HIGH SPEED Modem and FAX FAMILY

CH2056/TBR/ETBR	– V.90 / 57,600bps/TBR21
CH1799/TBR/ETBR	– V.34bis / 33,600bps/TBR21
CH1794	– V.32bis / 14,400bps

FEATURES

- Supports V.90, V.34bis, V.34, V.32bis, V.32, V.22bis, V.22A/B, V.23, V.21, Bell 212A and 103.

- CH2056 supports V.80 Synchronous operation.

- Error correcting: V.42 LAMP, MNP 2-4 and MNP10.

- Data Compression: V.42bis and MNP 5

- MNP10 Data through put enhancement for cellular operation.

- DTE serial interface with speeds up to 230.4kbps (CH2056), 115.2 (CH1799) or 57.6kbps (CH1794).

- Automatic baud rate adaptability utilizing speed sensing, flow control and data buffers.

- Send & Receive FAX class 1, Group 3 supported.

- Serial V.24, 5 volt interface.

- NVRAM directory and stored profiles.

- AT Command structure, with extensions.

- Built-in DAA with 1500 VAC RMS isolation 2122V peak surge protection.

- UL 1950 and CSA C22.2 950 Recognized (E104957).

- Leased Line version available CH1799LL

- FCC part 68 Approved/DOT CSA CS-03 Part I Approvable.

- +5 Volt operation with zero power option

- Small size: 1.35" x 1.38" x 0.61" (nominal, 0.55" upon request).

- Pin compatible with low speed/low cost CH1786

- TBR21 compliant versions available: CH1799TBR/ETBR and CH2056TBR/ETBR.

INTRODUCTION

The CH2056, CH1799 and CH1794 (HS Modem Family) are industrial grade high-speed modem modules. Each HS Modem product supports a range of modem standards and speeds from 300bps to 14,400bps, 28,800bps, 33,600bps or 57,600bps. By using built in compression algorithms the operation speed can be expanded to the maximum DTE rate of 57.6kbps for the CH1794, 115.2kbps for the CH1799 and 230.4kbps for the CH2056. A choice of error correcting schemes is available including MNP 10 for cellular telephone applications. The HS Modem family supports Send and Receive FAX. The CH1799LL operates exclusively on non-voltage bearing leased line.

The HS Modem family is pin compatible with Cermetek's low cost CH1786 V.22bis, 2400bps modem family. Each module in the HS Modem family is a self-contained modem and is FCC Part 68 approved and Canadian DOT approvable. Additionally, the CH1799TBR/ETBR and the CH2056TBR/ETBR products meet the European TBR21 requirements.

These ultra small modules are designed for PCB through-hole mounting and are 1.35" x 1.38" x 0.61" (nominal, 0.55" upon request) in size. The HS Modem family requires only two external interfaces: a CCITT V.24 serial interface for direct access to a UART, and a Tip and Ring RJ-11C Jack for the PSTN line connection. The HS Modem can be controlled with industry standard AT commands and is compatible with available industry communication software.

DESCRIPTION OF FUNCTIONAL BLOCKS AND DISCUSSION OF BASIC OPERATIONS

Figure 1 contains a functional block drawing of the HS Modem family of products. Each HS Modem product consists of a serial interface buffer, modulator/demodulator, modem controller with error correction and data compression, non-volatile RAM and a DAA.
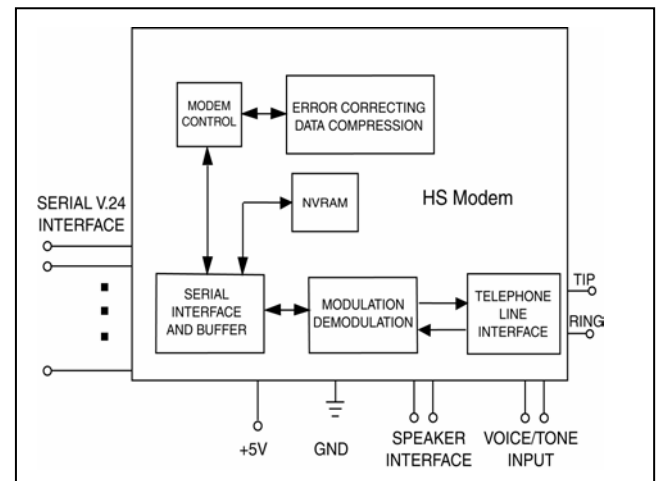

Figure 1. Functional Block Diagram of HS Modem Family.

Serial Host Interface Buffer. The HS Modem utilizes a serial V.24 EIA 232-E 5V interface to control the modem. The HS Modem products can communicate over the serial interface with the Data Terminal

Equipment (DTE) at a fixed speed regardless of the carrier line modulation speed (DCE) of the PSTN modem connection. This eliminates the need to have the DTE step up or step down in speed based on the in-coming or out-going PSTN communication data rate. Hence, the DTE can train the CH2056, to say 56kbps, and talk to a slower in-coming data connection at say, 2400bps without changing host speed. Conversely, the host DTE trained at 14.4kbps can also communicate with the modems at higher speeds, say 28.8kbps. This is accomplished by invoking internal automatic data flow control. The HS Modem family has a resident buffer to allow for this auto baud operation.

Non-Volatile RAM (NVRAM). NVRAM can store user-customized 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 made active upon reset or power up. The **ATZn** command immediately recalls and activates a stored configuration. See Tables 7A and 7B for storable S-Registers and Commands.

