



HIGH SPEED INTERNET MODEM FAMILY

CH2124	-	Send/Retrieve Email. 2 I/O Ports 2400bps.
CH2160	-	Send/Retrieve Email. 2 I/O Ports, V.90.
CH2165	-	Send/Retrieve Email. Unlimited Email, 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 streaming email of unlimited length; or pre-stored email up to 5M bytes in RAM (CH2165).
- Retrieve multiple messages (CH2165) or select individual message (CH2124/60).
- Once online CH2165 can stay online and send, retrieve and/or delete email.
- Programmable using serial interface (CH2124/60/65).
- Remote programming using PSTN (CH2124/60).
- 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.
- 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[®] 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/DOT CSA 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.

- Low cost **iModem Network** ISP providing email to Voice, Fax, and email re-routing services.
- 90 day free trial subscription to **iModem Network** ISP provided with each iModem.

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[®] macro commands, has the look and feel of conventional modem AT commands. With the @T[®] 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.

COMPARISON OF CH21XX IMODEM DEVICES

The CH2165 represents the next generation in internet enabled devices. This product provides the user with unsurpassed command and control capabilities. The CH2165 communicates asynchronously with the host controller (via the serial port) and the internet (via the PSTN connection) *simultaneously*. Consequently, the user can intersperse CH2165 specific management commands with internet commands. Further, commands can be queued. The CH2165 will also send or retrieve email messages of virtually unlimited length by using streaming email techniques. The CH2165 is ideal for applications where larger data transfers are required and/or where large amounts of data must be stored locally on the iModem device.

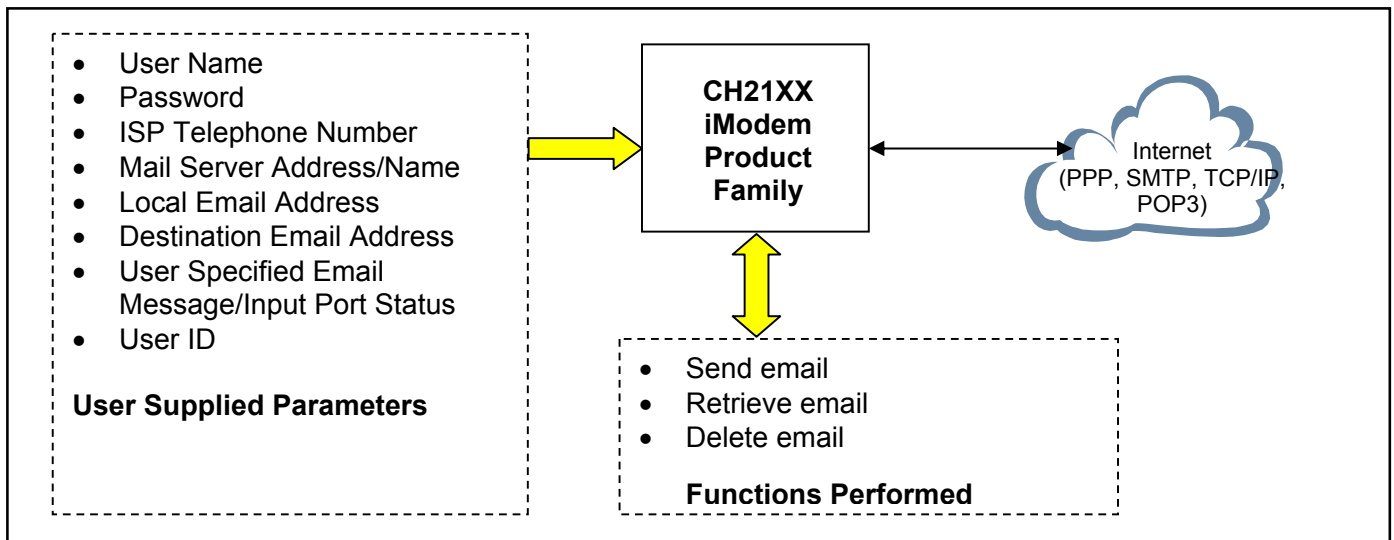


Figure 1. Conceptualized Block Diagram illustrating the Cernetek CH21XX iModem product family performing the embedded internet application function.

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.

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.

Cernetek'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 Cernetek's **iNetWizard**[®] telecommunications software package or, alternatively, one of a variety of commercially available terminal emulation software

packages. **iNetWizard**[®] 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: CH2165. The CH2165 has the ability to send and retrieve emails of virtually unlimited length by employing a technique referred to as streaming email. Once in streaming email mode, the user simply continues to supply data to the CH2165's serial port, and terminates the data stream with a **<CR>.<CR>**. Alternatively, messages of finite length can pre-stored locally on the CH2165 in RAM memory and then sent when needed. The data stream termination sequence for pre-stored messages is the **CTRL D** characters.

