CH1787

Small Footprint Hardware Controllable 2400bps Modem

INTRODUCTION

The CH1787 is a small footprint, full function 2400bps, V.22bis asynchronous modem designed to be used in applications where there is little or no external controller intelligence to command the modem. The CH1787 allows the user to operate the modem via hardware resources only, not requiring AT command execution for basic operation. For those applications where an external controller is available, the CH1787 operates like a standard AT Command driven modem.

The CH1787 is ideal for use as a remote modem in applications such as alarm products and in industrial controllers. The CH1787 will dial a pre-stored telephone number under pin activation control to make a connection with another modem. The CH1787 can also answer incoming calls (either automatically or manually) using the **ANS** pin. A call is terminated by activating the **HNG** pin.

GENERAL DESCRIPTION OF FUNCTIONAL BLOCKS

Figure 1 contains a functional block diagram of the CH1787. The CH1787 is comprised of a modulator/demodulator, controller, an FCC Part 68 approved telephone interface 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 programmed 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 pre-stored numbers based on **TST**
HNG	Forces CH1787 to disconnect
AAR	Enables Auto Answer
TST	Selects phone number to be dialed. Works with **ORA**

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
- UL1459 Recognized
- 1000 VAC isolation barrier, 1500V peak isolation
- 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
- Commercial operating temperature: 0° to 70°C
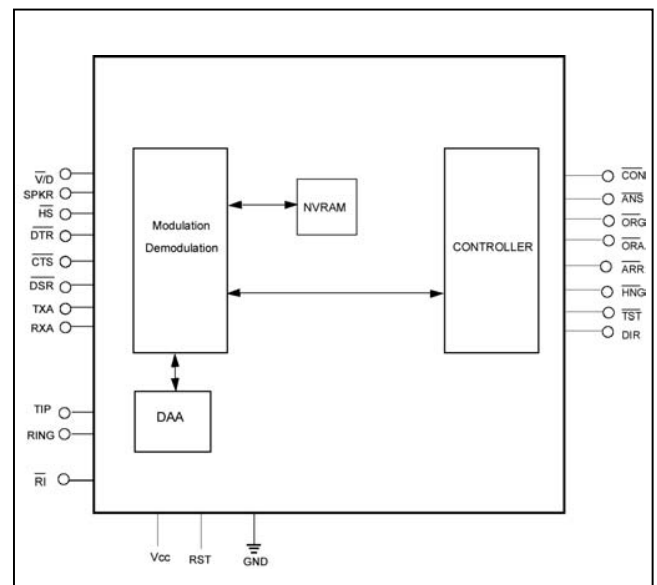- Extended temperature: –40° to 85°C (CH1787ET)

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 meets UL1459 with 1000VAC and 1500 volt peak surge isolation. As such, it complies with U.S., Canadian, and other international requirements that specify that level of isolation. The CH1787 is FCC Part 68 pre-approval. A label is provided with the registration number and ringer equivalent (REN). This label should be prominently displayed on the host equipment. 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 assistance.

NVRAM. NVRAM can save a maximum of four telephone numbers with up to 36 digits or modifiers in each. The **AT&Zn=s** command will store s, the telephone number dial string. The **ATDTS=n** command will cause the CH1787 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 numbers and Cermetek number. The **AT&Wn** command will store the active 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 configurations to be automatically recalled and made active upon reset or power up. The **ATZn** command immediately recalls and activates a stored configuration. See Table 2 and 3 for storable S-Registers and Commands.

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 the Cermetek website at http://www.cermetek.com for publication AT Commands and S-Registers.

Serial Host Interface. The serial interface is V.24 (EIA-232-D) compatible. See pin description in Table 1.

Speaker Interface. The SPK output reflects the receiver analog input and provides a signal that can be used to monitor call progress. Although the SPK signal can drive a 300Ω 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 8Ω 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 Voice/Data (V/D) 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 feature 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.