The NVRAM can save up to four telephone numbers, with up to 31 digits or modifiers in each telephone number. The **AT&Zn=s** command will store s, the telephone number dial string. The **ATDS=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.

Telephone Line Interface or DAA. High performance modems are extremely sensitive to DAA (Data Access Arrangement) performance. The difference between a good modem and a fair one is in the DAA performance. The HS Modem family includes a unique low distortion DAA designed for optimal performance over all PSTN line conditions thereby achieving the most reliable and best performance PSTN connections.

The HS Modem family is designed to meet North American telephone standards as set by the FCC Part 68 (USA) and CSA CS-03 Part I (Canada). Among the more critical parameters, the PSTN line interface is designed to meet 1500 VAC RMS isolation and provide 2122V peak surge protection. Consequently, the HS Modem family of products satisfies U.S. and Canadian requirements, and will meet other international approval agency requirements that specify these levels of isolation. The TBR/ETBR variants also meet the European TBR21 requirements.

Pins 1 and 2 function as both input and output connections to the PSTN. To maximize field reliability in hostile environments, for Canadian approval, for UL

compliance, and also optionally for FCC Part 15 compliance, these two pins must be routed through an external network such as that briefly described in Figure 6A and described in more detail in Cermetek Application Note # 126.

Each HS Modem product comes with FCC Part 68 approval and is shipped from the factory with an FCC Label indicating registration number and ringer equivalent. This label should be prominently displayed on the end product. With the exception of the U.S., most countries (including Canada) require submission of the final product or system containing the HS Modem to the appropriate governing regulatory agency for approval. Typically this is accomplished by submitting the final end product to an independent test house or consultant for evaluation. The test house/consultant then forwards the test results and applicable documents to the regulatory agency. Contact Cermetek for a list of suggested consultants.

Modulation/Demodulation/Error Correcting and Data Compression. These functions are provided by an industry standard modem chip set which has been adapted for use with the HS Modem family. The Modulation/Demodulation scheme supports the industry modem standards listed below.

SUPPORTED MODULATION STANDARDS	
Bell 103	CCITT V.22
Bell212A	CCITT V.22bis
	CCITT V.32
	CCITT V.32bis
	CCITT V.34
	CCITT V.34bis
	CCITT V.90

The HS Modem supports V.42 LAMP, MNP 2-4, MNP 10 error correcting protocols. The CH1794 uses MNP5 data compression techniques and the CH1799/CH2056 uses V.42bis data compression, allowing data transmission rates of up to a maximum of 57.6kbps/115.2kbps/230.4kbps, respectively. These high DTE data rates are supported by the HS Modem serial interface via its auto baud capability. Note that the maximum speed attained is limited by the maximum speed available from the DTE.

The resident Modulator/Demodulator supports line equalization and forward error correction.

IMPORTANT NOTE
The V.90 standard prescribes 56kbps downlink and 33.6kbps uplink. Consequently, two V.90 modems connected back-to-back will send at 33.6kbps.

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.

SUPPORTED FEATURES

AT Command Set. The HS Modem supports the **AT** Command set with extensions and can operate with industry standard communication software. The **AT** Commands are compatible with TR302.2/88-08006.

Serial Host Interface. The HS Modem family operates in asynchronous mode and supports a 5V, RS232- like interface called V.24 (EIA-232-E). The HS Modem supports a full RS-232C/V.24 serial interface. Signal levels are TTL rather than RS-232C level compatible, which allows direct connection of the HS Modem to the host's UART without level translating circuitry. See Table 3 for a complete set of pin descriptions.

The modem is controlled by sending serial commands over TXD and by monitoring serial status messages returned on RXD. All other serial interface lines may be utilized for the convenience of a particular application but are not required by the modem. Unused outputs from the HS Modem should be left unconnected. Unused inputs should be tied to the proper logic level. See Table 3.

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-ohm load directly. Typically, the SPK signal is input into an audio power amplifier and the amplifier, in turn, drives the speaker coil. The speaker is activated with the **ATM** command. The speaker volume is adjusted using the **ATLn** command; where n is 0, 1, 2, or 3. Increasing numbers correspond to higher volume. Figure 3 indicates one method of driving an external 8-ohm speaker.

Zero Power Mode. If an application calls for zero power during standby periods, the power may be switched off using external circuitry and then reapplied when the HS Modem's RI pin becomes active. The HS Modem can thus be powered down to zero.

Referring to Figure 2, the controller activates the relay switch, supplying power (+5V) to the HS Modem. In this configuration, the ring signal is used to "wake up" the HS Modem when the HS Modem is in the power down state.

The internal structure of the RI pin consists of an open collector opto transistor with a 30k ohm pull-up through a blocking diode to 5V. The user should apply his own pull-up resistor to an active 5V source when the HS Modem is powered down. The internal blocking diode provides supply isolation.

