

CH1724 Low-Cost Modem Module

DESCRIPTION

The Cermetek CH1724 compact module provides a complete, low-speed modem. As a leadless surface mount module, the CH1724 requires less than half the board space of the leading competitor and is less than half as tall as well.

Despite being a low cost module, the CH1724 includes many advanced features such as; error correction, non-volatile memory for configuration storage and stored number dialing, and active line monitoring to permit the CH1724 to discreetly share the telephone line with standard telephones and other equipment.

Every CH1724 includes conveyed FCC Part 68 registration and Global Telecom compatibility. This eases the compliance burden on the designer adding of security, process control, medical monitoring, point-of-sale, or remote diagnostic systems.

MODELS

CH1724 - 2400 bps; 0°C to 70°C

CH1724 ET - 2400 bps; -40°C to 85°C

FEATURES

- Small Size: 1.6" x 0.8" x 0.220"
- Data transfer rates; 300 bps to 2400 bps
- Control & configuration via AT commands.
- 3.3 and 5 volt compatible serial interface
- Error control and correction
- Line current and voltage monitoring to prevent interference with voice communications.
- Complete integrated, Global DAA
- Nonvolatile configuration storage
- Contact ID and SIA Format Security protocols
- User transferable FCC Part 68 registration
- Industry Canada CS-03 Registration
- World-wide telephone network compliance.
- UL60950 Compliance
- Low Power operation; 3.3 Volts, 130 mW
- RoHS compliant

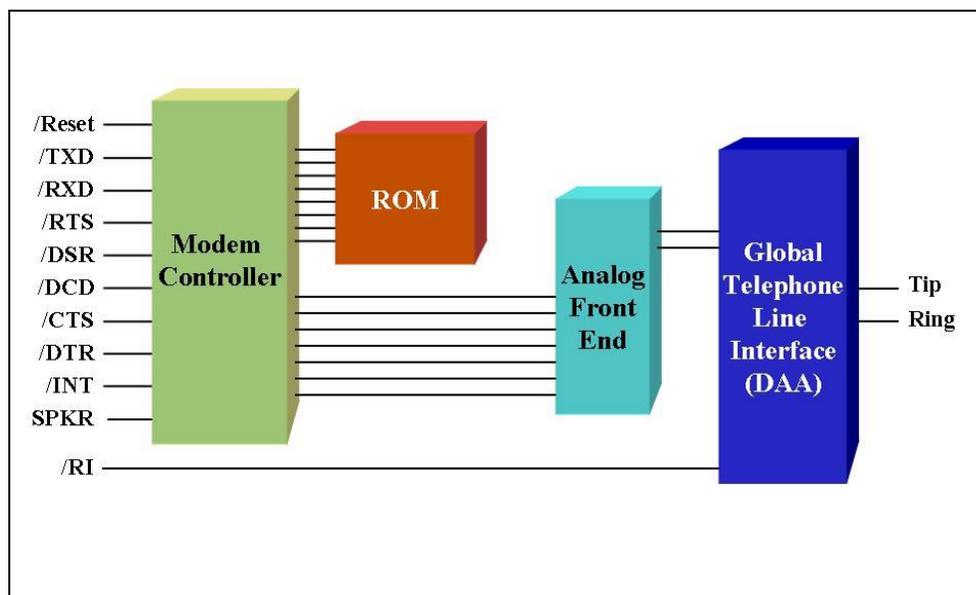


Figure 1: Functional Block Diagram of CH1724

CH1724 DESIGN NOTES

The following design notes assist the developer in achieving maximum utility from the CH1724 modem.

Power Supply: The CH1724 decodes millivolt range analog signals from the telephone line. Steps must be taken to ensure power supply noise on all supply lines, including ground, remains below 50 mV peak-to-peak. At any frequency between 20 kHz and 150 kHz power supply noise must be less than 500 microvolts peak. Dedicated power and ground planes are recommended. Failure to provide clean power could cause the CH1724 to function erratically.

The CH1724 uses a single $+3.3V \pm 0.3$ volt supply. Cermetek recommends by-pass capacitors be placed as close to the modem's supply input as practical. We suggest a 10 μ F Tantalum capacitor in parallel with a 0.01 μ F ceramic capacitor.

Error Correction: The CH1724 employs error correction to preserve data integrity. The CH1724 monitors blocks of data for errors and retransmits any data blocks containing errors. The **ATN** command controls error correction in the CH1724. The modems negotiate error correction on completion of the modem handshake. Both modems must have error correction available for successful error control handshake. The **ATW** command causes the modem to report the status of the error correction negotiations as part of the CONNECT response.

Flow Control: Flow control prevents the loss of data due to buffer overrun when employing error correction or data buffering. With flow control active, **AT&K** command, the modem signals the Host when its transmit data buffer nears capacity. Likewise the Host signals the modem if its input buffer fills. Two methods of signaling are available: Hardware flow control uses the **RTS** and **CTS** control lines for signaling; software flow control employs **XON** and **XOFF** characters in the data stream to signal a buffer full condition.

Loop Monitoring: The CH1724 monitors loop current and voltage to prevent the modem from interfering with other devices connected to the telephone line including interruption of an ongoing call or preventing an emergency call from being placed. The **ATLS** command controls the shared line features.

Non-Volatile RAM (NVRAM): The CH1724 uses NVRAM to store a user defined modem profile and phone numbers for automated dialing. The **AT&W** command stores the active modem configuration in the NVRAM. The CH1724 is delivered with factory default parameters pre-stored in NVRAM.

The **AT&Yn** command selects the configuration to be automatically recalled upon a reset or power up. The **ATZn** command immediately recalls and activates the stored profile.

The CH1724 uses NVRAM to store two telephone numbers of up to 60 digits and modifiers each. The **AT&Zn=s** command stores the telephone number dial string "s" in location "n;" n equals 0 or 1. The **ATDTS=n** command initiates dialing of the stored telephone number in location "n."

World-wide Telecom Compliance: The CH1724 can be configured for telecom requirements from around the world. The **AT+GCI** command includes settings for more than 75 countries.

Serial Interface: The CH1724 connects to the Host through a 5 volt tolerant 3 volt serial interface. TXD, RXD and Ground must be used. Use of the remaining signals, inputs /RTS, /DTR, and /Reset and outputs /CTS, /DCD, /DSR, and /RI is optional. If you elect to not use the /RTS and /DTR inputs, install a 1K pull-down resistor to force those signals to the active state. The /Reset line should be left open if not used. Any of the outputs which are unused can be left open.