The total CH2165 RAM memory available to the user is approximately 5M bytes. For messages that need to be stored semi-permanently, the user has access of up to 1M byte of Flash ROM for message storage. Messages stored in ROM can also be sent when needed.

When retrieving emails, the user continues to save the data streaming out of the CH2165's serial port until a **<CR>.<CR>** is received.

Refer to Cernetek Application Note # 325, **@T**[®] Command Set Description and Usage For CH2165 iModem, for more details.

Send, Retrieve and Delete Email: CH2124/60. 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[®] Command Set Description and Usage For CH2124/60 iModems](#), for more details.

iModem Hardware Configuration. Each CH2160/65 (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 μ P controller with associated internal logic. The μ P controller and the logic provide all the functions required for internet communication via standard PSTN telephones lines. The CH2165 contains an additional 8 Mbytes of RAM and 2 Mbytes of Flash ROM. All CH21XX iModem products utilize TCP/IP, PPP, PAP, CHAP, SMTP and POP3 internet protocols.

Required External Connections. The iModem requires an external RJ-11C jack for the PSTN line connection. An CCITT 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 Canadian DOT CSA CS-03 approvable.

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 NETWORK ISP

A valid ISP account ID and password are required to access the internet. As a convenience to our customers, and to facilitate operational use of the iModem, Cermetek supplies each iModem with a pre-programmed account on the Cermetek **iModem Network** ISP. This account is provided on a 90 day free trial offer basis. Cermetek established the **iModem Network** ISP to provide embedded internet appliance users with features and services tuned to the unique demands of the internet appliance environment. In addition to standard email service, the **iModem Network** ISP can provide: email to FAX, email to Voice, email to dynamic web page update, and email re-routing. Refer to Cermetek Application Note # 149, [Cermetek Internet Service \(ISP\) Description of Features and Services](#), for more details.

The CH2165 can utilize any non-proprietary commercial or private ISP for internet access as well as the Cermetek **iModem Network** ISP. We recommend the Cermetek **iModem Network** ISP because of its machine friendly features and low cost \$2.00 per month access. Please see www.imodem.net for more details.

iMODEM CONTROL METHODOLOGIES

The iModem receives **@T[®]** commands from the host processor or receives an event status flag on the Send Email Control Pin (Pin #6 – CH2124/60) 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[®]** commands. For CH2165 products, see Table 2.

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.