The pins of the HS Modem will be in an undefined state when powered is switched off. This must be taken into consideration to assure that no unwanted signals are presented to the HS Modem during power down.
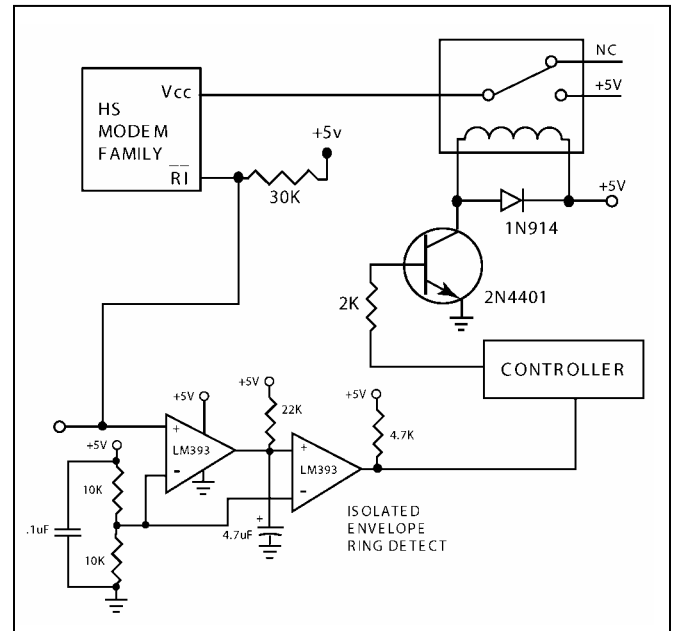

Figure 2. Zero Power Operation.

Power Supply. The HS Modem module is a complex set of sensitive subsystems. During the course of normal operation, the HS Modem decodes analog signals from the telephone line that are in the millivolt range. Steps must be taken by the user to guarantee that power supply noise on all supply lines, including ground, does not exceed 25mV peak to peak. If necessary, use dedicated power and ground planes. Failure to provide such operating conditions could cause the HS Modem to malfunction or to function erratically.

The HS Modem family requires +5V ±5% supply. It is recommended that bypass capacitors be placed on the power supply as close to the HS Modem's supply input pins as practical. It is recommended that a 10 µF or greater tantalum capacitor in parallel with a 0.1 µF ceramic capacitor be used. The user must also provide shielding from nearby sources of EMI, such as relays, motors and other power supplies.

Automatic Speed/Format Sensing. The HS Modem supports both Command and Data modes of operation.

The HS Modem can automatically determine the speed and format of the data sent from the DTE over the serial interface; and can sense the following broad range of speeds:

CH1794   300, 600, 1200, 2400, 4800, 7200, 9600, 12000, 14400, 19200, 38400, and 57600bps.

CH1799   300, 600, 1200, 2400, 4800, 7200, 9600, 12000, 14400, 16800, 19200, 21600, 24000, 26400, 28800, 38400, 57600, and 115200bps.

CH2056   300, 600, 1200, 2400, 4800, 7200, 9600, 12000, 14400, 16800, 19200, 21600, 24000, 26400, 28800, 38400, 57600, 115200, and 230400bps.

The data formats in Table 1 are recognized by the HS Modem family of products.

Table 1. Data Formats Recognized by HS Modem Family.

Parity	Data Length (No. of Bits)	No. of Stop Bits	Character Length (No. of Bits)
None	7	2	10
Odd	7	1	10
Even	7	1	10
None	8	1	10
Odd	8	1	11*
Even	8	1	11*
*11 bit characters are sensed, but the parity bits are stripped off during data transmission in Normal and Error Correction modes.			

The HS Modem can sense data with mark or space parity and configures itself as described in Table 2.

The HS Modem is trained to a selected speed with an **AT<CR>** training sequence. Thus, the DTE to modem serial interface speed can be set independent of the DCE or line carrier connecting speed (with minor restrictions, see the **AT+ MS** command). This allows greater flexibility when selecting DCE line carrier modulation speed thereby affording the user with optimum data throughput performance. To maximize effective modem data throughput speed, the DTE to modem serial interface speed should be set to the highest speed available without invoking the use of the HS Modem's built-in flow control. Although flow control facilitates communication with higher speed modes by the DTE, use of flow control causes an overall throughput data rate penalty.

Voice/Tone Injection Port. The HS Modem Family provides pin T1 to allow the user to share the PSTN line interface associated with the modem for voice and DTMF applications. Figure 5 contains a schematic which uses a 5 Volt single supply operational amplifier and indicates one possible configuration for voice/tone utilization.

Refer to Cermetek Application Note #170, 2-4 Wire Converter for Use with CH179X and CH2056 Modems,

for an alternative voice/tone implementation that utilizes dual supply operational amplifiers.

Table 2. HS Modem Auto Configuration Based on DTE Configuration.

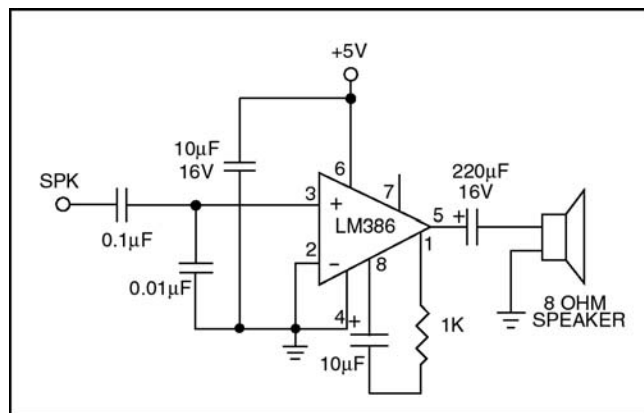| DTE Configuration	HS Modem Configuration
7 mark	7 none
7 space	8 none
8 mark	8 none
8 space	8 even

Figure 3. Speaker Control Circuit.

All HS Modem products are designed with pin T1 coupled directly to the internal DAA. When using the HS Modem in data mode, T1 should float and be disconnected from any potential signal because any signal on T1 during data operation will affect the HS Modem's output. If T1 is being asserted from another application, use a relay or zero impedance switch to disconnect T1 when in data mode.