SLEEP MODE

Sleep Mode is a power down feature designed to minimize power consumption. When activated, the CH1787 will automatically enter Sleep Mode after a user specified period of inactivity. The inactivity counter increments in whole seconds and is selected by the **ATS24** command. The default is 0 seconds. The modem returns to normal operation when a ring signal is received or upon an input low signal on TXD. **ATS24 = 255** disables Sleep Mode.
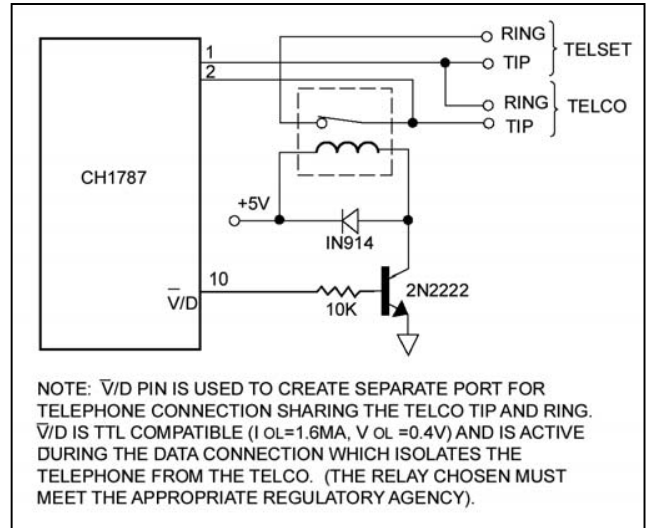

Figure 2. Voice/Data Port Control.

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. Sleep Mode reduces power consumption by approximately 50%.

Transmission Speed. The CH1787 can be either originating (calling modem) or answering (remote modem). The transmission rate of the host computer must be 300, 1200, or 2400bps. The CH1787 will connect at the selected speed or will fall back to the speed set by the remote or answering modem (the DTE transmission speed). The following table indicates the speeds:

Originate Speed	Connect Speed Based on Answer Speed of:		
	300	1200	2400*
300	300	300	300
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 300bps) 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 CH1787 automatically adapts to the caller's speed on answer calls.

The CH1787 matches the host's parity when it returns status messages to the host. During a data connection, however, the CH1787 passes parity through without interpretation or alteration.

POWER SUPPLY

The CH1787 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 CH1787 decodes analog signals from the telephone line that are in the millivolt range. All though the CH1787 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 20kHz 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 CH1787 to malfunction.

The CH1787 requires 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 10µF Electrolytic capacitor in parallel with a 0.01µF ceramic capacitor be used.

IMPORTANT NOTE

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 may be controlled by sending serial ASCII command sequences on TXD (Pin 16). After execution of the command, the CH1787 returns a serial status message on RXD (Pin 31).

Initializing the Modem. Before commands may be sent to the CH1787, 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).

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 a 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 after power up.
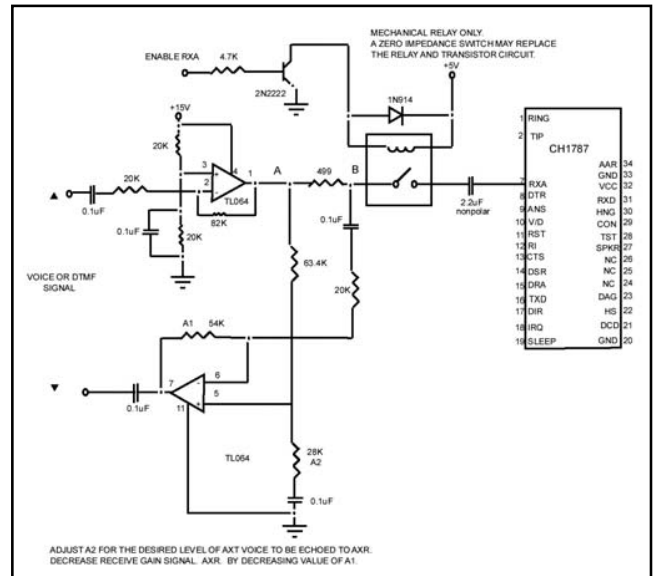

Figure 3.   Voice/Tone Injection.

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.

Enter: **AT<CR>**
          Where: **A** and **T** must be upper case or lower case **<CR>** represents carriage return

The modem will respond with one of the following status messages, depending on whether it is optioned for abbreviated (terse) or English (verbose) status messages.

