CH1787 Small Functional Modem

INTRODUCTION

The CH1787 is a small full function modem that is FCC Part 68 approved. It has been designed to be used in applications where there is little or no controller intelligence to command the modem. This allows the user to operate the modem via hardware resources only, not requiring AT Command execution for basic operation. For those applications where there is controller intelligence, the CH1787 operates like a standard AT Command driver 2400bps, V.22bis asychronous modem.

The CH1787 is ideal as a remote modem such as found in alarm products and in industrial controllers. Upon some operational event, the modem will dial a prestored telephone number under pin activation to make a modem connection with a host or another site. The modem can also be set to automatically answer incoming calls or manually answer a call, using an answering pin. A call can be ended via a hang-up pin.

GENERAL DESCRIPTION OF FUNCTIONAL BLOCKS

Figure 1 is a functional block diagram of the CH1787. Each block will be described. The CH1787 is a highly integrated, full function modem, comprised of a modulator/demodulator, controller, and an FCC Part 68 approved telephone interface, also called a Data Access Arrangement (DAA) and NVRAM.

Modulation/Demodulation and Control

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

Controller

The controller is a programed microprocessor that provides commands to the modem in response to external pin activation. The following pins are controlled by the microprocessor and are described in detail in Table 1. These pins are operational when the modem is in use at 2400bps only.

ANS - Manual Answer Pin Input - Answer mode- Places modem in answer mode
ORG - Manual Originate Pin Input - Originate mode - places modem in originate mode
ORA- Automatic Dial Pin Input - Dials one of two prestored numbers based on TST
TST - Steering Pin Input used with ORA to select the user stored number or Cermetek test number
HNG- Hang-up Pin Input used to terminate an active modem connected
AAR- Automatic Answer Pin - used to place the modem in Auto Answer Mode

See pin description Table 1 for more details.

FEATURES

- Supports Standards CCITT V.22bis, V.22, Bell 212, and Bell 103
- FCC Part 68 approved and DOC approvable
- Does not require a microprocessor to operate
- Pin activated hang-up
- Pin activated answer
- Manual originate and answer pins
- AT Command structure available
- 1000 VAC isolation barrier
- Single 5 volt operation
- Low power sleep mode
- Automatic adaptive and fixed compromise equalization
- Test modes and diagnostics
- Size: 2.0" x 1.25" x 0.53"
- NVRAM allows storage of custom configurations and telephone numbers
- Operating temperature 0°-70°C
- Extended temperature -40°C to 85°C order CH1787ET

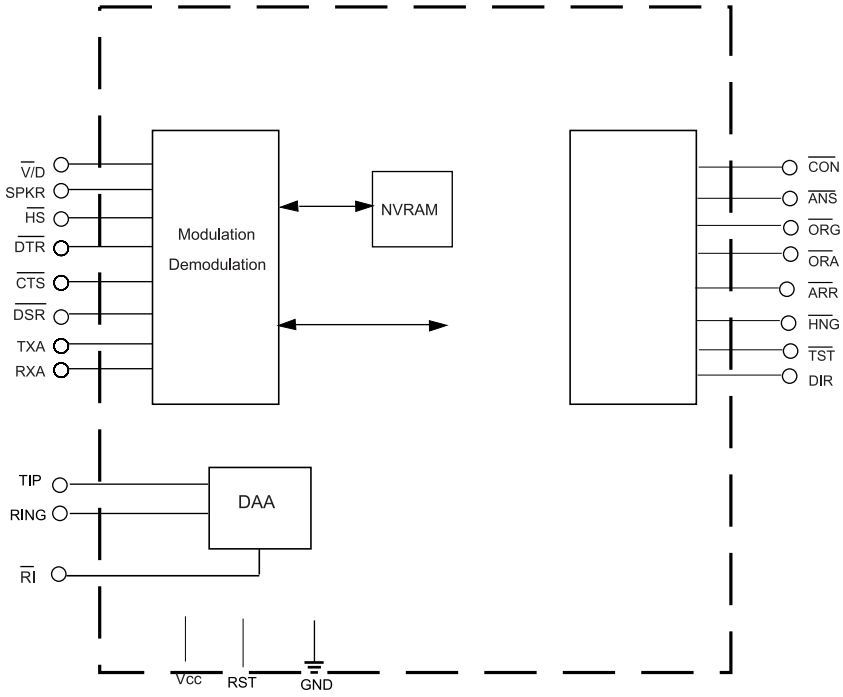


Figure 1. CH1787 Functional Block Diagram

DAA

The CH1787 is designed to meet North American telephone standards as set by FCC Part 68 and DOC. The telephone line interface is designed to meet 1000VAC and 1500 volt peak surge isolation, among other parameters. As such, it will meet U.S. and Canadian requirements and other international requirements that specify that level of isolation. The CH1787 comes with FCC Part 68 approval, a label is provided with the registration number and ringer equivalent. This label should be prominently displayed. As with most countries, except the U.S., Canada requires submission of the product containing the CH1787 for DOC approval. This can be done by submitting the design to a test house or consultant. Call Cermetek for a consultant list.

NVRAM

NVRAM can save up to two user-customized modem configurations. The AT&Wn command will store the active modem configuration in one of two NVRAM locations as selected by an n of 0 or 1. The AT&Yn command selects one of the stored modem configurations to be automatically recalled and active upon a reset or power up. The ATZn command immediately recalls and activates a stored configuration. See Tables 2 and 3 for storable S-Registers and Commands.