AT commands control several modem interface signals. The **AT&C** command can force /DCD to the active state. The **AT&D** command controls modem use of /DTR. The **AT&S** command can force /DSR to the active condition. **AT&K3** controls the use of /CTS for flow control.

CH1724 AT COMMANDS

"AT" commands control CH1724 operation. This section describes the AT command format and lists the commands, registers and result codes.

Command Mode: The CH1724 enters command mode on power-up, reset, a lost connection, or receipt of the escape code. In command mode the modem accepts commands from the host on /TXD. Appropriate result codes are returned on /RXD.

Note: For backward compatibility some functions are controlled by multiple commands. In these instances the last command issued determines the setting.

Command Line Format: AT commands follow a strict format. Each command line, except A/, begins with the prefix AT. The "A" and "T" may be either both upper case or both lower case but cannot be of different cases. The modem determines data rate of the host equipment by measuring the width of the incoming bits of the "A" and "T."

Multiple commands may be loaded into a command line of up to 60 characters. The CH1724 executes the commands in the sequence they appear. The carriage return at the end of the command line triggers command execution. The user may change the character used to terminate the command line with Register S3. Spaces inserted into the command line are not placed in the command buffer.

A backspace is used to edit the command line before execution. The backspace erases the previous character in the command line. Register S5 allows the user to select a character other than backspace to edit the command line.

If the command buffer overflows, the modem issues an "ERROR" result code, and the command is not executed.

Re-Execute Last Command – The A/ command causes the CH1724 to re-execute the previous command. This is the only command which does not use the "AT" prefix.

Omitted Parameters - Most commands require a parameter. If the command omits the parameter, the CH1724 assumes it to be a 0.

Escape Characters - A 3 character escape sequence switches the modem from data to command mode. An escape character, set by Register S2, entered 3 times in succession executes the escape. The user must then enter a command within a period set by S12. The default escape sequence is "+++."

Result Codes - The modem issues a result code after each action. Result codes may be full words, one or two digit numeric codes, or may be disabled. Each numeric result code ends with a carriage return. A Line Feed and Carriage Return precede and follow full word result codes.

SECURITY STANDARDS

The CH1724 supports a pair of Security Industry Association protocols; Contact ID (SIA DC-05-1999.09) and SIA Format (SIA DC-03-1990.01). The CH1724 controls these protocols with AT command variations.

Contact ID: The command AT-A1<CR> selects Contact ID. Contact ID uses a modified dial command to transfer the Contact ID messages, see below.

ATDT!xxx!1yyyy<CR>

In the above command "xxx" is the number to be dialed. The "1" identifies the digits that follow as Contact ID data. The characters "yyyy" represent the Contact ID message including the CRC. The Contact ID message may contain a maximum of 63 characters. Additional data can be sent using the AT!1zzz or !zzz commands.

Other commands and registers are also used in the Contact ID messaging. The AT-B command causes the modem to resend the previous message. S10, S61, and S90 control the Kissoff tone timing at end the transaction. S42 and S43 control the timing of the handshake tones.

Contact ID Responses: Contact ID mode uses the unique responses shown below.

- b Busy Tone Detected
- c Connect
- K Valid Kisosff Tone Detected
- k Kisosff Tone Exceeds the Time Limit Set by S10
- N No Carrier Detected
- n No Dial Tone Detected
- O OK, Valid Command Received
- R Ringing
- r Ringback Tone Detected
- t Dial Tone Detected
- ^ Kisosff Tone Detection Required
- , Dialing Complete

SIA Format: The command AT-A2<CR> selects SIA Format. SIA Format uses a modified dialing command to transfer the SIA formatted message see below.

ATDxx!2YYYY<CR> or ATD!xxx!2yyyy<CR>

“xxx” is the number to be dialed. The “2” identifies the following digits as SIA data. The characters “yyyy” are the SIA message. A maximum of 63 characters may be included in the SIA message. Additional data can be sent using AT!2zzz.

Other commands and registers are used in the SIA messaging. The AT-E and AT-Q commands determine handling of an Acknowledgement tone. AT-R selects the SIA Format Column Parity calculation. S42, S61, S62, S7, S90, S92, S96, S99 and S102 control handshaking in SIA mode.

SIA mode uses the unique responses shown below.

- b Busy Tone Detected
- c Connect
- E Negative Acknowledgement Detected
- N No Carrier Detected
- n No Dial Tone Detected
- O OK, Valid Command Received
- P Positive Acknowledgement Detected
- R Ringing
- r Ringback Tone Detected
- t Dial Tone Detected
- T Acknowledgement Time Out
- , Dialing Complete

AT COMMANDS

An asterisk “*” indicates the factory default setting

A - Answer Command - Causes the modem to immediately go off-hook and attempt link negotiations.

D - Dial Command - Causes the modem to go off-hook and dial. Below is a list of the characters accepted in the dialing string.

0-9, A-D, #, * = Dialing Digits

L = Redial Last Number Dialed

P = Pulse dial

S=n = Dial number stored in location n

T = Tone dial

W = Wait for dial tone

, = Pause for the duration of S8

! = Switch hook flash

; = Return to the command state

@ = Wait for 5 seconds of silence

En - Command Echo - Determines if the modem returns the commands received from the host.

n=0 Do not echo commands

n=1 Enable command echo *

Hn - Switch Hook Control - Controls the connection to the telephone line.

n=0 Switch hook relay opens; modem on-hook

n=1 Switch hook relay closes; modem off-hook

In - Modem Identification - Provides product data.

n=0 Modem identity

n=3 Driver Version Number

n=4 Data Pump Firmware Version

n=9 Country ID

n=11 Connection Data

Ln - Speaker Volume - Selects speaker output level.

n=0 Low Volume

n=1 Low Volume

n=2 Moderate Volume *

n=3 High Volume

LSn – Shared Line Features – Controls modem operation on a shared telephone line.

- n=0 Loop Monitor Disabled *
- n=1 Display Line Voltage Value
- n=2 Display Line Availability
- n=3 Disconnect on Extension Pickup
- n=4 Report Extension Pickup; remain off-hook
- n=5 Display Loop Current Value
- n=6 Display Line Sense Thresholds
- n=7 Do not go off-hook if line is unavailable.
Disconnect on extension pickup.