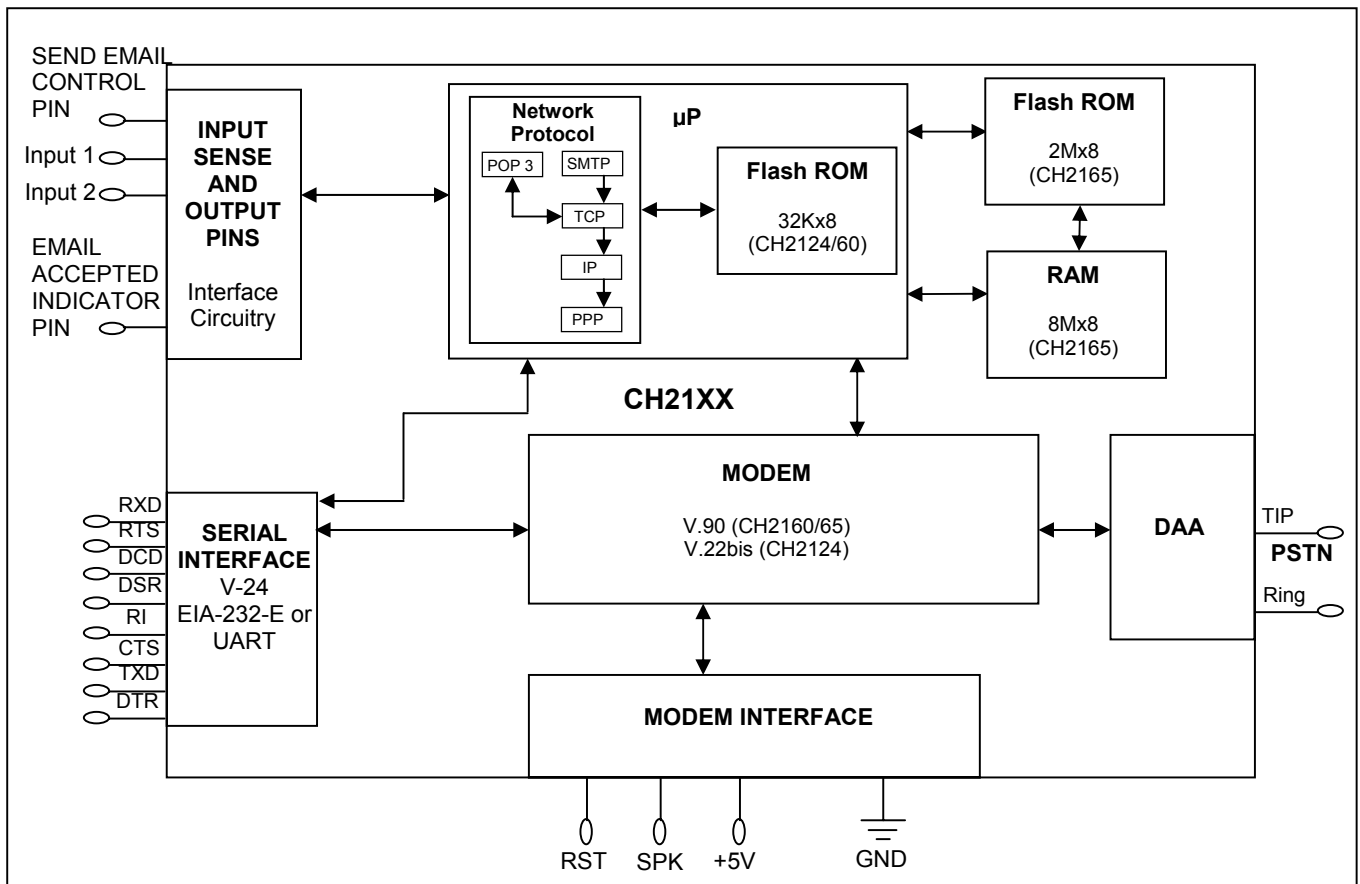


Figure 2. Functional Block Diagram of Cermetek CH21XX iModem Products. Note the additional RAM and ROM provided in the CH2165 iModem product.

Fully Autonomous On Demand Event Driven Control: CH2124/60. 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: CH2124/60. 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® 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: CH2124/60. This method is the most flexible, but requires issuance by the host processor of the necessary @T® 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® 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® Command.

Delete Email: CH2124/60. 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: CH2124/60. 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[®] Command Set Description and Usage For CH2124/60 iModems.](#)

Send Email: CH2165. To send email messages, the user must explicitly open the TCP socket connection using the **@TCP** command. This command automatically dials the specified local access POP phone number, performs user authentication, establishes a PPP connection and obtains an IP address.

Once connected to the internet, the user may use one of two methods to send email messages: use pre-stored messages contained in resident memory or use streaming messages obtained in real-time from the CH2165's DTE serial I/O port. In either case, multiple email destination addresses are allowed.

For the case of pre-stored messages, each message is associated with a user defined message name. The user enters the **@TD=msgname** command (where **msgname** is the message file name) and the CH2165 sends the email using the SMTP protocol.

For the case of streaming email, the user enters the **@TD=0** command (where **0** is a reserved name and signals the CH2165 that streaming email is desired). The CH2165 then sends the appropriate SMTP email headers and prompts the user to supply the body of the message. The user presents as many ASCII characters as desired to the CH2165's DTE serial port. When finished, the user must end the streaming input with a **<CR>.<CR>**. The CH2165 will then terminate the SMTP message and close the SMTP connection. If the SMTP inactivity timer limit is exceeded (currently set at 90 seconds), the CH2165 will automatically terminate the message and close the SMTP connection. To end the internet session, the user must explicitly close the TCP connection and terminate the PSTN dial-up phone call by entering the **@TCT** command.

When using pre-stored messages in resident memory, the user is responsible for message memory management and utilization. Exceeding the memory limits will cause memory wrap around and messages may become lost or corrupted.

Retrieve Email: CH2165. The CH2165 will retrieve email from POP3 servers complying with applicable internet governing RFCs. By executing the **@TES** command, the user may obtain an inventory listing

containing Subject Line and Message Number of all messages currently cached on the POP3 server. The user may selectively download individual messages (by message number) or may retrieve all messages on the server. Messages retrieved are provided to the user on the iModem's serial port and are not stored in CH2165 resident memory.

Delete Email: CH2165. The user may selectively delete any email message (by message number) or all messages cached on the POP3 server.

Email and Internet Activity Status: CH2165. Currently, the CH2165 provides two levels of internet and email status information. Using the **@TCS=PPP** command, the user can monitor all the internet PPP communication. Additionally, the user can determine internet connectivity status by issuing the **@TCS=PING** command. The **@TCS=PING** command causes the iModem to send four successive PING commands directly to the internet host. Responses from the host include Host IP address and connectivity information.