NVRAM can save up to four telephone numbers with up to 36 digits or modifiers in each telephone number. The AT&Zn=s command will store s, the telephone number dial string. The ATDTS=n command will cause the modem to dial one of the four stored telephone numbers. The NVRAM storage location for the four telephone numbers is selected by an n of 0, 1, 2, or 3. Location **1** is used for the ORA stored number and Cermetek number.

Supported Features

"AT" Command Set

A 40-character command line is supported. The command line starts with AT and may contain standard or enhanced commands. See Cermetek detailed command summary-www.cermetek.com.

Serial Host Interface

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

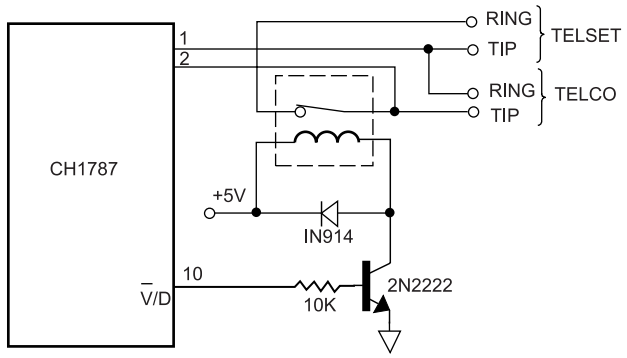
Speaker Interface

The SPK output reflects the receiver analog input and provides a signal that can be used to monitor call progress. The SPK signal can drive a 300 Ω load directly. The SPK signal is usually input to an audio power amplifier and the amplifier drives a speaker coil. Figure 5 shows how to drive an 8 Ω speaker.

The speaker can be turned on and off with the ATMn command. The speaker volume can be adjusted by the ATLn command, where n is 0, 1, 2, or 3.

Phone Control

The CH1787 contains a pin called $\overline{\text{Voice}}$/Data ($\overline{\text{V}}$/D). This pin toggles high when the modem goes off hook and can be used to activate a relay which can switch a telephone on or off the Tip and Ring Telco lines. This allows the telephone to be disconnected when a data call is in progress, preventing the data from being disturbed by an inadvertent telephone pick-up. See Figure 2.



NOTE: $\overline{\text{V}}$/D PIN IS USED TO CREATE SEPARATE PORT FOR TELEPHONE CONNECTION SHARING THE TELCO TIP AND RING. $\overline{\text{V}}$/D IS TTL COMPATIBLE (I_{OL}=1.6MA, V_{OL} =0.4V) AND IS ACTIVE DURING THE DATA CONNECTION WHICH ISOLATES THE TELEPHONE FROM THE TELCO. (THE RELAY CHOSEN MUST MEET THE APPROPRIATE REGULATORY AGENCY).

Figure 2. Voice/Data Port Control

SLEEP MODE

To minimize the modem power consumption, the CH1787 includes a power down feature called the Sleep Mode. When activated the CH1787 will automatically enter the Sleep Mode after 0 to 255 seconds of inactivity. The time of inactivity is selected by the ATS24 command and 5 seconds is the default time. The modem returns to normal operation when a ring signal is received or is upon an input low signal on TXD. ATS24 = 255 disables the Sleep Mode and is the default.

A $\overline{\text{SLEEP}}$ output signal is available to control power to external devices. In Figure 5, a FET controlled by the $\overline{\text{SLEEP}}$ signal turns off the external speaker amplifier when the modem enters the Sleep Mode. In the sleep mode, power is reduced by 50% of normal operating power.

Transmission Speed

The transmission rate of the host computer must be 300, 1200, or 2400 bps. The modem will connect at the selected speed or will fall back to the speed set by the remote or answering modem's serial interface (the DTE transmission speed). That determines the originate speed. The modem can be either originating (calling modem) or answering (remote modem). The following table shows the speeds:

	Originate Mode		
Answer Mode	300	1200	2400*
300	300	1200	1200
1200	300	1200	1200
2400	300	1200	2400

***Pin activated operation at 2400bps only. Other speeds may be used with AT Command operation.

Speed and Parity Selection

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

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

POWER SUPPLY

The modem module is a complex sub-system that may be treated as any other component. Special attention should be paid to the power supply connections. The modem decodes analog signals from the telephone line that are in the millivolt range. Al though the modem is designed to withstand significantly induced power supply noise, there is a limit. Steps must be taken to guarantee that power supply noise on all supply lines, including ground, does not exceed 50 mV peak to peak. Any frequency between 20 kHz and 150 kHz must be less than 50 mV peak. If necessary, use dedicated power and ground planes. Failure to provide such operating conditions could cause the modem to malfunction.

The CH1787requires a single +5V ±5% supply. It is recommended that by-pass capacitors be placed on the power supply as close to the modem's supply input as practical. It is recommended that a 10 μF Electrolytic capacitor in parallel with a 0.01μF ceramic capacitor be used.

WARNING: The CH1787 has been FCC Part 68 approved as a data modem. Utilization of the Voice/Tone Port requires further registration. FCC will require that the system, including the CH1787 and the handset or DTMF transceiver, adhere to Part 68 rules.