When voice and data are both being used, and the T1 pin is active, it is typical for voice communication to precede data communication. In this case, the following commands should be used to configure the HS Modem to allow for full utilization of the Voice/Tone injection feature. These commands disable auto-answer and eliminate hang-up due to lack of carrier signal.

1. Enter: **ATS0=0<CR>**
2. Enter: **ATS7=255<CR>**
3. Enter: **ATS10=255<CR>**

The following command sequences illustrate implementation of common voice/tone port applications.

1. To answer a voice call:
    (a) Enter: **ATH1<CR>**
    (b) Switch local voice source into T1
    (c) Begin Voice Conversation

2. To switch to data mode, switch local voice source from T1:
   (a) At the Originate Modem, enter: **ATX1<CR>**
   (b) At the Answer Modem, enter: **ATA<CR>**

3. To disconnect (hang-up) a voice call or data call:
   (a) Return to control mode by entering: **+++**
   (b) Enter: **ATH<CR>**

4. To place a voice call using the HS Modem DTMF facilities:
   (a) Enter: **ATDT1234567<CR>**
       Where **1234567** is the phone number
   (b) Then switch to local voice source

MODEM CONTROL
The HS Modem may be controlled by sending serial ASCII command sequences. The commands are sent to the modem serially on the TXD pin. After execution of a received command, the modem returns a serial status message that completion status. Refer to Table 5A, 5B and 5C for a complete list of status messages.

MODEM STATES
The HS Modem can be in either command mode or data mode. When the modem is idle, it is in command mode by default and will recognize commands. When data transmission is in progress, the HS modem is in the data mode state and will not recognize commands. To force the HS Modem to recognize commands, the host must send an "escape sequence" to the HS Modem forcing it out of data mode and into command mode.

The escape sequence consists of a "guard time" (a period where no characters are sent to the modem), followed by 3 escape characters, followed by a second guard time. At power-up, the guard time is set to 1 second, and the escape character is set as "+." Note that a 50 msec delay is required between escape characters. These two parameters can be modified via registers S2 and S12, respectively.

The HS modem will stay off-hook with its carrier on after the escape sequence is received. The HS Modem will return an OK status message when it is ready to accept commands. To put the HS Modem back into data mode, issue command **ATO<CR>**.

THE COMMAND FORMAT
HS Modem commands consist of three elements:
1. The attention sequence,
2. The commands themselves and
3. A terminating carriage return.

Enter: **ATDT1234567<CR>**
Result: Modem goes off-hook and tone dials phone number 1234567.

WARNING
The HS Modem family of products has been FCC Part 68 approved as data/FAX modems. Utilization of the Voice/Tone Port requires further registration. The FCC requires that the entire system, including the HS Modem and the handset or DTMF transceiver, adhere to Part 68 rules.
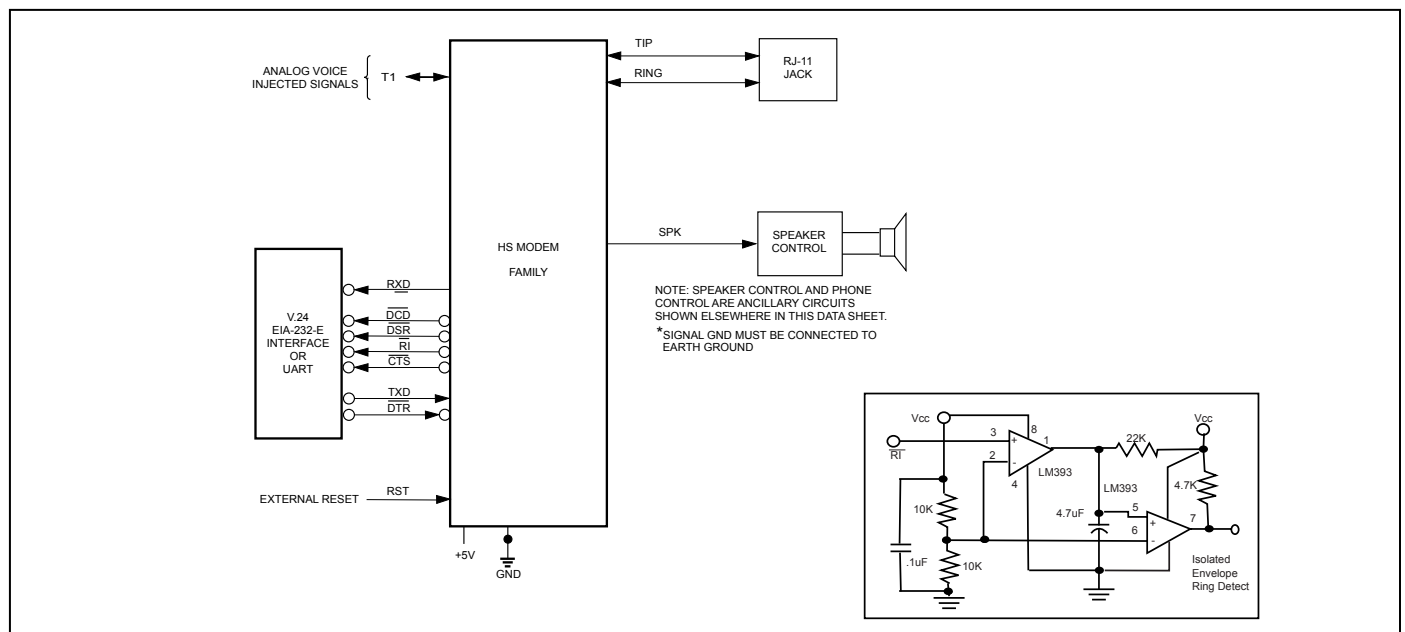

Figure 4.   HS Modem Family Application Diagram.