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.

DESCRIPTION OF FUNCTIONAL BLOCKS AND DISCUSSION OF BASIC OPERATIONS

Each CH21XX iModem product consists of the following functional blocks:

1. μ 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.
7. Additional Flash ROM (CH2165 only).
8. Additional RAM (CH2165 only).

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) (CH2124/60 only).

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.

µP Controller. The µP controller performs the required internet operations by interpreting each specific @T[®] command and executing the appropriate internet commands. The necessary internet protocol firmware is resident in flash ROM. The @T[®] 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 CH2160/65 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[®] command communication between the CH2160/65 (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 CH2160/65 iModem will only communicate with the DTE at 57.6/19.2 kbps and the

CH2124 at 2400bps. However, the user may modify the DTE speed with the appropriate @T[®] commands. Refer to Application Note # 155, @T[®] Command Set Description and Usage For CH2124/60 or to Application Note # 325, @T[®] Command Set Description and Usage For CH2165. 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 µP controller. Refer to Application Note # 158, Cermetek iModem Caveats and Definitions, for a more detailed discussion of this issue.

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 µP.

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

IMPORTANT NOTICE

If the user wants to change the DTE/Host communication speed to any speed other than the factory set speed of 57.6/19.2kbps for the CH2160/65 or 2400bps for the CH2124, the user must first change the DTE speed of the iModem using the appropriate all @T[®] 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.

(USA) and CSA 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.

Table 1. Summary of Available @T Commands For CH2124/60

Command	Query	Description/Function
Commands To Set and Query iModem Parameters		
A1	A1?	Set destination address.
D	---	Dial ISP, Send Input Port Status.
DG	---	Dial ISP, retrieve email.
DK	---	Dial ISP, delete email.
DM1	---	Dial ISP, send User Defined email message.
E1	E1?	Set "FROM" address.
H	---	Initiate hang-up sequence.
---	K?	Display all K parameters.
K0	---	Select CHAP and /or PAP.
K1	---	Set number of redial attempts for auto-redial.
K2	---	Set number minutes between redial attempts.
K3	---	Set number of Message Accepted required to exit auto-redial.
K4	---	Select ISP login method.
K5	---	Enable/Disable FailSafe™ Back Channel.
K8	---	Select Email message type to be sent when SEND pin is TTL Low.
K10	---	Select DTE Baud Rate
K11	---	Enable/Disable Remote Dial-Up Access.
L1	L1?	Set user name.
M1	M1?	Set User Defined email message.
N1	N1?	Set local access POP phone number.
OP1	OP1?	Set POP3 server IP address.
OS1	OS1?	Set SMTP server IP address.
PW	PW?	Set Dial-up password.
PM	PM?	Set POP3 password.
P1	P1?	Set ISP password.
Q	---	Terminate iModem Mode of remotely accessing iModem unit.
S1	S1?	Set email subject.
U1	U1?	Set email recipient "TO" name.
Z0	---	Restores factory profile.
Z1	---	Restore FailSafe™ Back Channel profile.
Commands To Interrogate iModem		
Command		Function
T1		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.
Note: Most commands that set iModem parameters will also serve the query function by appending a ? to the command. Example: @TS1?<CR> will return the email subject line text.		

Table 2. Summary of Available @T[®] Commands By Category for CH2165.

Command	Query	Description
Email Message Management		
@T[M][=n]	@T[M][?]	Enter email message, n . Length limited 100K bytes per message. All valid ASCII characters allowed. Use CTRL D to terminate message entry. Message is maintained in dynamic RAM until stored in Static Memory using the @TW command.
Send Email Message		
@T[D][=n]	-----	Dialup ISP and send email message, n . Use internet TO, FROM, REPLY, and ERROR TO addresses contained within message n . Use the POP dialup phone number currently active.
@T[D][=0]	-----	Dialup ISP. Use internet TO, FROM, REPLY, and ERROR TO addresses currently active. Use the POP dialup phone number currently active. Enter Streaming Email data entry mode. Terminate data entry using <CR>.<CR>. Message is sent immediately following receipt of <CR>.<CR> sequence.
POP Access Dialup Phone Number		
@T[N][=n]	@T[N][?]	Set POP dialup access dial-up phone number string, n . Special characters supported: Each comma will cause a 2 second delay. Use a dash as a delimiter. Dashes are ignored.
Password		
@T[PI][=n]	@T[PI][?]	Set ISP Login password, n .
@T[PM][=n]	@T[PM][?]	Set POP3 email retrieve password, n .
Username		
@T[UI][=n]	@T[UI][?]	Set ISP Login username, n .
@T[UM][=n]	@T[UM][?]	Set POP3 email retrieve username, n .
POP3 Retrieval		
@T[ED][=n]	-----	Delete message number, n .
@T[EO][]	-----	Open POP3 mailbox.
@T[EQ][]	-----	Quit POP3 mailbox activity and close POP3 server.
@T[ER][=n]	-----	Retrieve message number, n .
@T[ES][]	-----	Inventory all messages currently on POP3 server and list message number and subject line.
DCE and DTE Attributes		
@T[BC][=n]	@T[BC][?]	Select DCE Baud rate, n . Allowable values: n=57600. n=38400. n=19200. n=9600. n=4800. n=2400. By default, if no value is specified, the CH2165 will automatically determine the maximum baud rate supported by the PSTN connection. This is referred to as auto-bauding.
@T[BE][=n]	@T[BE][?]	Toggle DTE echo. n=on Enable DTE echo (default). n=off Disable DTE echo.
@T[BT][=n]	@T[BT][?]	Select DTE Baud rate, n . Allowable values: n=57600. n=38400. n=19200. (Default). n=9600. n=4800. n=2400.