Mn - Speaker Activity - Selects speaker activity

- n=0 Speaker off
- n=1 Speaker on until carrier received *
- n=2 Speaker remains on with modem off-hook
- n=3 Speaker on until carrier except during dialing

Nn - Link Negotiations - Selects how the Register S37 value will be used in link negotiations

- n=0 Connect only using the speed selected by S37
- n=1 Begin negotiations at the selected speed but allow fallback *

On - On Line - Puts the modem back into data mode from the on-line command mode.

- n=0 Return On Line with no retrain *
- n=1 Initiate retrain while returning On Line.
- n=3 Initiate rate renegotiation on return On Line.

Qn - Responses - Determines if the modem will send responses to the host.

- n=0 Send responses *
- n=1 No Responses

Sr? - Interrogate Register – Read register value.

Sr=n - Set Register Value - Set register value.

Vn - Result Codes - Determines what the type of result codes to be issued.

- n=0 Numeric Result Codes
- n=1 English Word Result Codes *

Wn - Expanded Result Codes – Allows inclusion of protocol messages with the Connect responses.

- n=0 Report Host Receive Speed
- n=1 Report Host Receive Speed and protocol type
- n=2 Report Modem Link Speed and protocol *

Xn - Result Codes - Sets modem responses (see Table 3 on Page 11 for full response set)

- n=0 OK, RING, ERROR, CONNECT, NO CARRIER
- n=1 OK, RING, ERROR, CONNECT (with rate), NO CARRIER
- n=2 OK, RING, ERROR, CONNECT (with rate), NO CARRIER, NO DIALTONE
- n=3 OK, RING, ERROR, CONNECT (with rate), BUSY NO CARRIER, BLACKLISTED
- n=4 OK, RING, ERROR, NO CARRIER
- n=5 OK, RING, ERROR, NO CARRIER, NO DIALTONE *

Z - Reset - Causes an immediate modem soft reset and reconfigures the modem to the stored values

&Cn - Data Carrier Detect Operation - Determines how the modem will present /DCD.

- n=0 /DCD forced active at all times
- n=1 /DCD indicates modem carrier signal state *

&Dn - Data Terminal Ready - Selects how the modem will react to the removal of /DTR from the host

- n=0 Modem ignores status of /DTR
- n=1 If /DTR is removed with the modem on line, the modem enters on-line command mode
- n=2 /DTR must be active to maintain link *
- n=3 Reset modem with on to off transition of /DTR.

&F - Restore Factory Configuration - Returns modem configuration to its factory settings.

&Kn - Local Flow Control - Determines the operation of flow control between the modem and local host.

- n=0 No Flow Control
- n=3 RTS/CTS (hardware) Flow Control *
- n=4 XON/XOFF (software) Flow Control

&Sn - Data Set Ready - Determines how the modem will present /DSR to the host.

- n=0 Force /DSR active *
- n=1 /DSR shows modem is ready to communicate

&Tn - Modem Test Modes - Control diagnostics

- n=0 Terminate Test in Progress
- n=1 Local Analog Loopback test

&V - View Active Configuration - Presents current modem configuration information

&W - Store Active Configuration - Places the current configuration into the NVRAM.

&Zx=n - Store Number n in Location "x" - Permits storing telephone number "n" in memory location "x." ATDTS=n dials the stored number.

- x=0 Location 0
- x=1 Location 1

\Fn - Fast Connect – Controls the V.22 Fast connect and V.23 turn around functions.

- n=0 Disable V.22 Fast Connect & V.23 Turnaround.
- n=1 V.22 Fast Connect Enabled
- n=5 V.23 turnaround using RTS
- n=6 V.23 Turnaround using DTR

\Jn - Data Buffer – Determines if data buffers will be used on non-error controlled connections.

- n=0 Data Buffer Enabled *
- n=1 Modem will not connect at a rate faster than the serial interface speed.

\Kn - Break Signal Response (Data Mode) -

Determines how the modem handles a break signal

- n=0 Enter command mode, do not transmit break
- n=1 Clear data buffers, transmit break
- n=2 same as n=0
- n=3 immediately transmit break
- n=4 same as n=0
- n=5 Transmit nondestructive break in line with data
- n=6 Ignore the break signal

\Nn - Error Control Mode - Selects which protocols will be used during data connections.

- n=0,1 Buffer Data, No Error Control
- n=2 Error Correction required
- n=3 Auto Error Correction *
- n=6 SDLC Formatted Data

-An - Security Mode – Selects the Security mode used by the modem

- n=0 Normal Operation
- n=1 Contact ID Format
- n=2 SIA DC-03-1990.01 Format

-B - Retransmit Contact ID message – Causes the modem to immediately resend the most recent Contact ID message.

-En - Detect SIA Format Acknowledgement Tone – Determines if the modem will detect the SIA Format Acknowledgement Tone.

- n=0 Do not detect Acknowledgement Tone
- n=1 Detect Acknowledgement Tone

-Kn - Response to Invalid SDLC Frame format – Determines how the modem responds to a nonconforming SDLC data.

- n=0 send "bad CRC" message
- n=1 send abort character

-Qn - Hang-up on Receipt of Acknowledgment Tone – This command selects how the modem disconnects in response to receipt of the Acknowledgement Tone.

- n=0 Do not Disconnect
- n=1 Disconnect upon Timeout
- n=2 Disconnect upon negative acknowledgement
- n=3 Disconnect on positive acknowledgement

-Rn - SIA Format Column Parity Calculation – This command selects whether or not the modem will calculate the Column parity.

- n=0 Do not Calculate Column Parity
- n=1 Calculate column parity

+ER=n - Error Control Reporting - Determines if the Error Control status of the connection will be reported.

0 = Error Control Report enabled *

1 = Error Control Report Disabled

+GCI = a Country Selection (Hex code) - Chooses the modem's country configuration. The country configuration is always stored in nonvolatile memory.