MODEM CONTROL

The CH1787 modem may be controlled by sending serial ASCII command sequences. The commands are sent to the modem serially on TXD. After execution of the command, the modem returns a serial status message on RXD, to indicate the completion status of the command.

Initializing the Modem

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

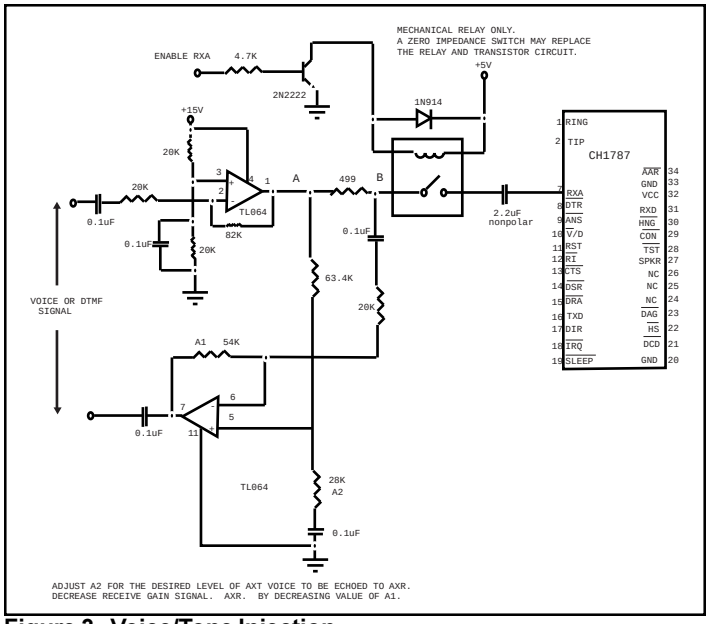


Figure 3. Voice/Tone Injection

Power-up Reset

After applying power to the modem, an internally generated reset pulse is created. The user can also reset the modem externally by applying the high-going reset pulse to RST for at least 10ms after the +5V power supply has stabilized. Delay sending commands to CH1787 for 100-200ms.