AT [Commands]<CR>.
Where: **AT** represents attention sequence. **A** and **T** may be either upper or lower case but must be the same case. [**Command**] represents command strings.

Where: **<CR>** represents carriage return (ASCII 13 or HEX 0D)
  <LF> represents line feed (ASCII 10 or HEX 0A)

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

Result: **0 <CR>** (Terse)
  or
Result: **<CR><LF>**
  OK
  <CR><LF> (Verbose)

After accepting the **AT<CR>** command the HS modem is in idle mode and is ready to accept additional commands.

An alternate attention sequence **A/** may be issued which behaves much like the **AT** sequence except that it causes the last entered command specified with an **AT** prefix to be executed. When given, it must be in upper case ASCII. No carriage return is needed for this command.

When entering commands to the modem, the backspace character-control-H (ASCII 8 or HEX 08) can be used to edit mistakes. **AT** and **A/** may not be edited however. Multiple commands may be placed on a command line. A command line may be as long as 40 characters, excluding the letters **AT**. By way of example, the command below instructs the HS Modem to configure itself to not echo characters when in command mode (**E0**) and then puts itself in answer mode (**A**).

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

AT Command Set. The available command set is divided into four types of commands: dial modifiers, basic commands, ampersand and percent commands. Refer to the complete list in Tables 6A and 6B.

INITIALIZING THE MODEM
Before commands may be sent to the HS Modem, the modem must be initialized. This is a two step process:

Step 1. Modem Reset. This is accomplished by applying a hardware-reset pulse to pin RST or by switching the power off then back on.

Step 2. Initial Modem Training. The modem must be trained to the host DTE speed and parity (odd, even, mark, space or none). These activities are briefly described below.

HS Modem Reset. Upon applying power to the HS Modem, the HS Modem automatically generates an internal reset pulse. The user can also reset the modem externally by applying a high-going reset pulse to the RST pin for at least 10 msec after the +5V power supply has stabilized. Delay sending commands to the HS Mode for 2 seconds after reset has been initiated to allow the HS Modem time to properly reconfigure.

On power up, or when reset is initiated either by the **ATZ<CR>** command or by the RST pin, the modem will reconfigure to its default state with the line carrier modulation speed set to:
1. 14.4kbps for the CH1794
2. 33.6kbps for the CH1799
3. 57.6kbps for the CH2056

If desired, any speed, error correction, or data compression method available on the HS Modem can be locked in, using the **ATNn** and/or **AT+MS** commands.

Training the Modem. Each modem must be trained to match the host DTE speed and parity so that it is able to recognize serial asynchronous commands sent to it by the DTE.

The DTE must retrain the modem each time a reset pulse is applied on RST or after a RESET serial command has been issued.

STATUS MESSAGES AND RESULTS CODES
A result code is issued by the HS Modem to the DTE for all commands executed by the HS Modem except dialing commands. Further, various activities on the PSTN are also signaled to the DTE by the HS Modem. All result codes have either a terse, short form version (which is identified by a number followed by a **<CR>**) or a verbose long form English-like message version (which is preceded and terminated with a **<CR>** and **<LF>**).

The user may suppress certain subsets of the non-extended result codes. This is accomplished by selecting subsets of the result code set using the **ATXn** command, where n=0, 1, 2 or 3. Optionally, the user may specify an extended set of results codes (codes above 35) by setting Register S95. See the detailed description of results codes in Table 5A, 5B and 5C.

All **AT** commands, other than dialing commands, will be responded to with either an OK (short form result

code 0) or the command is valid or accepted, or with an ERROR (result code 4) if the command is not recognized. The detail contained in the error result codes signaled to the DTE depends on the level of message suppression employed by the user. As can be seen from Tables 5A, 5B and 5C, specifying X4 allows the HS Modem to utilize the entire range of non-extended messages, whereas X0 suppresses all but the very basic result codes. Most of the result codes allowed under X1, X2 and X3 are considered call progress status codes and, in practice, are suppressed except for the case of debugging activities. It is recommended that the non-extended result codes be used in all cases.

It should be noted that the default connect result codes 9-20 indicate DTE connection speed, not Carrier Line DCE speed. Hence, a CH1794 will connect at a maximum speed of 19.2kbps (result code 16). The CH1799 will connect at a maximum DTE speed of 38.4kbps (result code of 17) and the CH2056 will connect at a maximum speed of 57.6kbps (result code 18) unless the DTE is forced to a higher speed by selection of data compression. In this case, the maximum DTE to modem speed is 230.4kbps (result code20).

Extensions to the basic result code set may be specified by Register S95, which allows for the use of result codes 40-64, 165-194.

IMPORTANT NOTE
Result codes 53-64 are supported by the CH1799 and CH2056. Result codes 165-194 are only supported by the CH2056. To obtain a detailed status report for a given modem communication configuration, use the **AT\V1** command. Executing this command at setup will cause the modem to connect and return a message on line consisting of <DTE speed> <modulation> <error protocol> <line speed of connection>.