Response: **0<CR>** terse
              <CR><LF>OK<CR><LF>   verbose

Where: **<CR>** represents carriage return (ASCII 13)
          <LF> represents line feed (ASCII 13)

The CH1787 may be retrained at any time when in idle.

Another attention sequence A/ is much like the AT sequence except it repeats the previously entered command specified with an AT prefix. When given, it must also be in upper case ASCII. No carriage return is needed.

THE COMMAND FORMAT

Typical commands consist of three elements: the attention sequence, the commands themselves, and a terminating carriage return.
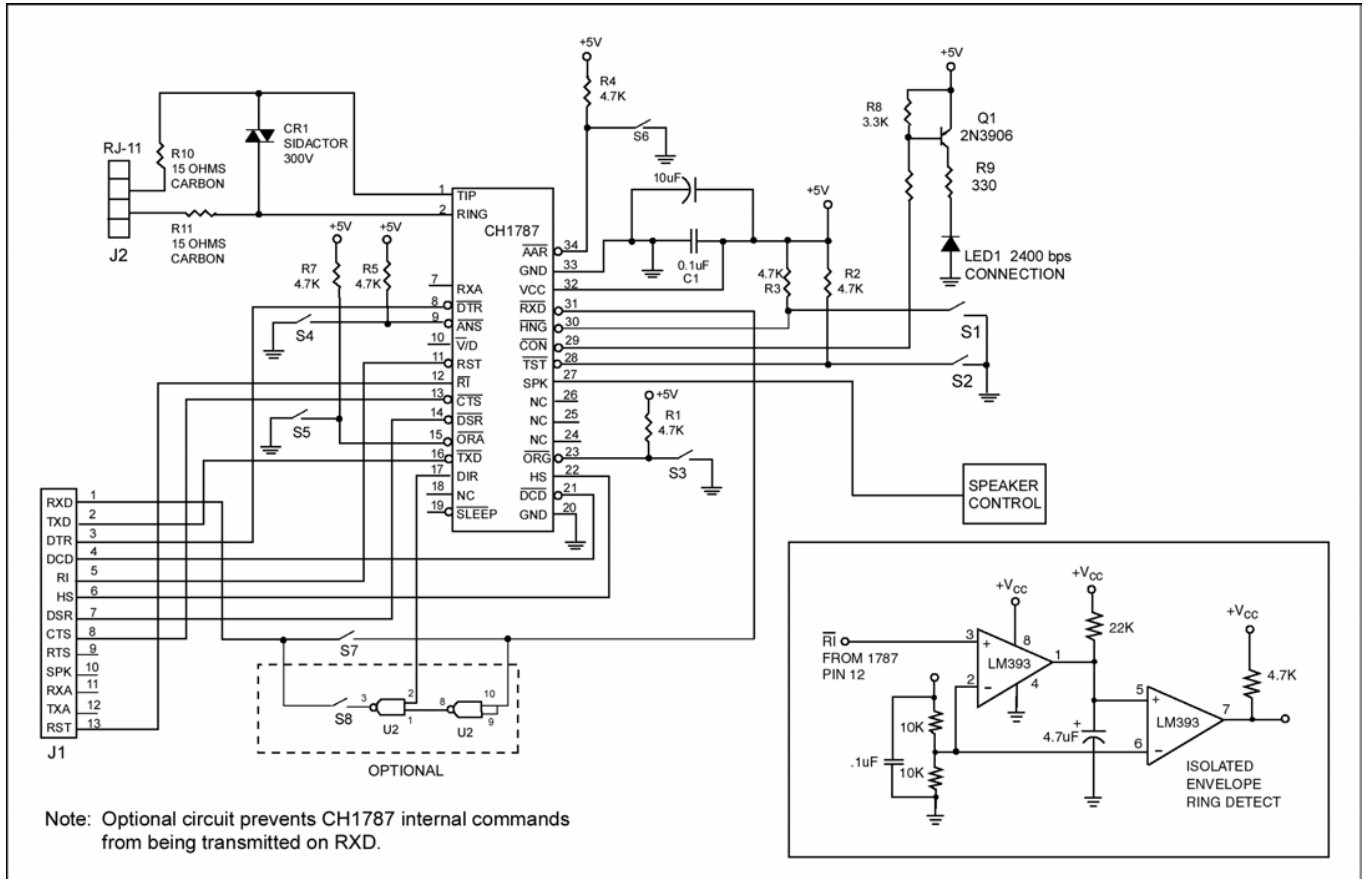

Figure 4.   CH1787 Application Diagram of Test Circuit.

