, use an external 3 terminal device with an earth ground.

### 3. EMI/RFI Suppression.

No external EMI/RFI 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 affecting FCC Part 68 approval.

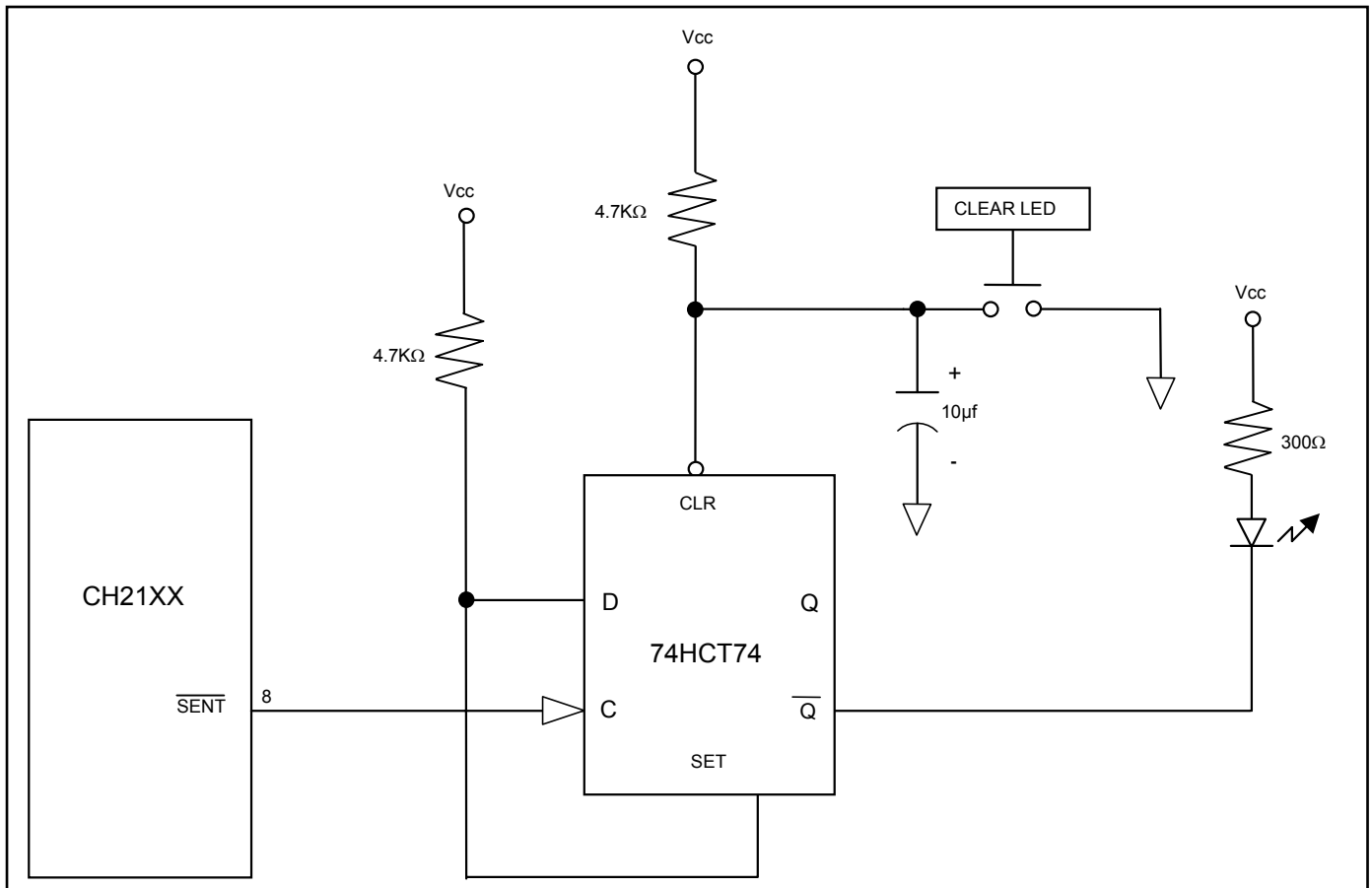
- A. To provide adequate EMI/RFI suppression, the capacitor/inductor network contained in dashed Box #3 should be located as close to the RJ-11C jack as possible. Further, this network should be provided with an excellent ground path to the chassis.
- B. Capacitors C1 and C2 should not exceed 0.005 $\mu\text{f}$ . They must have a rating of 1.5KV and typically are 0.001 $\mu\text{f} \pm 20\%$ . Inductors L1 and L2 may be either individual inductors or a dual inductor. Refer to Application Note #130 for a complete list of recommended vendors and associated part numbers. 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 4. Analog Characteristics.**

NAME	TYPE	CHARACTERISTICS	VALUE
SPK	O(DF)	Minimum Load	300ohm
		Maximum Capacitive Load	0.01µf
		Output Impedance	10ohm
		Output Voltage	2.5 ± 1.6V
		D.C. Offset	<20mV