Training the Modem

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

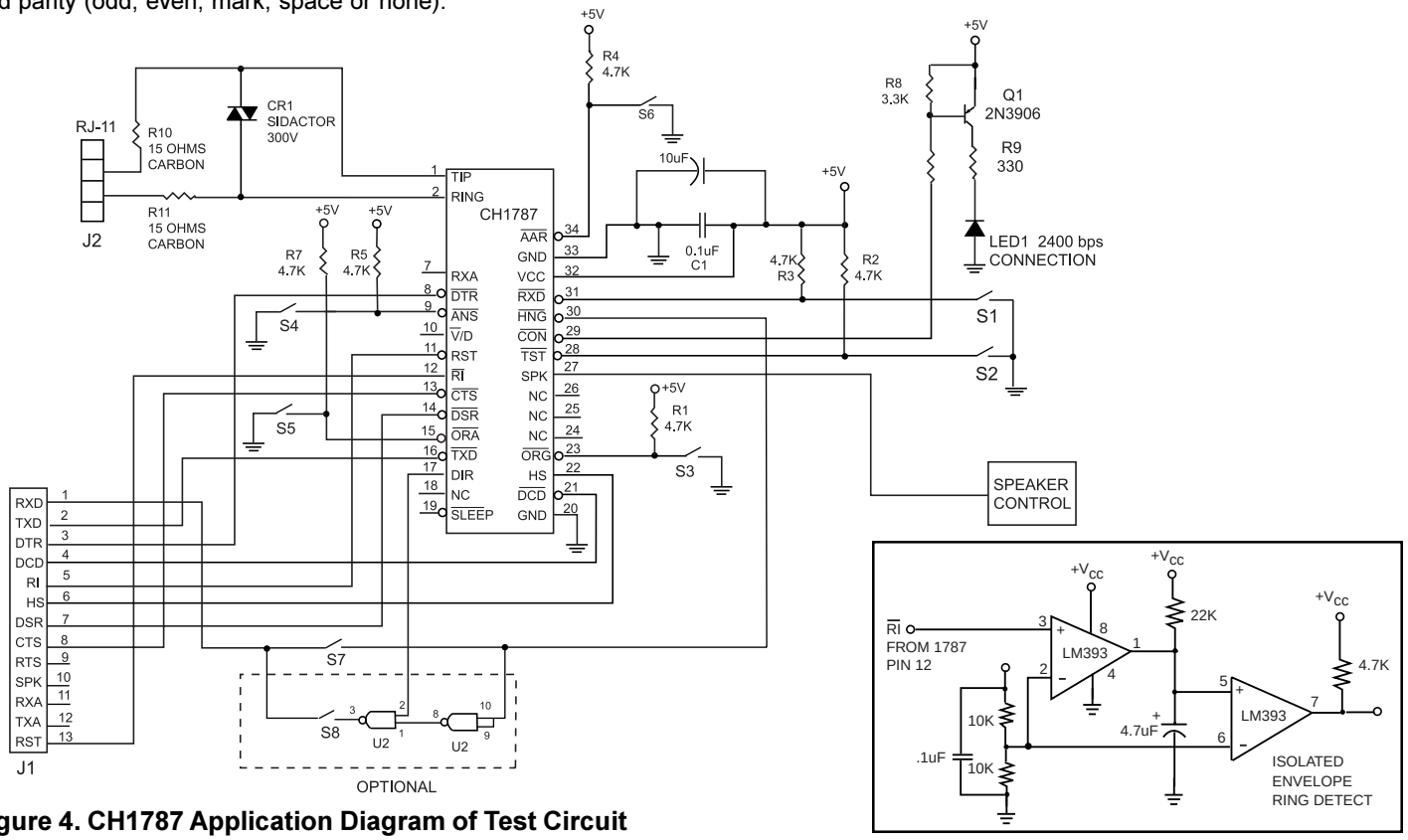


Figure 4. CH1787 Application Diagram of Test Circuit

Table 1. CH1787 Pin Descriptions

PIN	NAME	I/O	FUNCTION
1	RING	I/O	Directly connects to the telephone line's Ring lead through a user supplied RJ-11C jack.
2	TIP	I/O	Directly connects to the telephone line's Tip lead through a user supplied RJ-11C jack.
7	RXA	O	ANALOG VOICE INJECTED. Transit and receive signal. Let float if not used.
8	$\overline{DTR}$	I	DATA TERMINAL READY input. ActiveLOW. Switching off DTR can either return modem to command state, disconnect phone call, or reset modem. DTR should be set LOW when not used.
9	$\overline{ANS}$	I	Answer input has two modes of operation depending on its state during reset. 1. When ANS is low during reset the CH1787 will go off hook in the answer mode, sending answer tone continuously waiting for an originating tone. This mode of operation is used on a dedicated non dial-up telephone line (leased line). 2. When ANS is high during reset, the modem will initiate an answer tone whenever ANS Pin goes low during normal operations. The modem will send the answer tone for 30 seconds and then stop. If ANS is still low at the completion of the 30 seconds, the modem will attempt another answer tone sequence as long as ANS is low. Used to manually answer an incoming call.
10	$\overline{V/D}$	O	VOICE/DATA output is used to switch between telephone and modem line use. When low the modem is in the control mode and a voice circuit can be switched out, RXA, TXA when high the modem is in the data mode and the input should be RXD/TXD.
11	RST[1]	I	RESET input (active high). This input must be asserted HIGH for at least 10 ms to reset the modem. RESET is then returned LOW for normal operation. If no system reset is available, let this pin float to enable internal reset.
12	$\overline{RI}$	O	RING INDICATION: This signal follows the frequency of the ringing signal normally about 20 to 40 Hz for 2 seconds off for for 4 seconds.
13	N/C	-	No Connection.
14	$\overline{DSR}$	O	DATA SET READY output. LOW indicates handshaking with a remote modem is in progress, and/ or the data carrier of a remote modem is detected.
15	$\overline{ORA}$	I	ORA is an input that is active low. When LOW it will dial one of two stored telephone numbers depending on the state of the TST pin. The numbers are stored in NVRAM. One is a user defined number that is loaded in by the user one time with the AT&ZO=(phone number) command. The other number is a prestored number that is located at Cermetek(408_____) and is in a permanent loop back answering on the second ring. CH1787 will attempt to connect with the stored number up to 15 tries at 60 second intervals to obtain a successful connection as long as ORA is low. The state of DCD indicating carrier designates a successful connection. If ORA goes high, further attempts to connect will be terminated. If after disconnecting from a valid connection, ORA still low the modem will be unresponsive until ORA is placed high then low. The FCC requireds that automatic dialing attempts do not exceed 15 to the same number. TST low dial the user stored number.
16	$\overline{TXD}$	I	TRANSMIT DATA. Serial receive data input. Marking, or a binary 1 condition is transmitted when a HIGH is asserted.
17	DIR	O	DIR is an output that indicates when TXD data may be sent to the modem and when RXD data is valid from the modem. The user should monitor this pin or gate it as shown in Figure 4 to prevent data from being erronously interpreted by the user's host processer. DIR tells when the TXD and RXD lines are used for internal CH1787 connection. When DIR is high, valid data is on RXD and TXD. When DIR is low the user may ignore RXD data and should not place any data on TXD since it will be ignored by the CH1787.
18	IRQ	-	4.7KW resistor to 5V
19	$\overline{SLEEP}$	O	SLEEP output. A LOW indicates modem is in low power idle mode. Used to control power to other devices. See Figure 5. Register S24 is the sleep timer register. When the modem is inactive for a period of time specified by S24, the CH1787 will periodically power down by about 50% of its normal operating power. I/O lines will become undefined. The default for the CH1787 is that sleep mode is inhibited. This is done by loading 255 into S24.

Note: (1) If VCC has a slow power up ramp time, the internal reset may be ineffective.