a Country Code

00 = Japan
 04 = Germany
 07 = Argentina
 09 = Australia
 0A = Austria
 0D = Bangladesh
 0E = Barbados
 0F = Belgium
 14 = Bolivia
 16 = Brazil
 19 = Bulgaria
 1E = Belarus
 20 = Canada
 25 = Chile
 26 = People's Republic of China
 27 = Columbia
 2B = Costa Rica
 2D = Cyprus
 2E = Czech Republic
 31 = Denmark
 35 = Ecuador
 36 = Egypt
 3C = Finland
 3D = France
 46 = Greece
 49 = Guatemala
 50 = Hong Kong
 51 = Hungary
 52 = Iceland
 53 = India
 54 = Indonesia
 57 = Ireland
 58 = Israel
 59 = Italy
 5E = Jordon
 61 = Korea

a Country Code

62 = Kuwait
 64 = Lebanon
 69 = Luxembourg
 6C = Malaysia
 70 = Malta
 73 = Mexico
 77 = Morocco
 7B = Netherlands
 7E = New Zealand
 7F = Nicaragua
 82 = Norway
 83 = Oman
 84 = Pakistan
 85 = Panama
 87 = Paraguay
 88 = Peru
 89 = Philippines
 8A = Poland
 8B = Portugal
 8C = Puerto Rico
 8E = Romania
 98 = Saudi Arabia
 9C = Singapore
 9F = South Africa
 A0 = Spain
 A1 = Sri Lanka
 A5 = Sweden
 A6 = Switzerland
 A9 = Thailand
 AE = Turkey
 B2 = Ukraine
 B3 = United Arab Emirates
 B4 = United Kingdom
 B5 = United States
 B7 = Uruguay
 BB = Venezuela
 BC = Vietnam
 C1 = Serbia and Montenegro
 F8 = Latvia
 F9 = Lithuania
 FC = Slovakia
 FD = Slovenia
 FE = Taiwan

+IFC = a,b Local Flow Control - Selects the flow control settings for the modem.

a - Host control of data from the modem

- 0 = No Flow Control
- 1 = XON/XOFF (Software Flow Control)
- 2 = RTS/CTS (Hardware Flow Control) *

b - Modem control of data from host

- 0 = No Flow Control
- 1 = XON/XOFF (Software Flow Control)
- 2 = RTS/CTS (Hardware Flow Control) *

+ILR=a - Report Serial Data Rate - Determines if the local serial data rate will be reported as part of the Connect message.

- 0 = Do not transmit local serial data rate with the Connect response
- 1 = Transmit the local serial data rate as part of the Connect message.

+IPR=a - Fix Serial Data Rate - Sets the speed of the serial interface to a predetermined rate.

a = Data Rate Setting

- 0 = Automatic rate detection
- 110 = 110 bps
- 300 = 300 bps
- 600 = 600 bps
- 1200 = 1200 bps
- 2400 = 2400 bps
- 4800 = 4800 bps
- 9600 = 9600 bps
- 14400 = 14,400 bps
- 19200 = 19,200 bps
- 38400 = 38,400 bps
- 57600 = 57,600 bps
- 115200 = 115,200 bps

+MS=a,b,c,d,e,f - Select Modulation - Selects the starting modulation for link negotiations.

a - Carrier

- V22B = V.22bis connection
- V22 = V.22 connection
- Bell212A = Bell 212A connection
- V23C = V.23 connection
- V21 = V.21 connection
- Bell103 = Bell 103 connection

b - Automatic Modulation negotiations

- 0 - Disabled
- 1 - Enabled *

c - Minimum receive data rate (300 to 2400 bps)

d - Maximum receive data rate (300 to 2400 bps)

e - Minimum transmit data rate (300 to 2400 bps)

f - Maximum transmit data rate (300 to 2400 bps)

+VCID=n - Caller ID Selection - Controls the use of Caller ID in the CH1724

- n=0 Caller ID Disabled
- n=1 Caller ID presented as formatted data.
- n=2 Caller ID presented as raw data.

CH1724 REGISTER SETTINGS

- S0 Answer on nth Ring:** Register S0 sets the modem to automatically answer on the nth ring. Setting S0 to 0 disables automatic answer.
Range: 0 to 255
Units Rings
Default 0
- S1 Ring Count:** S1 is a read-only register showing the number of rings detected. If no ring is detected within 8 seconds, S1 is reset.
Range: 0 to 255
Units Rings
Default 0
- S2 Escape Character:** Register S2 defines the ASCII escape character. Values 0-127 select valid characters; values 128-255 disable the escape sequence.
Range: 0 to 255
Units ASCII Character
Default 43 (+)
- S3 Line Termination Character:** Register S3 determines the ASCII character used to terminate commands and modem responses.
Range: 0 to 127
Units ASCII Character
Default 13 (Carriage Return)
- S4 Line Feed Character:** Register S4 sets the ASCII character used as a Line Feed in modem responses.
Range: 0 to 127
Units ASCII Character
Default 10 (Line Feed)
- S5 Backspace Character:** Register S5 defines the character used to edit the command line.
Range: 0 to 127
Units ASCII Character
Default 8 (Back Space)
- S6 Dial Tone Wait Time:** Register S6 determines how long the modem waits for dial tone before dialing. 2 seconds is the minimum wait time.
Range: 0 to 255
Units Seconds
Default 3
- S7 Wait for Carrier after Dialing:** Register S7 controls how long the modem waits for a valid carrier signal after dialing.
Range: 0 to 255
Units Seconds
Default 50
- S8 Comma Pause Time:** Register S8 defines the length of the pause caused by a comma inserted in the dialing string
Range: 0 to 255
Units Seconds
Default 2
- S10 Kisosff Tone Window:** Register S10 governs how long the modem will look for the Kisosff Tone during Contact ID operations.
Range: 0 to 255
Units 16 ms
Default 78 (1.248 second window)
- S11 DTMF Dialing Speed:** Register S11 controls DTMF tone duration and spacing.
Range: 50 to 150
Units: milliseconds
Default 55
- S12 Escape Code Guard Timer:** Register S12 sets the modem's escape code guard timer. Any data received within the guard timer causes the modem to abort the escape from data mode.
Range: 10 to 255
Units 0.02 Seconds
Default 50