**Table 5. Summary of CH2124/60 iModem Family of Products.**

Model	Summary of Features	Operating Temperature
CH2124	2 Input Sense Pins, Send and Retrieve Emails. Email Send Control Pin, Full Function, V.22bis, 2400bps, FCC Part 68 Approved, UL1950 listed.	0°C to 70°C
CH2160	2 Input Sense Pins, Send and Retrieve Email. Email Send Control Pin Full Function, V.90, 56Kbps, FCC Part 68 Approved, UL 1950 listed.	0°C to 70°C



**Figure 4. Example Circuit for illumination of Email Accepted LED for CH2124/60. This circuit is not needed for the CH2165 product.**

**Table 6A. CH2124 iModem Electrical Specifications.**

Symbol	Characteristic	Min.	Typ.	Max.	Units
V <sub>CC</sub>	Positive Supply Voltage	4.5	5.0	5.5	V
I <sub>CC</sub> Off Hook	Nominal Operating Current @ V <sub>CC</sub> = 5.5V when modem is Off Hook		30.0	50.0	mA
V <sub>IH</sub>	High Level Input Voltage @ 5.0V	2.0		3.5	V
V <sub>IL</sub>	Low Level Input Voltage @ 5.0V	1.0		2.2	V
V <sub>T+</sub>	Positive Hysteresis Threshold for RESET Pin		2.6		V
V <sub>T-</sub>	Negative Hysteresis Threshold for RESET Pin		2.4		V
V <sub>OH</sub>	High Level Output (I <sub>OH</sub> = 0.5mA)*	2.4			V
V <sub>OL</sub>	Low Level Output (I <sub>OL</sub> = 1.6mA)*			0.6	V
I <sub>IN</sub>	Input Leakage Current (TXD, $\overline{\text{DTR}}$ , $\overline{\text{RTS}}$ , IN1, IN2, SEND)			100	uA
I <sub>IL</sub>	Input Current (RST)			580	uA
C <sub>P</sub>	Capacitive Load (TXD, $\overline{\text{DTR}}$ , $\overline{\text{RTS}}$ ) Capacitive Load (RTS)			10 8	pF pF

**Table 6B. CH2160 iModem Electrical Specifications.**

Symbol	Characteristic	Min.	Typ.	Max.	Units
V <sub>CC</sub>	Positive Supply Voltage	4.5	5.0	5.5	V
I <sub>CC</sub> Off Hook	Nominal Operating Current @ V <sub>CC</sub> = 5.5V when modem is Off Hook		120.0		mA
V <sub>IH</sub>	High Level Input Voltage @ 5.0V	2.0		3.5	V
V <sub>IL</sub>	Low Level Input Voltage @ 5.0V	1.0		2.2	V
V <sub>T+</sub>	Positive Hysteresis Threshold for RESET Pin		2.5		V
V <sub>T-</sub>	Negative Hysteresis Threshold for RESET Pin		1.2		V
V <sub>OH</sub>	High Level Output (I <sub>OH</sub> = 0.5mA)*	2.4			V
V <sub>OL</sub>	Low Level Output (I <sub>OL</sub> = 1.6mA)*			0.6	V
I <sub>IN</sub>	Input Leakage Current (TXD, $\overline{\text{DTR}}$ , $\overline{\text{RTS}}$ , IN1, IN2, SEND)			100	uA
I <sub>OH</sub>	Input Current (RST)			580	uA
C <sub>P</sub>	Capacitive Load (TXD, $\overline{\text{DTR}}$ , $\overline{\text{RTS}}$ ) Capacitive Load (RTS)			10 8	pF pF

**IMPORTANT NOTE**

Cermetek recommends a minimum of 50ms inter-character delay when sending commands to the CH2124/60 iModem. Failure to do so could result in unpredictable performance.



**Table 7A. CH2124 iModem Electrical Specifications.**

Parameter	Minimum	Typical	Maximum	Units	Comments
Off Hook Impedance	20			Mohm	
Trans Hybrid Loss		25		dB	600 Ohm, RXA, TXA
Ring Voltage Loop		15		V <sub>PP</sub>	On 48VDC line voltage for sustained periods
Line Loop Current - (Off Hook)		20	60	mA	
Return Loss @ 1000 Hz		15		dB	600 Ohm
Ring Frequencies	18	20	30	Hz	
Receiver Insertion Gain	-0.5	0.0	+0.5	dB	
Transmit Power		-9.5		dBm	600 Ohm- Data Mode
First Character After Reset See Note 1	10.0			sec	Delay
Inter Character Delay	20	50		msec	Between all command characters
Command Delay	100	200		msec	Between all AT commands
Minimum Reset Pulse	10			msec	If user supplied

**Note: 1. All CH2124 iModem devices perform an internal self-check upon reset and will not respond to commands issued during this self-check sequence.**