LEASED LINE OPTION
The CH1799LL is a leased line version of the CH1799. Whereas the CH1799 requires an active voltage bearing or wet PSTN line for normal operations (typically, 48VDC on-hook line voltage), the CH1799LL is designed to operate over a non-voltage bearing or dry line.

The CH1799LL will only operate properly on a dry line. Damage will occur if used on a wet line. The CH1799LL does not support ring detect but does support off-hook control. Refer to Cermetek Application Note # 116 for examples and instructions to establish a connection over a leased dry line wire pair. Note that the length of the leased line is limited to 20,000 feet. Use PSTN line protection as

recommended in Figure 6B and in Cermetek Application Note # 126. Follow all applicable requirements for FCC Part 68 compliance. The User is responsible to ensure that FCC Part 68 compliance is maintained.

As an alternative, the CH1799 will operate on a leased line if the line is made wet by application of a DC voltage. Refer to Cermetek Application Note # 114.

WARNING
Operation of the CH1799LL on a standard PSTN line will damage the CH1799LL and void its warranty. Further, operation of the CH1799LL on a dry line without using proper current limiting circuitry as outlined in Cermetek Application Note # 126 may cause damage to the CH1799LL and will also void its warranty.

Table 4. Pin Comparison of CH1786 and HS Modem Family.

PIN	CH1786	HS Modem Family
1	RING	RING
2	TIP	TIP
3	RXA	T1
4	TXA	NC
5	SPK	SPK
6	NC	NC
7	NC	NC
8	SLEEP	OPEN*
9	NC	NC
10	$\overline{TXD}$	TXD
11	$\overline{RXD}$	RXD
12	$\overline{V/D}$	OPEN*
13	$\overline{DTR}$	$\overline{DTR}$
14	$\overline{DST}$	$\overline{DSR}$
15	$\overline{RI}$	$\overline{RI}$
16	$\overline{CTS}$ (FX only)	$\overline{CTS}$
17	DCD	$\overline{DCD}$
18	HS	NC*
19	V_{CC}	V_{CC}
20	GND	GND
21	RST	RST
22	NC	$\overline{RTS}$

NOTES:
1. * Indicates a difference between the CH1786 and the HS Modem. The HS Modem may be directly substituted for the CH1786 except in applications where pins 8, 12, or 18 are used.

2. NC signifies 'No Connect.'

3. Effective 31 March 2000, the HS Modem will no longer support the HS indication function. Therefore, pin 18 should be a 'No Connect' in all applications.

Table 3.   HS Modem Family Pin Descriptions.

PIN	NAME	I/O	FUNCTION
1	RING	I/O	**TELCO/TELSET INPUT**. Directly connects to the telephone line's RING lead through a user supplied RJ-11C jack.
2	TIP	I/O	**TELCO/TELSET INPUT**. Directly connects to the telephone line's TIP lead through a user supplied RJ-11C jack.
3	T1	I/O	**ANALOG VOICE INJECTED**. Input (See Figure 5). 2.2V P-P max. Let float if not used.
4	NC	-	No connection.
5	SPK	O	**SPEAKER**. Audio output for speaker. See speaker control diagram.
6	NC	-	No connection.
7	NC	-	No connection.
8	NC	-	No connection.
9	NC	-	No connection.
10	TXD	I	**TRANSMIT DATA**. Serial Transmit data input. Marking, or a binary 1 condition, is transmitted when a HIGH is asserted.
11	RXD	O	**RECEIVE DATA**. Serial Receive data output. Received marking or a binary 1 condition is indicated by a HIGH.
12	NC	-	No connection.
13	$\overline{DTR}$	I	**DATA TERMINAL READY**. Active LOW. Switching off DTR can either return modem to command state, disconnect phone call, or reset the modem. DTR should be set LOW when not used.
14	$\overline{DSR}$	O	**DATA SET READY**. LOW indicates handshaking with a remote modem is in progress, and/or the data carrier of a remote modem has been detected.
15	$\overline{RI}$	O	**RING INDICATION**. This signal follows the frequency of the ringing signal and is normally about 20 to 40 Hz for 2 seconds on with 4 seconds off.
16	$\overline{CTS}$	O	**CLEAR TO SEND**. Active LOW. Indicates that the modem is ready to accept data from the DTE.
17	$\overline{DCD}$	O	**DATA CARRIER DETECT**. LOW indicates a data carrier from a remote modem has been detected. This feature must be enabled using the **&C1** command.
18	NC	-	No connection.
19	VCC	-	**POWER SUPPLY**. 5 Volts ± 5%. Note: Noise should be less than 25mV peak-to-peak.
20	GRD	-	**GROUND**. Note: Noise should be less than 25mV peak-to-peak.
21	RST	I	**RESET**. Active HIGH. This input must be asserted HIGH for at least 10-msec to reset the modem. RESET is then returned to LOW for normal operation. If no system reset is available, let this pin float to enable the internal reset.
22	$\overline{RTS}$	I	**REQUEST TO SEND**. Active LOW. Used for flow control. Should be tied low if not used.

NOTE: (1) If VCC has a slow power up ramp time, the internal reset may be ineffective.
           (2) Do not drive LED's directly from any output. Use Buffers.

AT COMMAND APPLICATIONS

Dialing a Phone Number. 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: **ATD1234567<CR>**

In response to this command, the HS Modem dials the telephone number "123-4567" and then waits for a carrier from the distant modem. If no carrier is detected within a given time (the default time is 30 seconds), the HS Modem automatically releases the line and sends a NO CARRIER result code. If a carrier is detected, the HS 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 a line without dialing a number.