Table 1.   CH1787 Pin Descriptions.

PIN	NAME	I/O	FUNCTION
1	RING	I/O	**RING**. Directly connects to the telephone line's RING lead through a user's supplied RJ-11C jack.
2	TIP	I/O	**TIP**. Directly connects to the telephone line's TIP lead through a user's supplied RJ-11C jack.
7	RXA	O	**ANALOG VOICE INJECT**. Transit and receive analog voice signal. Let float if not used.
8	$\overline{DTR}$	I	**DATA TERMINAL READY** input. Active LOW. Switching off a 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	**ANS.** Used to manually answer an incoming call. Input has two modes of operation depending on its state during reset. When ANS is low during reset, the CH1787 will go off hook in the answer mode and send an answer tone continuously waiting for an originating tone. This mode of operation is used on a dedicated non dial-up telephone line (leased line). When ANS is high during reset, the modem will initiate an answer tone whenever the ANS Pin goes low during normal operation. The modem will send the answer tone for 30 seconds and then stop. The CH1787 will then repeat the answer tone sequence as long as ANS is low.
10	$\overline{V}/D$	O	**VOICE/DATA.** 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 TXD/TXD.
11	RST[1]	I	**RESET** (active high). Must be asserted HIGH for at least 10ms 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 which is typically 20 to 40 Hz for 2 seconds on and 4 seconds off.

Table 1.   CH1787 Pin Descriptions (Continuation).

13	CTS	-	**CLEAR TO SEND**. Active LOW. Output always low. Indicates CH1787 is ready to accept data from DTE.
14	DSR	O	**DATA SET READY**. LOW indicates handshaking with a remote modem is in progress, and/or the data carrier of a remote modem is detected.
15	ORA	I	**ORA** (active low). When LOW, CH1787 will dial one of two stored telephone numbers depending on the status of the **TST** pin. The numbers are programmed using the **AT&ZO** command. A pre-stored number is provided to allow testing. It is in permanent loop back answering on the second ring. The CH1787 will make up 15 attempts to connect with the stored number at 60 second intervals as long as **ORA** is low. **DCD** low indicates a successful connection. If **ORA** goes high, no further attempts to connect will be made. If, after disconnecting from a valid connection, **ORA** is low the CH1787 will be unresponsive until **ORA** is first placed high then low. The FCC requires that automatic dialing attempts not exceed 15 to the same number.
16	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** indicates 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. The user should monitor this pin or gate it as shown in Figure 4 to prevent data from begin erroneously interpreted by the user's host processor.
18	IRQ	-	4.7KW resistor to 5V.
19	SLEEP	O	**SLEEP**. A LOW indicates modem is in low power idle mode. Used to control power to other devices. See Figure 5. When the modem is inactive for a period of time specified by register **S24**, the CH1787 will power down to about 50% of its normal operating power. I/O Lines will become undefined. The factory set default for the CH1787 is sleep mode is inhibited (**S24=255**).
20	GND	I	**GROUND**.
21	DCD	O	**DATA CARRIER DETECT**. LOW indicates that a data carrier from a remote modem has been detected. **DCD** follows carrier is the default.
22	HS	O	**SPEED INDICATION**. A LOW on this pin indicates the modem is operating at 2400bps.
23	ORG	I	**ORIGINATE** (active LOW) places CH1787 in off hook mode without dialing. Used to originate a connection on dedicated leased lines (i.e.,"dry" lines). The remote modem must be in answering mode.
24	N/C	-	No connection.
25	N/C	-	No connection.
26	N/C	-	No connection.
27	SPK	O	**SPEAKER**. Audio Output. See Figure 5.
28	TST	I	Test pin input used in conjunction with **ORA** to steer the dialing between a user stored number (**TST** LOW) and a pre-stored Cermetek test number (**TST** HIGH). See **ORA** description.
29	CON	O	**CON** indicates a valid 2400bps connection. May be used in place of **DCD** and **HS** to start the communications or to indicate the start of an exchange of data.
30	HNG	I	**HNG** (active LOW). Used to force the CH1787 to disconnect. The **HNG** pin is only functional when **DCD** is active (LOW).
31	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 ± 5%. Note: Noise should be less than 50mV
33	GND	I	**GROUND**.
34	AAR	I	**AAR** (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 auto answer condition e.g., S0 ≥ 1.
Spare pins are available for custom functions. Contact Cermetek with your requirements.			