- S29 Hook Flash Duration:** Register S29 controls the duration of the hook flash generated by the “!” dial modifier in the dialing string.
 Range: 0 to 255
 Units 0.01 Seconds
 Default 70
- S30 Disconnect Inactivity Timer:** Register S30 determines how long the modem remains on line while no data flows. A zero prevents the modem from disconnecting due to inactivity.
 Range: 0-255
 Units: 10 Minutes
 Default: 0
- S36 Response to LAPM Negotiation Failure:** Register S36 defines the modem action taken if the selected error correction negotiations fail.
 0 = Disconnect
 1 or 3 = Maintain link with no error correction
 4 = A MNP negotiation is attempted, disconnect if unsuccessful
 5 = MNP negotiation attempted, establish normal connection if unsuccessful
 7 = MNP negotiation attempted, establish normal connection if unsuccessful *
- S37 Line Data Rate:** Register S37 determines the maximum line data rate that can be negotiated.
 0 = Automatic rate negotiation *
 2 = 1200/75 bps (V.23)
 3 = 300 bps
 5 = 1200 bps
 7 = 2400 bps
- S42 Data Delay Time:** Register S42 sets the time during which the modem ignores received data after handshaking is initiated.
 Range: 0 to 255
 Units 2 milliseconds
 Default 125
- S43 Contact ID Handshake Timer:** Register S43 governs the time the CH1724 allows to complete handshaking in the Contact ID mode.
 Range: 0 to 255
 Units 1 milliseconds
 Default 50
- S61 Acknowledgement Timer:** Register S61 sets the time for the CH1724 to detect acknowledgement or Kisosff tones in Security modes.
 Range: 0 to 255
 Units 8 milliseconds
 Default 35 (280 milliseconds)
- S62 SIA Handshake Timer:** Register S62 defines the time allotted for the CH1724 to detect handshake tones in SIA mode.
 Range: 0 to 255
 Units 8 milliseconds
 Default 113 (904 milliseconds)
- S71 Delay Before Acknowledgement:** In SIA mode Register S71 determines the delay after transmitting a message before the modem looks for the Acknowledgement Tone.
 Range: 0 to 255
 Units 8 milliseconds
 Default 130 (1.04 seconds)
- S90 Acknowledgement Timeout:** Register S90 sets the time allotted for the CH1724 to receive an acknowledgement or Kisosff tone in Security modes before disconnecting.
 Range: 0 to 255
 Units 16 milliseconds
 Default 156 (2.496 seconds)
- S92 Sync Delay:** Register S92 controls the time between the Handshake Tone and the Synchronization signal in SIA mode.
 Range: 0 to 255
 Units 4 milliseconds
 Default 120 (480 milliseconds)

S96 Mute Delay: Register S96 determines how long the modem will transmit null characters after the message is sent in SIA mode.

Range: 0 to 255

Units 1 millisecond

Default 54

S102 Speed Synchronization Signals: Register S102 selects how many Speed Synchronization Signals will be sent in SIA Format. Each sync signal is 26.67 milliseconds.

Range: 0 to 255

Units Sync signals

Default 10

Table 1: CH1724 Modem Responses

Verbose Result Code	Numeric Result Code	Description
<CR><LF>OK<CR><LF>	0<CR>	Command line executed successfully
CR><LF>CONNECT<CR><LF>	1<CR>	Modem Link established
CR><LF>RING<CR><LF>	2<CR>	An incoming Ring has been detected
CR><LF>NO CARRRIER<CR><LF>	3<CR>	Modem lost carrier, does not detect answer tone, or does not detect a carrier signal
CR><LF>ERROR<CR><LF>	4<CR>	Invalid command received
CR><LF>CONNECT 1200<CR><LF>	5<CR>	1200 bps connection established. When extended result codes are enabled "MNP4" is added for an error controlled connection and "NoEC" for a normal connection
CR><LF>NO DIALTONE<CR><LF>	6<CR>	No Dialtone was detected
CR><LF>BUSY<CR><LF>	7<CR>	A Busy Tone was detected
CR><LF>NO ANSWER<CR><LF>	8<CR>	Remote modem did not answer
CR><LF>CONNECT 2400<CR><LF>	10<CR>	2400 bps connection established. With extended result codes enabled "MNP4" is added for an error controlled connection and "NoEC" for a normal connection
CR><LF>CONNECT 38400<CR><LF>	28<CR>	A connection was established at the host rate of 38,400 bps. When extended result codes are enabled "MNP4" is added for an error controlled connection and "NoEC" for a normal connection
CR><LF>CONNECT 57600<CR><LF>	18<CR>	A connection was established at the host rate of 57,600 bps. When extended result codes are enabled "MNP4" is added for an error controlled connection and "NoEC" for a normal connection
CR><LF>CONNECT 115200<CR><LF>	87<CR>	A connection was established at the host rate of 115,200 bps. When extended result codes are enabled "MNP4" is added for an error controlled connection and "NoEC" for a normal connection

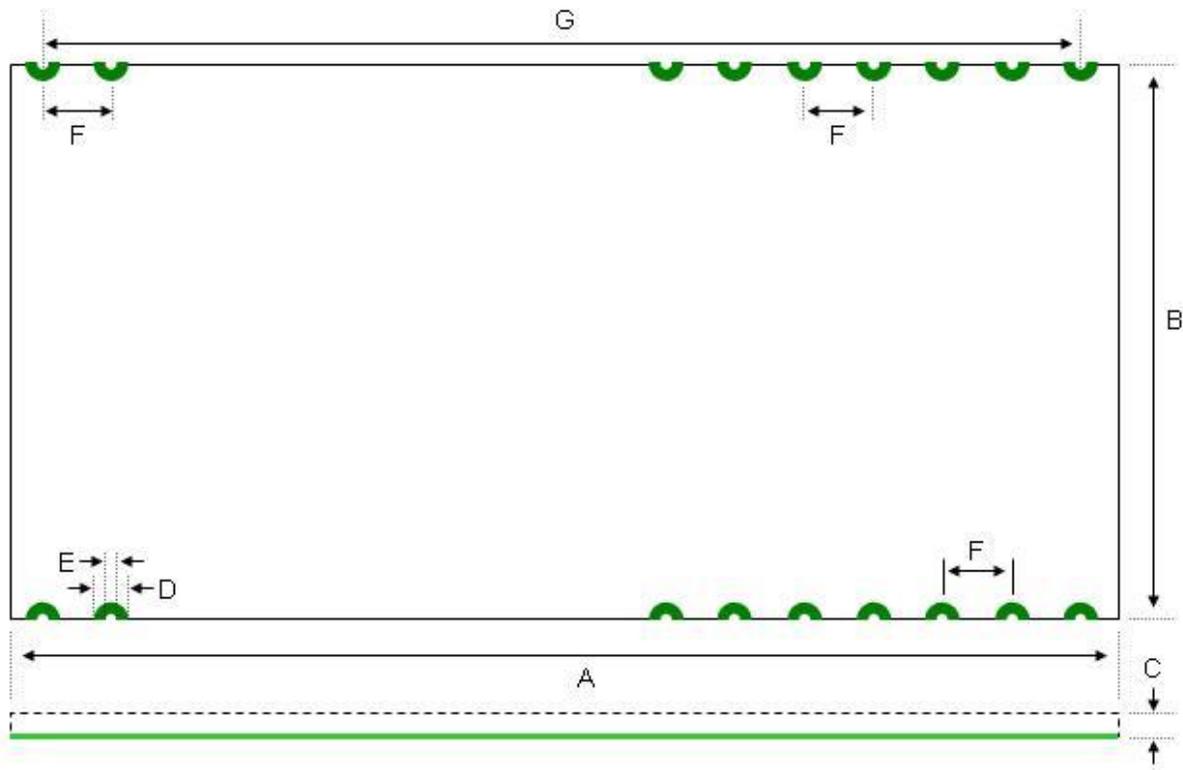


Figure 2: CH1724 Mechanical Specifications

Table 2: CH1724 Mechanical Specifications

DIMENSION	MIN	TYP	MAX	DESCRIPTION
A		1.60		Module Length in inches
B		0.80		Module Width in inches
C		0.220		Module Height in inches
D		0.050		Solder Pad Diameter in inches
E		0.039		Solder Pad Castellation Diameter in inches
F		0.100		Center to center space between Pads in inches
G		1.500		Pin row Length in inches