Table 2. Summary of Available @T[®] Commands By Category for CH2165 (continued).

Command	Query	Description
Email Addresses and Email Subject Line		
@T[AD][=n]	@T[A][?]	Set email DESTINATION address, n . This is the address to which the email will be sent. This is the address that appears in the TCP/IP header.
@T[AE][=n]	@T[A][?]	Set email ERROR address, n . This is the address to which reply emails will be sent when an email delivery error is encountered by the SMTP server. This address becomes the DESTINATION address of the Error Email and appears in the TCP/IP header.
@T[AF][=n]	@T[A][?]	Set email FROM: address, n . This is the address that follows the FROM: located in the body of the email message. The FROM address is the address used by the POP3 server to retrieve email. By convention, the FROM: address matches the email sender's address. However, this is not required for proper delivery of the email message. This address appears in the TCP/IP header.
@T[AR][=n]	@T[A][?]	Set email REPLY address, n . This is the address to which reply emails will be sent when the Email Reply button is selected. This address becomes the DESTINATION address and appears in the TCP/IP header.
@T[AS][=n]	@T[A][?]	Set email SUBJECT LINE, n . This is the subject line that appears in the email message.
@T[AT][=n]	@T[A][?]	Set email TO: address, n . This is the address that follows the TO: located in the body of the email message. By convention, the TO: address matches the DESTINATION. However, this is not required for proper delivery of the email message.
Static RAM Memory Management		
@T[W][=n]	----	Store filename, n , in Static RAM memory. Files stored in Static RAM memory will be retained when power is removed.
Server Addresses		
@T[SS][=n]	@T[SS][?]	Set SMTP server symbolic name, n . This symbolic name is used by the CH2165 to determine the SMTP server address.
@T[SM][=n]	@T[SM][?]	Set POP3 server symbolic name, n . This symbolic name is used by the CH2165 to determine the POP3 server address.
Help Topics		
----	@T[H][?]	Displays all supported commands. Currently: A Display Addresses and Subject Line command syntax. C Display PPP connectivity command syntax. D Display send email command syntax. E Display retrieve email command syntax. I Display IMAP and POP3 email command syntax. M Display create or view email message command syntax. N Display local POP access phone number command syntax. P Display password command syntax. S Display mail/SMTP server command syntax. U Display username command syntax. V Display verbose command syntax. Z Display factory re-set command syntax.
----	@T[H][?=n]	Displays details for specified command, n , and provides an example of command usage. See supported commands above.
Internet Connectivity Status		
@T[CS][=PPP]	----	Displays all PPP connectivity information.
@T[CS][=PING]	----	Sends four successive ping commands to the imodem.net server.

Table 2. Summary of Available @T® Commands By Category for CH2165 (continued).

Command	Query	Description
TCP Management		
@T[CP][]	----	Establish TCP connection. This command causes the CH2165 to perform the following tasks in the order listed: 1. Go Off-Hook and dial POP phone number specified @TN=n command. 2. Connect to internet using Login ISP Username specified by @TUI command and ISP Login Password specified by @TPI command. 3. Obtain IP address and establish TCP socket connection.
@T[CT][]	----	Terminate TCP connection. This command causes the CH2165 to perform the following tasks in the order listed: 1. Close TCP socket connection. 2. Disconnect from the internet. 3. Go On-Hook.

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

- 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).

- Connection to the PSTN line should be made through an RJ-11C jack.
- 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.
- 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.
- 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.

- 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.
- The supplied FCC registration label must be applied visibly on the outside of the product.
- 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 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:

- Direct soldering.
- 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 AT&C1 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 @T commands for CH2160 only. DO NOT CONNECT for CH2124.