PIN	NAME	I/O	FUNCTION
20	GND	I	**GROUND.**
21	$\overline{DCD}$	O	**DATA CARRIER DETECT** output. **LOW** indicates a data carrier from a remote modem is detected. DCD follows carrier is the default.
22	$\overline{HS}$	O	**SPEED INDICATION**. High speed select output. A LOW on this pin indicates the modem is operating at 2400bps.
23	$\overline{ORG}$	I	Originate input (active LOW) places to modem off hook in the originating mode without dialing. Used to make a connection on dedicated leased lines between two points. The remote modem must be in answering mode.
24	NC	-	No Connection
25	NC	-	No connection.
26	NC	-	No connection.
27	SPK	O	SPEAKER - Audio Output. See Figure 5.
28	$\overline{TST}$	I	Test pin input used in conjunction with ORA to steer the dialing between a user stored number and a pre-stored Cermetek test number. See ORA description.
29	$\overline{CON}$	O	Connect output indicates a valid 2400bps connection. Can be used in place of DCD and HS to start the communications. Can be used to indicate the start of an exchange of data.
30	$\overline{HNG}$	I	The hang-up input pin (active LOW), forces the modem to disconnect. The HNG pin is only functional when DCD is active (low).
31	$\overline{RXD}$	O	**RECEIVE DATA**. Serial receive data output. Received MARKING or a binary 1 condition is indicated by a HIGH.
32	VCC	I	5 Volts $\pm$ 5% Note: Noise should be less than 50MV.
33	GND	I	**GROUND**.
34	$\overline{AAR}$	I	AAR pin is an input (active LOW). When asserted low then high, CH1787 will auto answer during a Ring cycle. AAR can be tied low primarily to enable Auto Answer on the first RING. AAR will not override an AT auto answer condition e.g., S0 $\geq$ 1.
Spare pins are available for custom functions. Contact Cermetek with your requirements.			

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Table 2 Register	Ch1787 Register Summary Function
S0*	Ring to Answer On
S1	Ring Count
S2	Escape Code Character
S3	Carriage Return Character
S4	Line Feed Character
S5	Back Space Character
S6	Wait For Dial Tone
S7	Wait Time for Data Carrier
S8	Pause Time for Comma
S9	Carrier Detect Response Time
S10	Lost Carrier to Hang-up Delay
S11	DTMF Dialing Speed
S12	Escape Code Guard Time
S14*	Bit Mapped Options Register
S16	Modem Test Options
S18*	Test Timer
S21*	Bit Mapped Options Register
S22*	Bit Mapped Options Register
S23*	Bit Mapped Options Register
S24	Sleep Mode Inactivity Time
S25*	Delay to DTR
S27*	Bit Mapped Options Register
S28*	Bit Mapped Options Register

*=S-Registers stored in NVRAM upon receipt of &W command

Table 3 Basic Commands	Ch1787 "AT" Command Set Summary Function
AT	Attention Code
A	Answer command
A/	Repeat Last Command
*Bn	Communications Standard Option
D	Dial Command
*E	Off-Line Character Echo Option
Hn	Switch Hook Control Option
*Ln	Speaker Volume Option
*Mn	Speaker Control Option
On	On-Line Command
P	Pulse Dial
*Qn	Result Code Display Option
Sn	Select an S Register
Sn=	Write to an S Register
Sn?	Read an S Register
*Vn	Result Code Form Option
*Xn	Result Code Set/Call Progress Option
+++	Escape Code Sequence
,	Pause
?	Returns Last Addressed S Register
*Yn	Long Space Disconnect Option
Fn	On Line Echo character Option
Z	Reset

Ampersand Commands	Function
*&Dn	Data Terminal Ready Option
&F	Load Factory Defaults
*&Gn	Guard Tone Option
*&Pn	Make to Break Ratio Selection
*&Sn	Data Set Ready Option
&Tn	Test Command Option
&V	View Active Configuration
*&Wn	Store active profile
*Yn	Recall active profile
*&Zn	Store telephone numbers
*&Cn	Not supported

Percent Commands	Function
%Dn	DTMF Attenuation
%J	Load Secondary Factory Defaults

NOTE: A detailed definition of all commands and registers is available from Cermetek Microelectronics, Inc.
*= Commands that can be stored in NVRAM.

"AT" COMMAND APPLICATIONS

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

Example: Dial 9, pause, dial number.

Enter AT DT9, 1234567

Multiple commas may be used for a greater delay time.

TOUCH TONE AND PULSE DIALING "T and P"

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

Example: Pulse dial 9, pause, touch-tone dial number.
Enter: AT DP9, T1234567

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

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

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

Example: Touch-tone dial 9, pause, dial number, return for command.
Enter: AT DT9, 1234567;

Result: OK

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

S0	DO NOT ANSWER TELEPHONE
S1	ANSWER ON RING 1
S2	ANSWER ON RING 2
S3	ANSWER ON RING 3

S0=255 ANSWER ON RING 255

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

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

Enter: AT S0=6

Result: OK

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

Example: Dial number.

Enter: AT D1234567

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

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

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

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

Two of these lines are all that are required for proper modem operation: TXD, RXD and DTR. The modem is controlled by sending it serial commands over TXD and can be monitored by serial status messages returned on RXD.

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

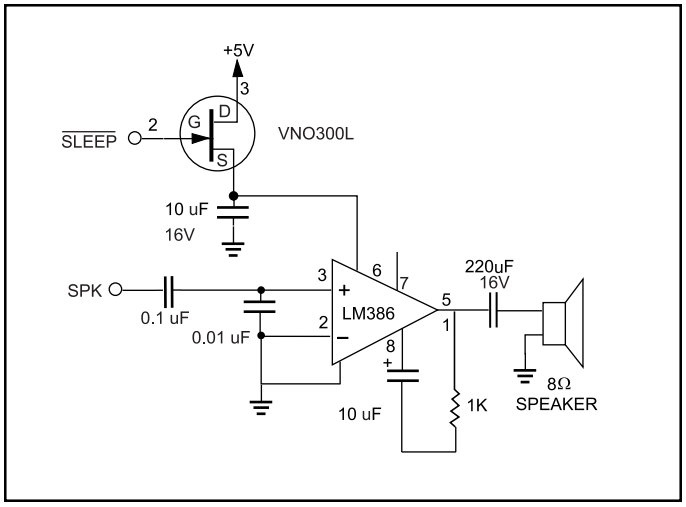


Figure 5. Speaker Control Circuit--optional to allow for call progress monitoring.