Pause During Dialing. 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. The factory default pause time is 2 seconds.

Example: Dial 9, pause, dial number.
Enter: **ATDT9, T1234567<CR>**
Result: **OK<CR><LF>**

Multiple commas may be used for a greater delay time.

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

Example: Pulse dial 9, pause, touch-tone dial
                number.
Enter: **ATDP9, T1234567<CR>**
Result: **OK<CR><LF>**

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

Go Off-Hook and Return to Command State. The modem can be forced to reenter the command state after going off-hook by issuing the ATDT command with a semi-colon. This is useful when using the modem with an independent DTMF tone generator.

Example: Touch-tone dial 9, pause, go off-hook,
                return for additional **AT** commands.
Enter: **ATDT9, T;<CR>**
Result: **OK<CR><LF>**

Automatic Answering.
S0=0*   DO NOT ANSWER TELEPHONE
S0=1-254   ANSWER ON RING 1 TO RING 254
S0=255   ANSWER ON RING 255

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

PHONE LINE CONNECTION GUIDELINES

1.   The HS Modem must be mounted in the final assembly such that it is isolated from exposure to any hazardous voltages within the assembly. Adequate separation and restraint of cables and cords must be provided.

2.   The circuitry from the HS Modem to the telephone line interface must be provided in wiring that carries no other circuitry other than that specifically allowed in the FCC rules (such as A and A1 leads).

3.   Connection to phone line should be made through an RJ-11C jack.

4.   PCB traces from the modem's RING and TIP pins to the RJ-11C jack must be 0.1 inch spacing or greater to one another and 0.2 inch spacing or greater to all other traces. The traces should have a nominal width of 0.020 inches or greater.

5.   The RING and TIP PCB traces should be as short as possible and oriented to prevent coupling other high speed or high frequency signals present on the host circuit PCB.

6.   No additional circuitry other than that shown in Figure 7 may be connected between the modem module and the RJ-11C jack. Doing so will invalidate the FCC approval.

7.   The HS Modem, the RJ-11C jack, the interfacing circuitry and all PCB traces in between, must be contained on a PCB with a 94 V-0 flammability rating.

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

9.   The product's User Manual must provide the user with instructions for connection and use as recommended in the FCC Registration Section below.

CANADIAN APPROVALS

The HS Modem family is approvable for use by DOT to CSA CS-03 Part I. However, per Canadian procedures, approval can only be granted after the HS Modem has been installed into the end product. Typically, Canadian approval is obtained by submitting the final end product to an independent test house or consultant for evaluation. The test house/consultant then forwards the test results and applicable documents to the regulatory agency. Cermetek offers a list of consultants to assist with this process.

PAN-EUROPEAN TBR21 APPROVALS

The CH1799TBR/ETBR and CH2056TBR/ETBR products have been designed to meet the requirements of *ETSI TBR – 021 Pan-European Approval for Connection to Analogue Public Switched Telephone Networks* in addition to the FCC Part 68 conveyed approval, Canadian DOT CSA CS-03 Part I compliance and UL 1950 Edition 3/CSA C22.2 950 recognition. Test reports (as required for CE marking) demonstrating TBR21 compliance are available upon request.

HS MODEM HANDLING AND ASSEMBLY RECOMMENDATIONS

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

There are two mounting techniques that are recommended for physically connecting the HS Modem to a PCB:
1. Direct soldering.
2. Sockets.

Direct Soldering. The HS Modem may be wave soldered onto a circuit card. All HS Modem products are hermetically sealed and will not be harmed by industry standard wave soldering processes.

Socketing. The socketing approach to mounting eliminates cleaning and desoldering concerns. When the socket is used, it must make a solid connection to all pins. Failure to do so will cause unreliable or intermittent operation. Also, steps should be taken to assure that the module remains tightly seated in the socket after the end product is shipped. Cermetek recommends socket CES-150-01-T-S by Samtec, 50 pin strip socket.

FCC REGISTRATION

All products in the HS Modem family are registered with the FCC (except the CH1799LL) under Part 68. To maintain the validity of the registration, you must serve notice to the end user of the product of several restrictions the FCC places on the modem and its use.

In addition to restriction notification, the FCC requires that Cermetek make all repairs to all products in the HS Modem family. If repairs are necessary after installation of the HS Modem and the end product has been delivered to the end user, the end product must be returned to the end product supplier where the HS Modem can be removed and then forwarded to Cermetek for repair. The following notice is recommended and should be included in the end product's user manual.

FOR YOUR USER'S MANUAL

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

Type of Service. The (insert end product name) is designed to be used on standard device telephone lines. It connects to the telephone line by means of a standard jack called the USOC RJ-11C (or USOC RJ45S). Connection to telephone-company-provided coin service (central office implemented systems) is prohibited. Connection to party lines service is subject to state tariffs.

Changes in Attestation Procedure for Plugs and Jacks. (Name of applicant) attests that the network interface plugs or jacks used on this equipment comply with and will continue to comply with the mechanical requirements specified in Part 68, Sub-part F, specifically the dimensions, tolerances and metallic plating requirements. The compliance of these connectors will be assured by purchase specifications and incoming inspection. Documentation of such specifications and/or inspections will be provided by the FCC within 30 days of their request for the same.

Telephone Company Procedure. The goal of the telephone company is to provide 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 effect 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.

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 all 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. Consult your telephone provider.