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

AT [commands] <CR>. Where **<CR>** represents carriage return (ASCII 13). When entering commands to the CH1787, the backspace character CTL H (ASCII 8) can be used to edit mistakes. **AT** and **A/** may not be edited. Multiple commands may concatenated on a single command line. Command lines may not exceed 40 characters, excluding **AT**. The command string below instructs the CH1787 to train itself, to not echo characters in the command mode **E0** and then go to the answer mode **A**.

Enter: **ATE0A<CR>**
Response: **OK <CR><LF>**

AT COMMAND DATA RATE
With the serial interface, the rate is speed sensed for parity and format.

AT COMMAND SET
The command set is divided into three types as listed in Table 2: basic commands, dial modifiers and ampersand commands.

THE STATUS MESSAGES
The CH1787 responds with a status message after each command is executed. This status message may either be a single digit followed by a carriage return or a carriage return and line feed with a message in English, followed by a carriage return and line feed.

The basic status code subsets are enabled with the **Xn** command. Where n=0,1,2,3,5 the status codes can be in message form or result codes selected for the five **Xn** commands.

X0 – Result Codes 0, 1, 2, 3, 4
X1 – Result Codes 0, 1, 2, 3, 4, 5, 10
X2 – Result Codes 0, 1, 2, 3, 4, 5, 6, 10
X3 – Result Codes 0, 1, 2, 3, 4, 5, 7, 10
X4 – Result Codes 0, 1, 2, 3, 4, 5, 6, 7, 10 (factory default)

Modem States. The CH1787 may be in either the Command mode or the Data Mode. When the CH1787 is idle, it is in Command Mode by default. When a data transmission is in progress, the CH1787 is in Data Mode and will not recognize commands. The host system must send an "escape sequence" to the CH1787 forcing it out of the Data Mode and into the Command Mode before commands will be accepted.

Escape Sequence. The escape sequence consists of a guard time (a period where no characters are sent to the CH1787) followed by 3 escape characters, followed by a guard time. At power-up, the guard time is set to 1 second (minimum), and the escape character is set as

"+." These parameters can be modified via registers S2 and S12, respectively.

The CH1787 will stay off-hook with its carrier on after the escape sequence is received. It returns an OK status message when it is ready to accept commands. The data mode is reentered by issuing the **ATO** command.

Result	Status Messages	Meaning
0	OK	Command executed.
1	Connect	Carrier detected at 300bps.
2	Ring	Ring detected.
3	No Carrier	Did not detect carrier.
4	Error	Entry error.
5	Connect 1200	Carrier detected at 1200bps.
6	No Dial Tone	Off-hook, but no response after 5 seconds.
7	Busy	Busy signal detected.
10	Connect 2400	Carrier detected at 2400bps.

Dial Modifiers	Function
P	Pulse Dial
R	Originate Call in Answer Mode
T	Touch Tone Dial
W	Wait for Dial Tone
;	Return to Idle State
@	Wait for Quiet Answer Command
!	Flash Hook
,	Pause
0-9/ A,B,C,D	Dial Digits/Characters

AT COMMAND APPLICATIONS
Dial A Number. The Dial command takes the form **Dn**, where n is a string of characters. In the simplest form, n will only the digits of the phone number to be dialed.

Example: Dial number

Enter: **AT D 1234567<CR>**

In response to this command, the CH1787 dials the telephone number "123-4567" and then waits for the carrier from the remote modem. If no carrier is detected within a given time (the default time is 30 seconds), the CH1787 automatically releases the line and sends a NO CARRIER result code. If a carrier is detected, the CH1787 issues a CONNECT result code and goes on-line, permitting communication with the remote modem.