Phone Line Connection Guidelines
1) The mounting of the CH1787 in the final assembly must be made so that it is isolated from exposure to any hazardous voltages within the assembly. Adequate separation and restraint of cables and cords must be provided.
2) The circuitry from the CH1787 to the telephone line interface must be provided in wiring that carries no other circuitry than that specifically allowed in the rules (such as A and A1 leads).
3) Connection to phone line should be made through an RJ-11 jack.
4) Traces from the modem's RING and TIP pins to the RJ-11 jack must exceed 0.1 inch spacing to one another and 0.2 inch spacing to all other traces. The traces should have a nominal width of 0.020 inches or greater.
5) The RING and TIP traces should be as short as possible and oriented to prevent coupling other high speed or high frequency signals onto the host circuit card.
6) No additional circuitry other than that shown in the following Figure may be connected between the modem module and the RJ-11 jack.
7) The CH1787, the RJ-11 jack, the interfacing circuitry and traces in between, must be mounted on a circuit board with a 94 V-0 flammability rating.

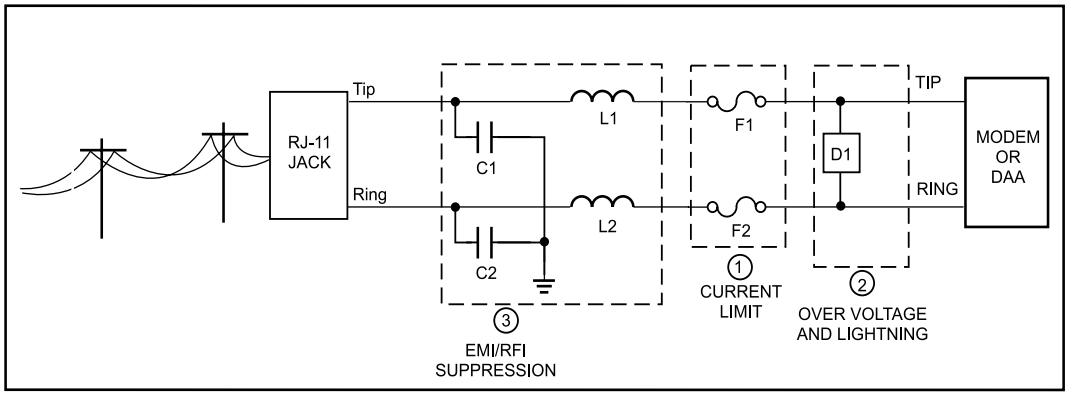


Figure 6. Telephone Interfaces

*1) Current Line Device: F1 and F2-1.25 amp
A. UL 1459 must use a current limit device. A Raychem Poly Fuse TR 600-150 is recommended as this device resets automatically after each power surge. Acceptable devices are fuses from Little Fuse, type 251.250, or Cooper Ind., Bussman Div., Type MCR 1/4.
B. Resistors (10 ohm carbon film or SMD 1/8W min.) can be used for non UL applications.

*2) Over Voltage and Lightning Protection
A. The Device is provided with an internal sidactor device that protects from metallic voltage surges.
B. DOC (Canada) May require current limit devices external to the module. Use 1ohm resistors (carbon film or SMD parts 1/8W min.) in each lead (Tip and Ring). You may substitute fuses or the Poly Fuse described in Section 2.
C. For lightning prone areas where there are more than 2 storms per year. Provide an earth ground connection and the following part, (this is FCC or DOC acceptable). Teccor Sidactors P3203AB or P3100BA70. These devices give metallic and longitudinal protection for the modem. This must also include the current protection in Section 2.

3) EMI/RFI Suppression
The capacitor/inductor network should be located as close to the RJ-11 Jack as possible with an excellent ground path to the chassis. Capacitors C1 and C2 should not exceed .005mF. They must have a rating of 1.5 KV and typically are on .001uF +/- 20%. Inductors L1 and L2 are Fair-Rite 2643666611 or 2943666661. These are ferrite cylinders and provide attenuation to high frequencies from system level components beyond the modem. These values to be adjusted per product design.

*Mandatory for reliable operation.

8) The supplied FCC registration label must be applied visibly on the outside of the host product.
9) The host product's User Manual must provide the user with instructions for connection and use as recommended in Section FCC Registration.

MOUNTING THE MODEM

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

There are two mounting techniques that are recommended for physically connecting the modem to your circuit card; 1) sockets, and 2) direct soldering.

The modem may be wave soldered on a circuit card. This part is hermetically sealed for normal wave soldering process.