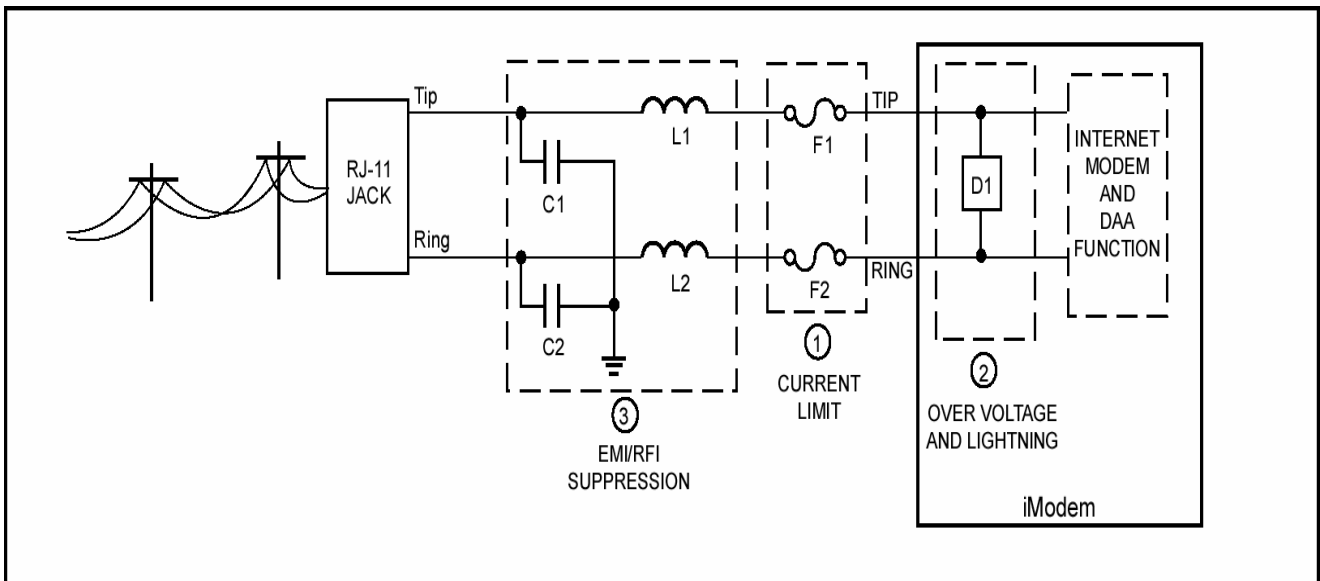


Figure 3. PSTN Line Interface for all iNet Appliance Products.

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 Recommend 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 Ω 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 Ω 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 μf . 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 Maximum Capacitive Load Output Impedance Output Voltage D.C. Offset	300ohm 0.01µf 10ohm 2.5 ± 1.6V <20mV

Table 5. Summary iModem Family of Products.

Model	Summary of Features	Operating Temperature
CH2124	Input 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
CH2165	Send and Retrieve Streaming Email. Email Send Control Pin Full Function, V.90, 56Kbps, FCC Part 68 Approved, UL 1950 listed.	0°C to 70°C