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

Using the Pause Character. 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 directs the CH1787 to pause for a specific length of time. The factory default pause time is 2 seconds.

Example: Dial 9, pause, and dial number.

Enter: **ATDT9,1234567<CR>**
Response: Dial tone, DTMF tone generation

Multiple commas may be used to increase delay time.

TOUCH TONE AND PULSE DIALING
The CH1787 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 CH1787 defaults to the type last specified. The power-on default value is **P**.

Example: Pulse dial 9, pause, and touch-tone dial number.

Enter: **ATDP9T1234567<CR>**
Response: Dial tone, Pulse dialing

Originate a Call in Answer Mode. The **D** command forces the CH1787 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. Use **A/**, the repeat command, to redial the last telephone number dialed when a busy signal is received.

Return to Command State. The CH1787 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 CH1787 as an auto dialer.

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.

Example: Touch-tone dial 9, pause, dial number, return for command.

Table 2. CH1787 Register Summary.

Register	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-Register stored in NVRAM upon receipt or & W command.	

Enter: **ATDT9,1234567;**
Response: Dial tone, DTMF tones, return to Command State

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

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

Example: assign the value **6** to **S0** to set the CH1787 to answer on the sixth ring.

Enter: **ATS0=6<CR>**
Response: **OK**

CONNECTING TO THE HOST UART
Since the CH1787 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 CH1787 supports the full RS-232C/V.24 serial interface. Signal levels are TTL rather than RS-232C level compatible, which allows the user to directly connect the CH1787 to the host's UART without needing level translating circuitry.

Table 3.   CH1787 AT Command Set Summary.

Basic Commands	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-Lone 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 From 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

*= Commands that can be stored in NVRAM.

NOTE: Refer to Cermetek Publication AT Commands and S-Registers for a detailed discussion of parameters in Table 2 and 3.

Two of these lines are all that are required for proper CH1787 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 (form modem) should be left unconnected. Unused inputs should be tied to the proper logic level. See pin description.
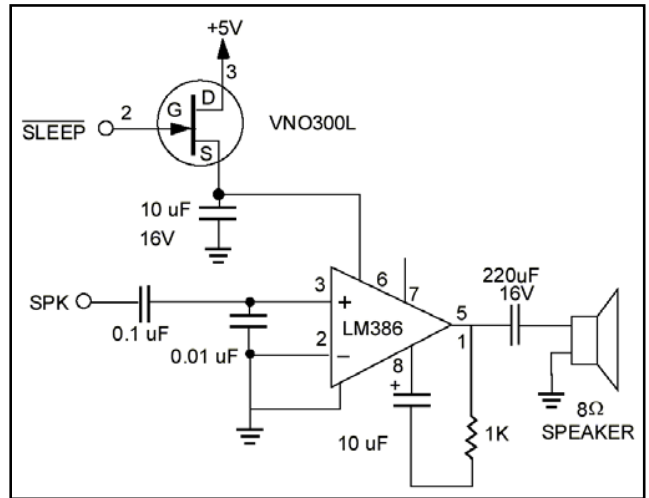

Figure 5.   Speaker Control. Circuit allows call progress monitoring.

PHONE LINE CONNECTION GUIDELINES

1. The mounting of 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 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.

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 socking 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 end user of the product that contains 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 the forwarded to Cermetek for repair.

FOR YOUR USER'S MANUAL
FCC Part 68 rules require the following (or equivalent) information be provided to the end user of equipment containing a DAA.

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, Subpart 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 suchspecifications and/or inspections will be provided by the FCC within 30 days of their request for the same.

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 (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, the telephone company will give you notice, in writing, to allow you to make any changes necessary to maintain uninterrupted service.

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 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 preformed by (insert your company name) or an authorized representative of (insert your company name). For information contact: (insert your company address).

PSTN PROTECTION REQUIREMENTS

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. Non-resettable **devices are** also acceptable. Refer to Application Note #130 for a complete list of recommended vendors and associated part numbers.

B. Resistors (10Ω 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 10Ω 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 RJ11 Jack as possible. Further, this network should be provided with an excellent ground path to the chassis.