**Table 7B. CH2160 iModem Electrical Specifications.**

Parameter	Minimum	Typical	Maximum	Units	Comments
Off Hook Impedance	20			Mohm	
Trans Hybrid Loss		25		dB	600 Ohm, RXA, TXA
Ring Voltage Loop		35		V <sub>PP</sub>	On 48VDC line voltage for sustained periods
Line Loop Current - (Off Hook)		20	100	mA	
Return Loss @ 1000 Hz		15		dB	600 Ohm
Ring Frequencies		20		Hz	
Receiver Insertion Gain	-0.5	0.0	+0.5	dB	
Transmit Power		-9.5		dBm	600 Ohm- Data Mode
First Character After Reset See Note 1	10.0			sec	Delay
Inter Character Delay	20	50		msec	Between all command characters
Command Delay	100	200		msec	Between all AT commands
Minimum Reset Pulse	10			msec	If user supplied

**Note: 1. All CH2160 iModem devices perform an internal self-check upon reset and will not respond to commands issued during this self-check sequence.**

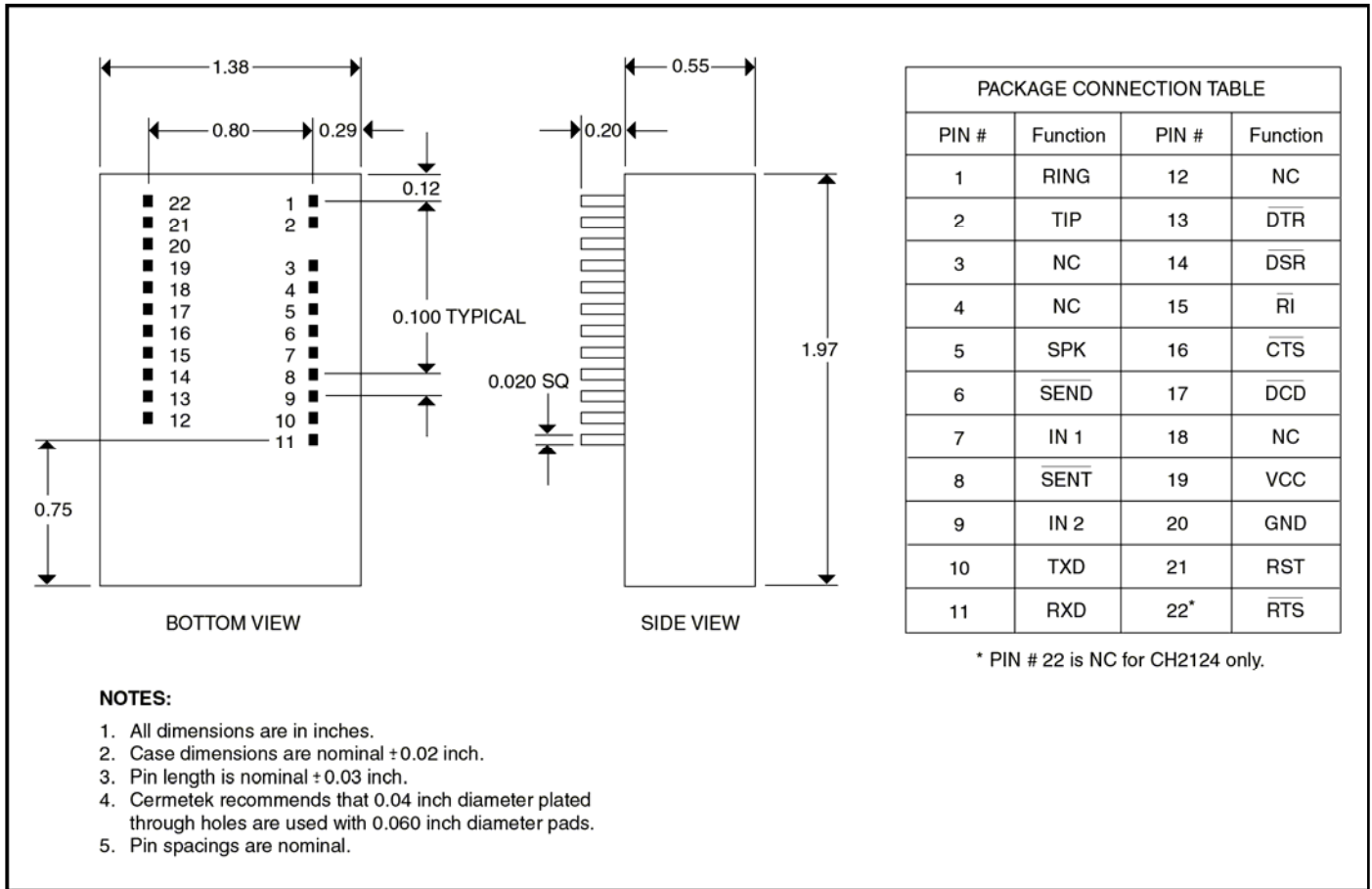


Figure 8. Physical Dimensions and Pin Functions for CH2124/60 Products.

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Cermetek provides the user with a FCC (USA) and IC (Canada) Approved or Approvable device. However, Cermetek does not have influence over nor knowledge of the specific user application environment. Therefore, for FCC and IC Approved or Approvable devices, the user assumes all risk for maintaining compliance to registration.

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