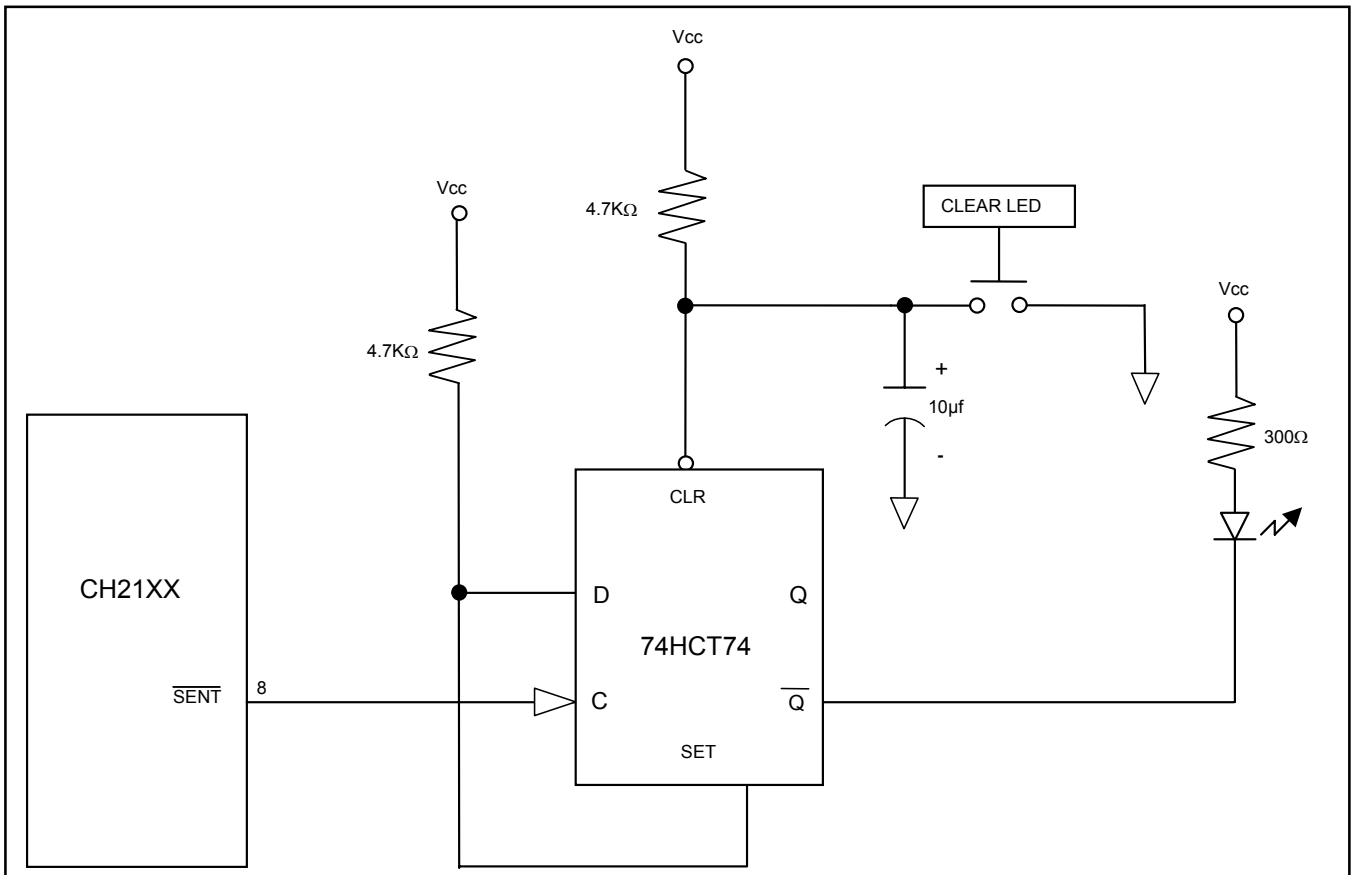


Figure 4. Example Circuit for illumination of Email Accepted LED for CH2124/60. This circuit is not needed for the CH2165 product.

Table 6A. CH2124 iModem Electrical Specifications.

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

Table 6B. CH2160 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	Nominal Operating Current @ V _{CC} = 5.5V when modem is Off Hook		120.0		mA
V _{IH}	High Level Input Voltage @ 5.0V	2.0		3.5	V
V _{IL}	Low Level Input Voltage @ 5.0V	1.0		2.2	V
VT+	Positive Hysteresis Threshold for RESET Pin		2.5		V
VT-	Negative Hysteresis Threshold for RESET Pin		1.2		V
V _{OH}	High Level Output (I _{OH} = 0.5mA)*	2.4			V
V _{OL}	Low Level Output (I _{OL} = 1.6mA)*			0.6	V
I _{IN}	Input Leakage Current (TXD, DTR, RTS, IN1, IN2, SEND)			100	uA
I _{OH}	Input Current (RST)			580	uA
C _P	Capacitive Load (TXD, DTR, RTS) Capacitive Load (RTS)			10 8	pF pF

Table 6C. CH2165 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	Nominal Operating Current @ V _{CC} = 5.5V when modem is Off Hook		300.0		mA
V _{IH}	High Level Input Voltage @ 5.0V	2.0		3.5	V
V _{IL}	Low Level Input Voltage @ 5.0V	1.0		2.2	V
V _{IH}	High Level Input Voltage (Excluding IN1, IN2, SEND) @ 5.0V	2.0		3.5	V
V _{IL}	Low Level Input Voltage (Excluding IN1, IN2, SEND) @ 5.0V			0.8	V
VT+	Positive Hysteresis Threshold for RESET Pin		2.9		V
VT-	Negative Hysteresis Threshold for RESET Pin		1.98		V
V _{OH}	High Level Output (Including SEND) with I _{OH} = 0.5mA	2.4			V
V _{OL}	Low Level Output (Including SEND) with I _{OL} = 1.6mA			0.6	V
I _{IN}	Input Leakage Current (TXD, DTR, RTS)			100	uA
I _{IL}	Input Current (RST, IN1, IN2, SEND)			1.0	uA
C _P	Capacitive Load (TXD, DTR, RTS) Capacitive Load (RTS)			10 8	pF pF

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 _{PP}	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 _{PP}	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.