B. Capacitors C1 and C2 should not exceed 0.005μf. They must have a rating of 1.5KV and typically are 0.001μf ± 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.
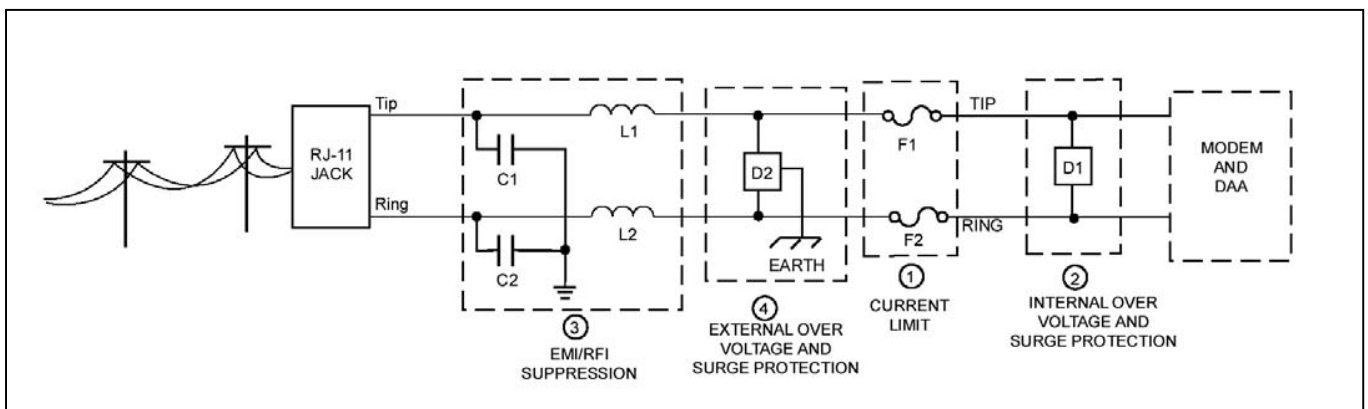

Figure 6.   Telephone Interfaces.

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 4.   CH1787 System Data Mode Compatibility Specifications.

Parameter	Specification	Parameter	Specification
Asynchronous	2400, 1200, 600bps character asynchronous. 0-300bps asynchronous	Receive Carrier Frequencies V.22bis, V.22, 212A	Originate+HZ 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 Originate 'space' 1070Hz +7Hz Originate 'mark' 1370Hz +7Hz
Asynchronous Format	8, 9, 10bits, 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.22bis, 16 point QAM at 600baud. V.22 and 2212A, 4 point, DPSK at 600baud. 103 binary phase coherent FSK.	Hysteresis	2dB 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.22bis, V.22, 212A	Originate 1200Hz +.01% Answer 2400Hz +.01%	Diagnostics Available	Local analog loopback. Local 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	With speaker or quiet screen messages (no dial tone, busy, ring-back, modem answer tone and voice).
		Computer Interface	IBM PX/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) V/D			0.3 0.3 0.4 0.26	V V V V
V_{OH}	Output High Voltage (I_{OH}=0.2mA) CON, DIR (I_{HL}=-100uA) SLEEP, DSR, DCD, HS, RXD (I_{OL}=0.4mA) V/D	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 Thresold for Reset Pin		2.7		V
VT-	Negative Hysteresis Thresold for Reset Pin		1.6		V

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	Minimum	Typical	Maximum	Units	Comments
DTMF Twist (Balance)		3		dB	
DTMF Tone Duration	50		255	ms	95ms 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	789ms default
Call Progress Passband Frequency	120		620	Hz	
Wait Time for Dial Tone	2		255	sec	Two second default

Table 8. Product Family Summary.