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

FCC REGISTRATION

The CH1787 is registered with the FCC (Federal Communications Commission) under Part 68. To maintain the validity of the registration, you must serve notice to the end user of the product that contains the modem of several restrictions the FCC places on the modem and its use. The following notice is recommended and should be included in the host product's USER MANUAL. Also, the FCC requires that Cermetek make all repairs to the modem. If repair is necessary after the modem is installed in your product and has been delivered to your customer, the modem must be returned to you where it can be removed from the host product and then forwarded to Cermetek for repair.

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.

FOR YOUR USER'S MANUAL

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

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

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

Table 4. CH1787 System Data Mode Compatibility Specifications

Parameter	Specification	Parameter	Specification
Asynchronous	2400, 1200, 600 bps character asynchronous. 0-300 bps asynchronous	Receive Carrier Frequencies V.22 bis, V.22, 212A	Originate +7Hz 2400Hz +7Hz Answer 1200Hz +7Hz
Asynchronous Speed Range	TxD may differ +1%, -25% from modem output. Offsets will be corrected by adding/deleting stop bits.	Bell 103	Answer 'space' 2025Hz +7Hz Answer 'mark' 2225Hz +7Hz Original 'space' 1070Hz +7Hz Original 'mark' 1370Hz +7Hz
Asynchronous Format	8, 9, 10 bits, including start, stop, parity	Receiver Sensitivity	OFF to ON threshold-43 dam ON to OFF threshold-48 dam
Telephone Line Interface	Two-wire full duplex over public switched network. On-chip hybrid and billing delay timers.		
Modulation	V.22 bis, 16 point QAM at 600 baud. V.22 and 2212A, 4 point, DPSK at 600 baud. 103 binary phase coherent FSK.	Hysteresis	2 dB minimum
Self Test Pattern Generator	Alternate 'ones' and 'zeros' and error detector, to be used along with most loopbacks. A number indicating the bit errors detected is sent to DTE.	Line Equalization	Fixed compromise equalization, transmit. Adaptive equalizer for PSK/QAM, receive.
Transmit Carrier Frequencies V.22 bis V.22, 212A	Originate 1200Hz+.01% Answer 2400Hz+.01%	Diagonostics Available	Local analog loopback. Local digital loopback. Remote digital loopback. Request remote digital loopback. Local interface loopback modem with self test.
Bell 103 mode	Originate 'space' 1070Hz+.01% Originate 'mark' 1270Hz+.01% Answer 'space' 2025Hz+.01% Answer 'mark' 2225Hz+.01%	Call Progress Tones Detected Computer Interface	With speaker or quiet screen messages (no dial tone, busy, ring-back, modem answer tone and voice). IBM PC/XT/AT bus compatible with an 8250/16450/16550A UART as a serial controller.

Table 5. CH1787 Electrical Specifications

T_a=25°C

Symbol	Characteristic	Min.	Typ.	Max.	Units
V_{CC}	Supply voltage	4.75	5.0	5.25	V
I_{CC}	Supply Current Off hook operating current On hook operating current Power down operating current		 50 40 16	 75	 mA mA mA
V_{OL}	Output Low Voltage (I_{OL}=0.4mA) CON (I_{OL}=5.0mA) DIR (I_{OL}=1.6mA) SLEEP, DSR, DCD, HS, RXD (I_{OL}=4mA) VAD			 0.3 0.3 0.4 0.26	 V V V V
V_{OH}	Output High Voltage (I_{OH}=-0.2mA) CON, DIR (I_{OH}=-100uA) SLEEP, DSR, DCD, HS, RXD (I_{OH}=-4mA) VAD	 4.45 2.4 4.18			 V V V
V_{IL}	Input Low Voltage TST, ORG, ORA, HNG, AAR, ANS DTR, TXD			 0.95 0.8	 V V
V_{IH}	Input High Voltage TST, ORG, ORA, HNG, AAR, ANS DTR, TXD	 3.3 2.4			 V V
VT+	Positive Hysteresis Threshold for Reset pin		2.7		V
VT-	Negative Hysteresis Threshold for Reset pin		1.6		V

In certain circumstances, it may be necessary for the telephone company to request information from you concerning the equipment, which you have connected to your telephone line. Upon request of the telephone company, provide the FCC registration number and the ringer equivalence number (REN); both of these items are listed on the equipment label. The sum of II of the REN's on your telephone lines should be less than five in order to assure proper service from the telephone company. In some cases, a sum of five may not be useable on a given line.

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

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

DEFAULT STATUS, PERFORMANCE, AND SPECS

Default Configuration Profile

Async mode selected
2400bps
Bell 212A operation at 1200bps
Even parity
Auto answer disabled
Command echo ON
All result codes enabled – extended
Wait for dial tone before dialing – 2 seconds
Detects busy signal
Full word result codes
Pulse dial make/break ratio = 39/61
DSR enabled
Modem enabled DTR
DCD enabled
Speaker enabled but off when receiving carrier
Speaker volume set to medium
Local modem will grant RDL request from remote modem
Guard tones disabled
Minimum DTR pulse width = 0.1 seconds
Ring count – 01 (CH1786)
Escape code character = 43
Carriage return character = 13
Line feed character = 10
Back space character = 08
Duration of wait for dial tone = 02 seconds
Duration of wait for carrier after dialing = 30 seconds
Duration of deal pulse (comma) = 02 seconds
Carrier detect response time = 0.1 seconds
Escape code guard time = 1 second
Length of use after comma = 2.0 seconds
Last carrier to hang up delay = 0.1 seconds
DTMF interdigit delay = 0.1 seconds
DTMF Attenuation = -4dB
Sleep mode inactivity time = 5 seconds
Long space disconnect disabled