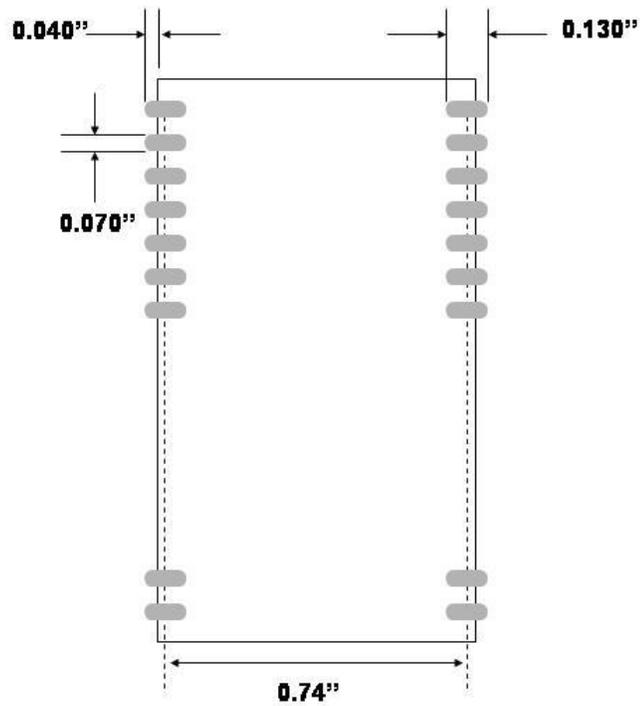


FIGURE 3: CH1724 RECOMMENDED LANDING PATTERN

Pad Dimensions: Oval 0.130 inches by 0.070 inches

Pad Extension beyond CH1724 PCB: 0.040 inches

Row Center to Row Center: 0.74 inches

Warning: No Vias, Traces or other Copper should be placed under the CH1724 module

CH1724 SURFACE MOUNT SOLDERING INSTRUCTIONS

The CH1724 is subject to damage if over-exposed to heat during solder reflow operations. Following the soldering instructions below will ensure that the process of soldering the module to the board does not damage the modem.

Absolute Maximum Temperature:	250° C
Maximum Time at 235° C:	15 Seconds
Maximum Time in reflow zone (217° C):	90 Seconds
Maximum Preheat Dwell Time:	180 Seconds