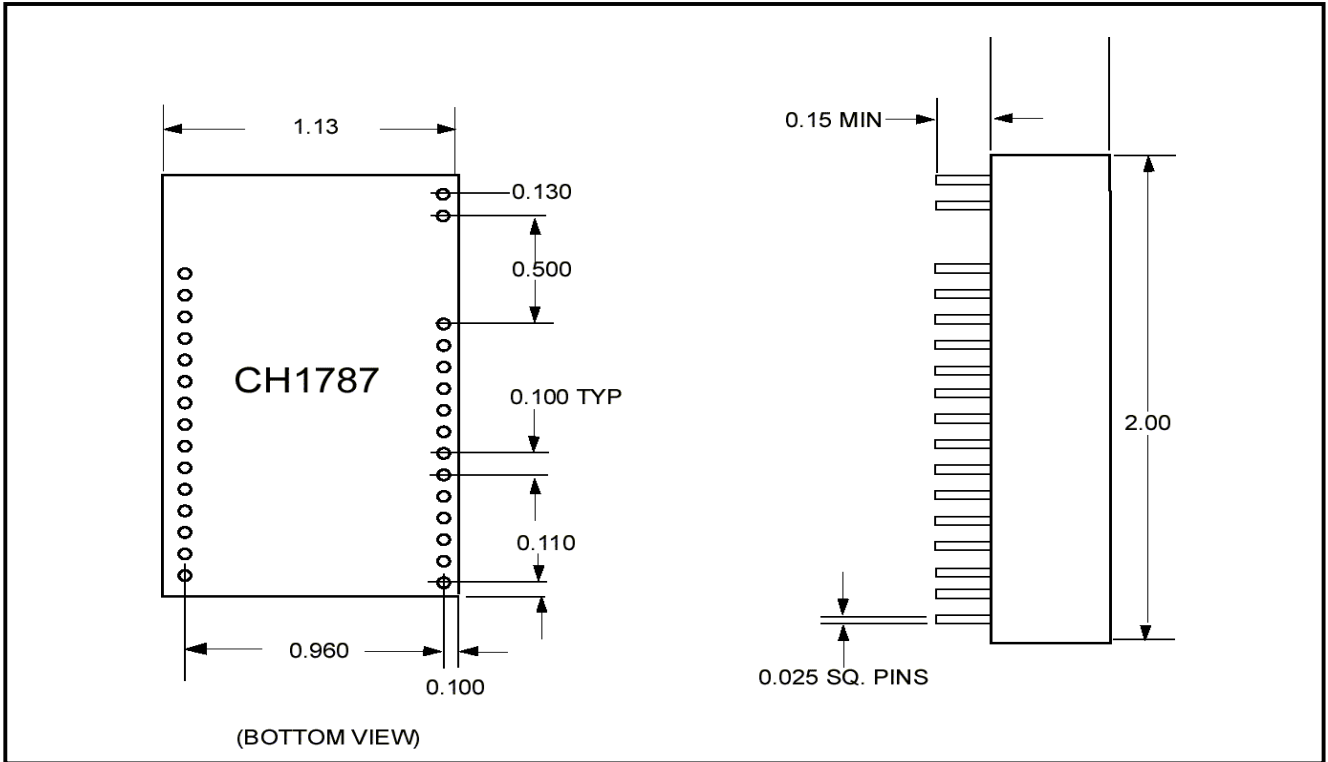| Model	Feature Summary	Operating Temperature
CH1787	FCC Part 68 Approved, UL1459 Registered	0°C to +70°C
CH1787ET	FCC Part 68 Approved, UL1459 Registered	-40°C to +85°C

Figure 7. CH1787 Physical Dimensions and Pin Functions.

Package Connection Table

Pin No.	Function	Pin No.	Function
1	RING	18	IRQ
2	TIP	19	$\overline{\text{SLEEP}}$
3	NOT POPULATED	20	GND
4	NOT POPULATED	21	$\overline{\text{DCD}}$
5	NOT POPULATED	22	$\overline{\text{HS}}$
6	NOT POPULATED	23	$\overline{\text{ORG}}$
7	RXA	24	N/C
8	$\overline{\text{DTR}}$	25	N/C
9	$\overline{\text{ANS}}$	26	N/C
10	$\overline{\text{V}}$/D	27	SPK
11	RST	28	$\overline{\text{TST}}$
12	$\overline{\text{RI}}$	29	$\overline{\text{CON}}$
13	$\overline{\text{CTS}}$	30	$\overline{\text{HNG}}$
14	$\overline{\text{DSR}}$	31	RXD
15	$\overline{\text{ORA}}$	32	VCC
16	$\overline{\text{TXD}}$	33	GND
17	DIR	34	$\overline{\text{AAR}}$

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