Table 7C. CH2165 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 _{PP}	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	25.0			sec	Delay
Inter Character Delay	20	50		msec	Between all command characters
Command Delay	100	200		msec	Between all AT commands
Minimum Reset Pulse	1			µsec	If user supplied

Note: 1. All CH2165 iModem devices re-load operating firmware upon reset and then perform an internal self-check. The CH2165 will not respond to commands issued during this sequence.

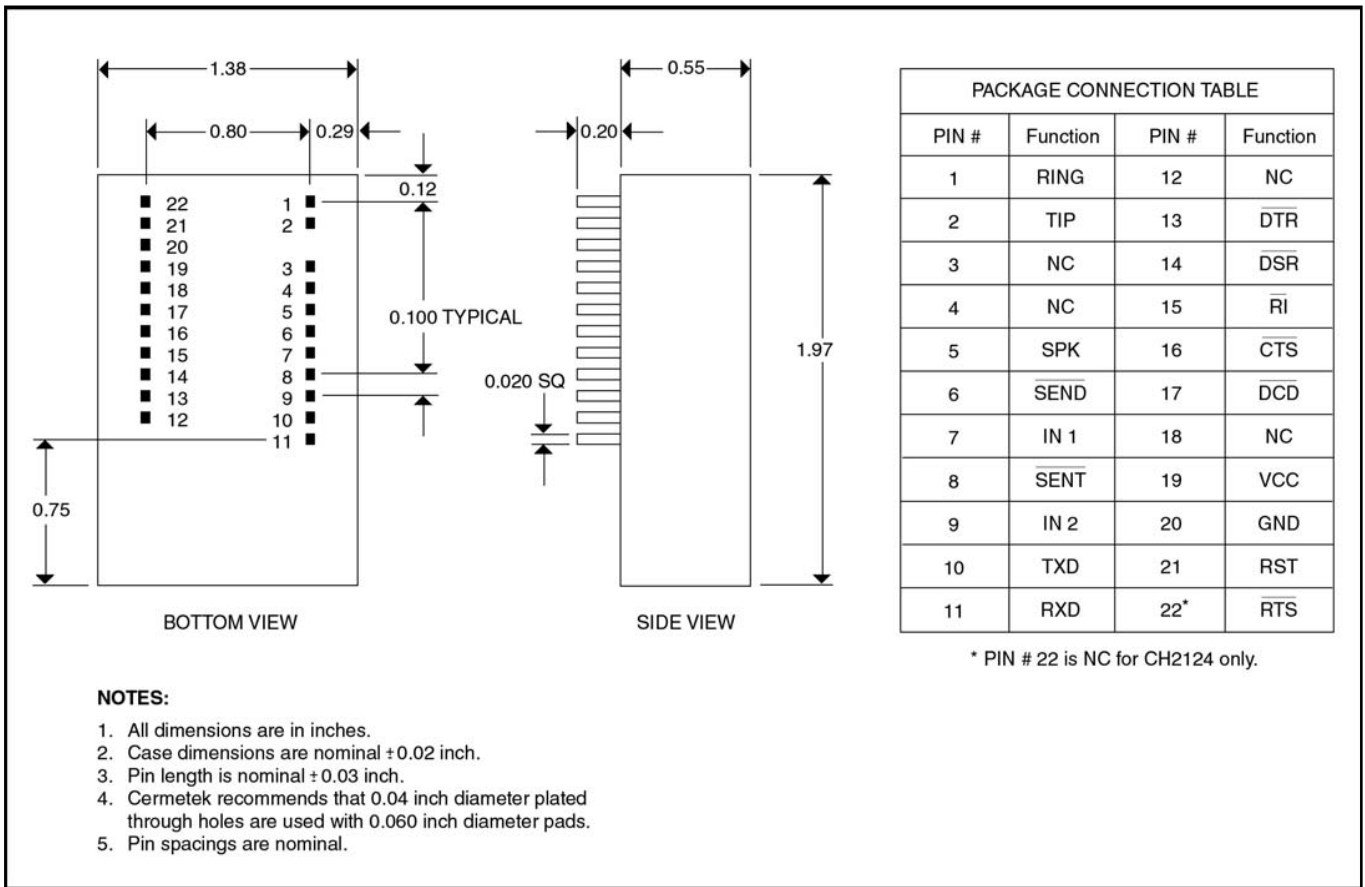


Figure 8. Physical Dimensions and Pin Functions for CH21XX Product Family.

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