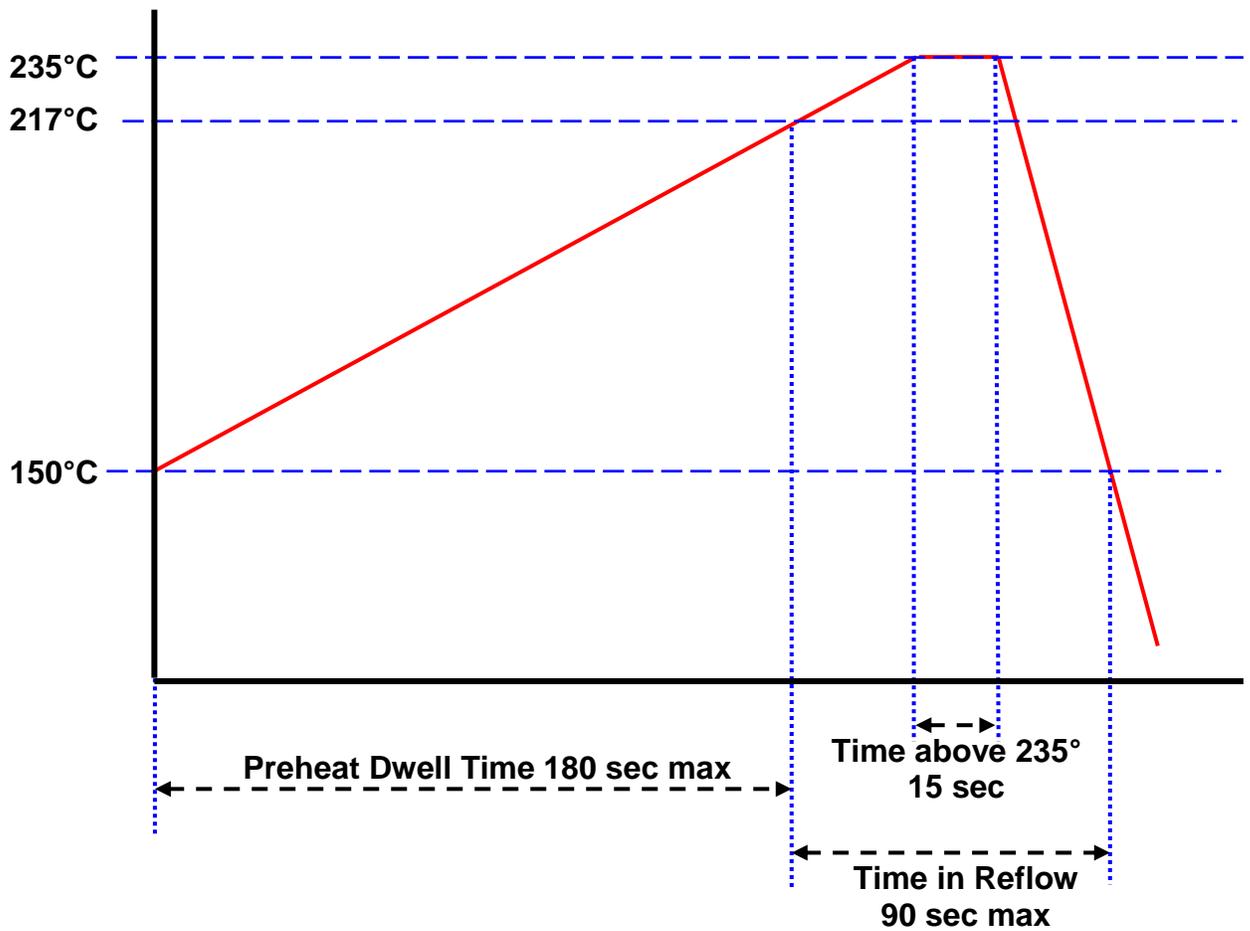


Figure 4: Maximum Recommended Solder Temperature Profile

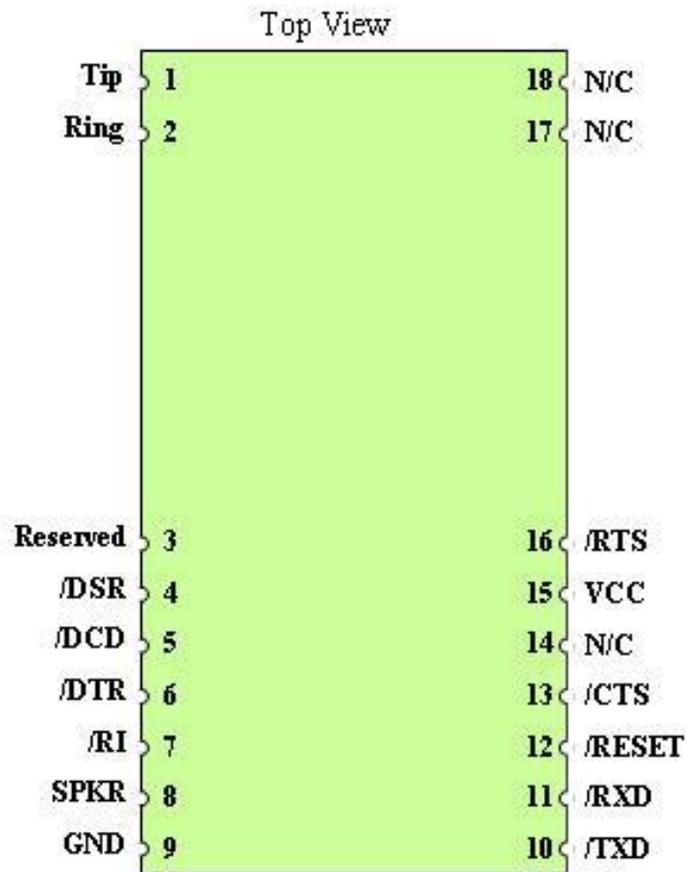


Figure 5: CH1724 Solder Pad Configuration

CH1724 PAD DESCRIPTIONS

PAD	SIGNAL	DESCRIPTION
1	TIP	Ring and Tip connect the modem to the telephone line. FCC Part 68 Rules require 1500 volt isolation barrier between the telephone line and all other circuits. This isolation must be preserved throughout the system. The telephone company places a DC "Battery" voltage across Tip and Ring on public switched telephone lines. The CH1724 operates regardless of the polarity of this voltage. The "Battery" voltage drives up to 100 milliamps of loop current. UL60950 requires minimum creepage and clearances distances between the Tip and Ring and all other circuits. Clearance is the shortest distance between conductive circuits; creepage is the distance between conductive points along a surface.
2	RING	Ring and Tip connect the modem to the telephone line.
3	Reserved	This pin is reserved for future use and should remain unconnected.
4	/DSR	/DSR is an active low modem output. An active /DSR typically indicates that the modem has established a communications link. The AT&S command defines the function of /DSR.
5	/DCD	/DCD is an active low modem output. The modem normally activates /DCD upon detection of a valid carrier signal. The AT&C command controls when the CH1724 asserts /DCD.
6	/DTR	/DTR is an active low modem input. An active /DTR traditionally indicates that the Host is ready to communicate. The AT&D command selects how the modem acts on /DTR.
7	/RI	/RI reports on the presence of an incoming ring signal. When a ring occurs on the telephone line, the /RI output goes low and toggles with the cadence of the ring signal.
8	SPKR	SPKR provides a Pulse Width Modulated version of the signal on Tip and Ring. This allows use of a speaker with the modem to monitor modem operations. The signal on SPKR is controlled by the ATL and ATM commands.
9	Ground	Ground provides the reference voltage for all host interface signals
10	/TXD	/TXD provides the path for transmit data and commands to be passed from the Host to the modem. Data starts with a high to low transition. Mark is represented by a HIGH
11	/RXD	/RXD provides the path for receive data and responses to be sent from the modem to the Host. Data starts with a high to low transition. Mark is represented by a HIGH
12	/RESET	/RESET is an active low modem input which initiates a hardware reset. /RESET must be active for a minimum of 100 milliseconds for a proper reset. No external reset is required; Leave the /RESET signal unconnected if an external Reset is not used.
13	/CTS	/CTS is an active low modem output. When hardware flow control is set, the modem asserts /CTS to indicate that it can accept data from the host on /TXD.
14	N/C	No Connection; this pad should remain unconnected.
15	VCC	VCC provides 3.3 volt power to the modem.
16	/RTS	/RTS is an active low modem input. When hardware flow control is set, an active /RTS indicates to the modem that the host has data to send.
17	N/C	This pad is provided only for mechanical stability. No electrical connection should be made.
18	N/C	This pad is provided only for mechanical stability. No electrical connection should be made.

Table 3: CH1724 Electrical Specifications

Parameter	Minimum	Typical	Maximum	Units	Notes
VCC	3.0	3.3	3.6	Volts	
ICC		40		mA	During Data Transfer
Ring Voltage Detected	26		150	V _{RMS}	Type B Ringer
Ring Frequencies Detected	15.3		68	Hz	Type B Ringer
Telephone Line Loop Current	10	20	100	mA	Off-Hook
Line Impedance		600		Ohms	
Transmit Level			-9.0	dBm	Data Transfer
			0.0	dBm	DTMF Signaling
V _{OH}			2.6	Volts	VCC = 3.3 Volts; I _{OH} = -1.8 mA
V _{OL}			0.4	Volts	I _{OL} = 1.8 mA
V _{IH}	2.31		5.5	Volts	VCC = 3.3 Volts
V _{IL}	-0.3		0.99	Volts	VCC = 3.3 Volts
EXT CLK		27.0		MHz	± 50 PPM

Table 4: CH1724 Absolute Maximum Ratings

Parameter	Minimum	Typical	Maximum	Units	Notes
Storage Temperature	-40°		85°	Celsius	
VCC			4.2	Volts	
V _{IH}			5.7	Volts	5 Volt tolerant Interface
Operating Temperature	0°		70°	Celsius	CH1724
	-40°		85°	Celsius	CH1724 ET

Model Numbers

Cermetek offers the CH1724 in the standard commercial operating temperature range of 0°C to 70°C and in extended range of -40°C to +85°C. Table 5 below lists the available CH1724 model numbers.