Table 6. CH1787 Electrical Specifications

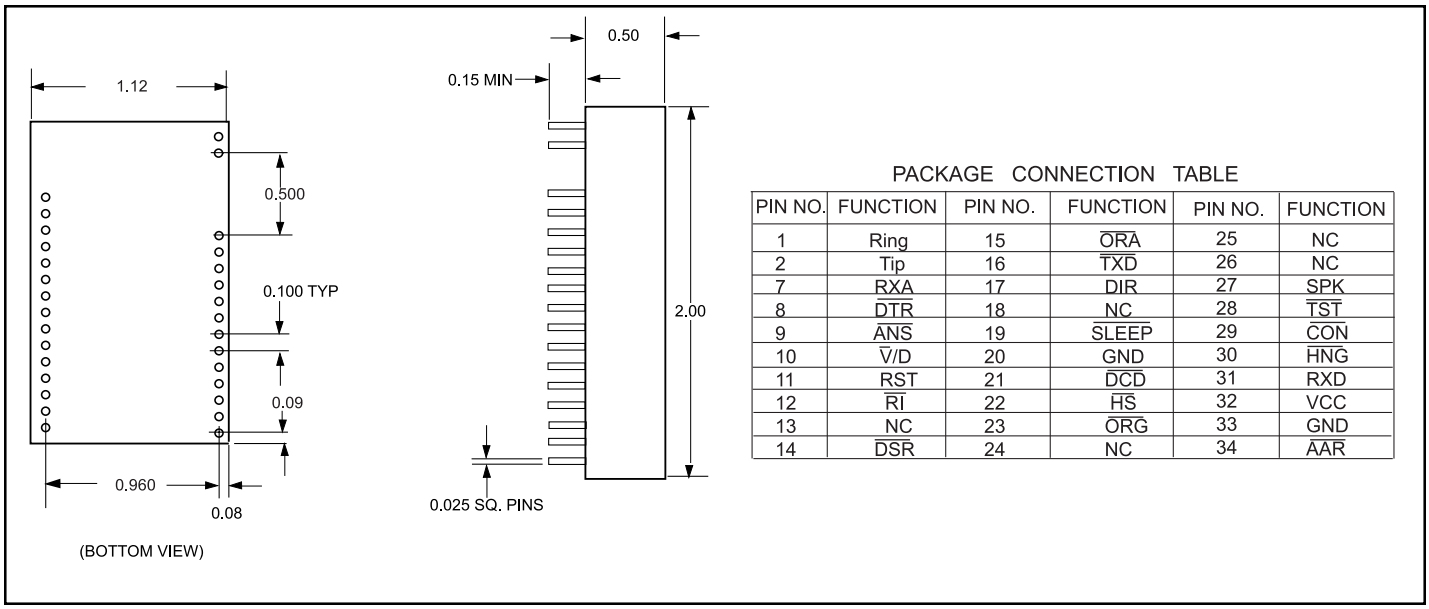
Parameter	Minimum	Typical	Maximum	Units	Comments
Ring Voltage Loop	40			VRMS	
Return Loss @ 1000 Hz		17		dB	600Ω
Ring Frequencies	15.3		68	Hz	
Transmit Level		-11		dBm	600Ω - Data Mode
Command Mode After Reset			5	sec	Delay
Inter Character Delay	20			msec	Between all command characters
Command Delay	100			msec	Between all AT commands
Minimum Reset Pulse	5			msec	If user supplied

Table 7. Other Performance Specifications

Parameter	Min.	Typ.	Max.	Units	Comments
DTMF Twist (Balance)		3		dB	
DTMF Tone Duration	50		255	ms	95 ms default
Pulse Dialing Rate		10	20	pps	10pps default
Pulse Dialing Make/Break		39/61		%	US, Canada default
Pulse Dialing Make/Break		33/67		%	UK, Hong Kong
Pulse Interdigit Interval	700		3000	ms	789 ms default
Call Progress Passband Frequency	120		620	Hz	
Wait Time for Dial Tone	2		255	sec	Two second default

Table 8. Temperature Options

Model	Operating Temperature
CH1787	0°C to +70°C
CH1787ET	-40°C to +85°C



PACKAGE CONNECTION TABLE

PIN NO.	FUNCTION	PIN NO.	FUNCTION	PIN NO.	FUNCTION
1	Ring	15	$\overline{ORA}$	25	NC
2	Tip	16	$\overline{TXD}$	26	NC
7	RXA	17	DIR	27	$\overline{SPK}$
8	$\overline{DTR}$	18	NC	28	$\overline{TST}$
9	$\overline{ANS}$	19	$\overline{SLEEP}$	29	$\overline{CON}$
10	$\overline{V}$/D	20	GND	30	$\overline{HNG}$
11	RST	21	$\overline{DCD}$	31	RXD
12	$\overline{RI}$	22	$\overline{HS}$	32	VCC
13	NC	23	$\overline{ORG}$	33	GND
14	$\overline{DSR}$	24	NC	34	$\overline{AAR}$

Figure 7. CH1787 Physical Dimensions and Pin Functions

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