Table 5: CH1724 Model Numbers

Model	Summary of Features
CH1724	2400 bps modem; Error Correction; NVRAM; 0°C to 70°C
CH1724 ET	2400 bps modem; Error Correction; NVRAM; -40°C to 85°C

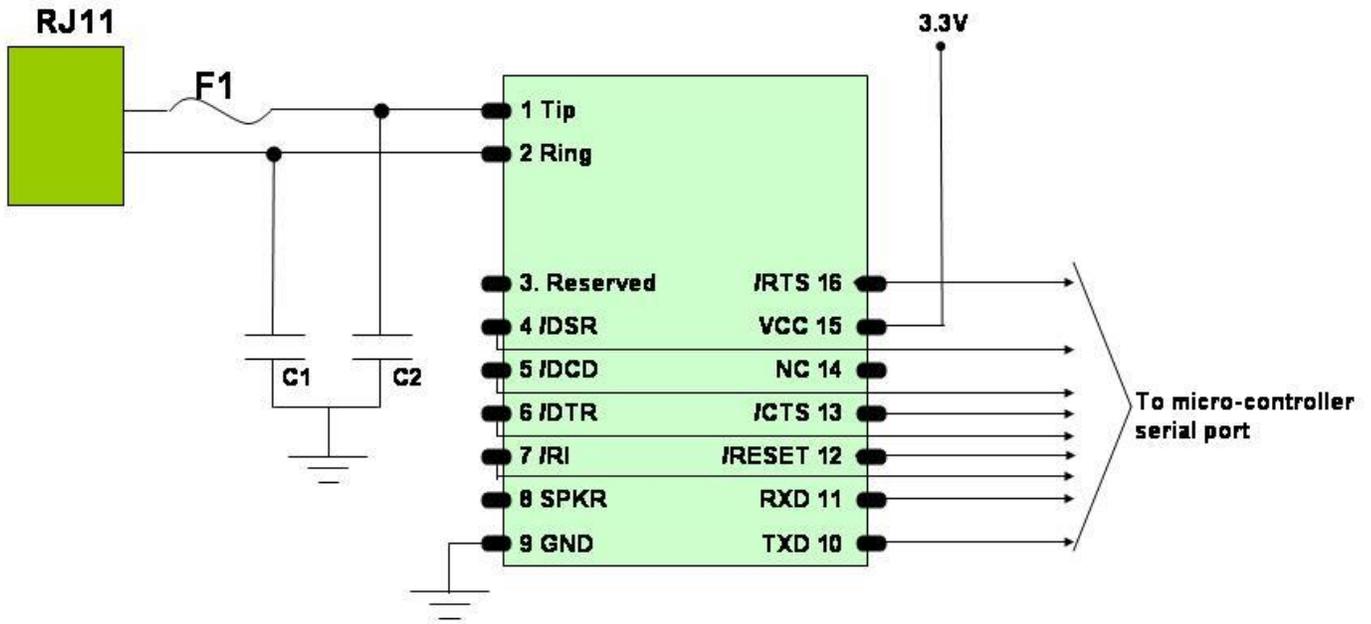


FIGURE 6: CH1724 TYPICAL CONNECTION DIAGRAM

Parts List for CH1724 Typical Connection Diagram

Reference Designation	Qty	Description
C1, C2	2	Cap 680 pFd, Y2
F1	1	PTC, TR600-150

Notes:

1. Capacitors C1 and C2 may be required for EMI filtering in your system. Without these components you may experience unintended radiation when the telephone cable is attached. C1 and C2 are high-voltage capacitors. This 680 pFd, 5000 volt capacitor will direct high frequency harmonics to the system ground.
2. F1 is a positive thermal coefficient (PTC) device which protects the modem from excessive current flow. This device is required for your system to pass UL60950. Fuses may be used in place of the PTC.

FCC INSTRUCTIONS**ACTA Product Registration Number: US: B46MM01BCH1724****CS-03 Registration # 176A-CH1724**

This equipment complies with TIA/EIA/IS-968 rules. Located on the equipment is a label that displays the FCC registration number. The FCC registration number includes information on the manufacturer, model number and ringer equivalence of the connection to the telephone network. If requested this information must be provided to the telephone company.

Ringer equivalence is used to determine the number of devices which may be connected to a telephone line. An excessive number of devices on a telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the Ringer Equivalence Numbers should not exceed five (5.0). To confirm the number of devices that may be connected to the line, as determined by the total Ringer Equivalence Numbers, contact the local telephone company for the maximum Ringer Equivalence for the calling area.

This equipment cannot be used on the telephone company-provided coin service. Connection to party Line Service is subject to State Tariffs.

If this equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. If advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe this is necessary.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advanced notice in order for you to make the necessary modifications in order to maintain uninterrupted service.

If trouble is experienced with this equipment, please contact;

Company Name: Cernetek Microelectronics, Inc.
Address: 374 Turquoise Street, Milpitas, CA 95035
Telephone: 408-942-2200
Fax: 408-942-1346

If the trouble is causing harm to the telephone network, the telephone company may request you to remove the equipment from the network until the problem is resolved.

The equipment using the CH1724 must use an approved USOC RJ11C jack.

It is recommended that the customer install an AC surge arrestor in the AC outlet to which this device is connected. This is to avoid damaging the equipment caused by local lightning strikes and other electrical surges.

Cernetek reserves the right to make changes in specifications at any time and without notice. The information furnished by Cernetek in this publication is believed to be accurate and reliable. However, Cernetek assumes no responsibility for its use, or for any infringements of patents or other rights of third parties resulting from its use. No license is granted under any patents or patent rights of Cernetek.

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

372 #2 TURQUOISE STREET | MILPITAS, CA 95035 | LOCAL: 408-942-2200 | FAX: 408-942-1346
CERMETEK WEB SITE: <http://www.cernetek.com> | EMAIL: sales@cermetek.com