If Problems Arise. If any of your telephone equipment is not operating properly, you should immediately remove it from you 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 connect the problem and informed of your right to file a complaint with the FCC. Contact your local telephone service provider 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 or (insert your company name). For information contact: (insert your company address).

DEFAULT STATUS, PERFORMANCE AND SPECS

Prior to delivery, Cermetek installs into each HS Modem the following default Configuration Profile:

Default Connect Speeds are 14,400bps, 33,600bps and 57,600bps for CH1794, CH1799 and CH2056 respectively
Serial port data rate auto baud enabled
Bell 212A operation at 1200bps
Parity – none
Auto answer disabled
Command echo ON
All result codes enabled – except \REL codes
Wait for dial tone before dialing – 2 seconds
Dials with touch-tone (T)
Detects busy signal (ATX4)
Full word result codes – non-extended
Pulse dial make/break ratio = 39/61-10pps
Test timer set to 0 seconds, test modes disabled
Inactivity timer set to 0 minutes
CTS always active
DSR is ignored
DCD is ignored
RTS to CTS delay - .01 seconds
DTR always active – hang up after transition
Long space disconnect disabled
Speaker enabled but off when receiving carrier
Speaker volume set to low
Local modem will not grant RDL request from remote modem
Guard tones disabled
Minimum DTR pulse width = .05 seconds
Ring count – 00
Escape code character = 43 (+)

Flash to on hook = 70 msec
Auto speed detection enabled
DTE connect speed, connect messages
Back space character = 08 (BS) Carriage return character = 13 (CR)
Line feed Character = 10 (LF)
Duration of wait for dial tone =2 seconds
Duration of wait for carrier after dialing = 50 seconds
Carrier detect response time = 0.6 seconds
Escape code guard time = 1 second
Length of use after comma = 2.0 seconds
Last carrier to hang up delay = 1.4 seconds
DTMF interdigit delay = .095 seconds
Auto sync address or address detection =0
Connection detected at DTE – Highest speed 38,400kbps
Auto retrain enabled – 30 seconds attempts
MNP error correction mode can be negotiated (&Q5)
MNP – non-extended service selected
MNP error correction block size is 128 characters selected
Data compression – negotiation enabled
Transmit break length is 0.3 seconds
All breaks are transmitted in sequence with data
Serial port flow control enabled = RTS/CTS
XON/XOFF flow control characters selected

Note: Upon power-up the HS Modem will recall user profile 0 which may override some of the above Factory Defaults. If desired the user may, at their option, save the factory defaults in user profile 0.

Table 5A. Summary of Non-Extended Result Codes.

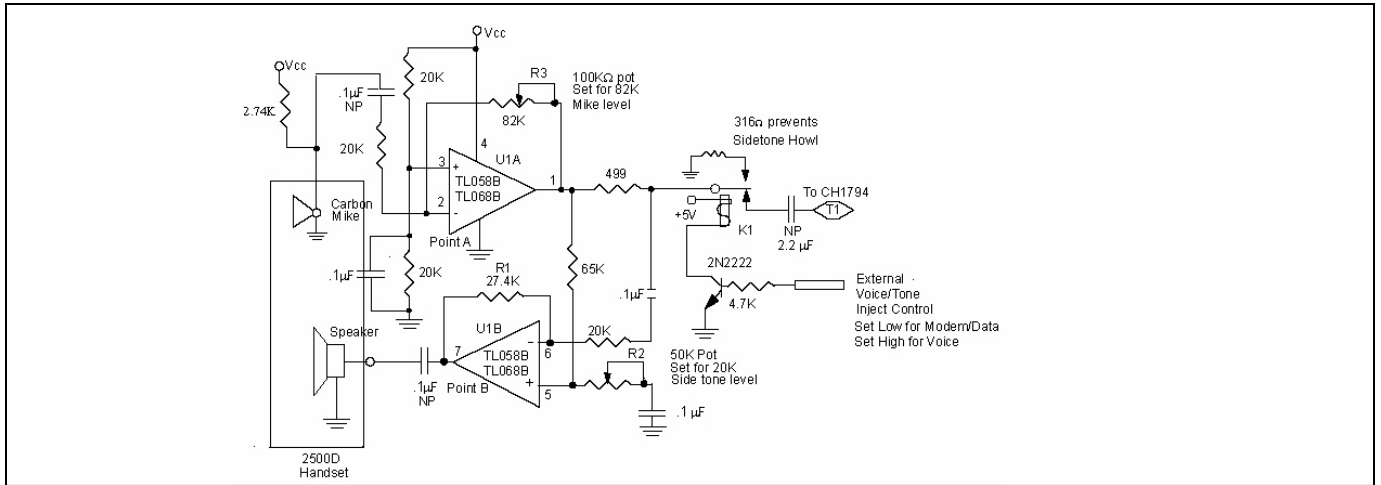| Result Code Form		n is ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
0	OK	X	X	X	X	X
1	CONNECT	X	X	X	X	X
2	RING	X	X	X	X	X
3	NO CARRIER	X	X	X	X	X
4	ERROR	X	X	X	X	X
5	CONNECT 1200	1	X	X	X	X
6	NO DIAL TONE	3	3	X	X	X
7	BUSY	3	3	3	X	X
8	NO ANSWER	X	X	X	X	X
9	CONNECT 0600	1	X	X	X	X
10	CONNECT 2400	1	X	X	X	X
11	CONNECT 4800	1	X	X	X	X
12	CONNECT 9600	1	X	X	X	X
13	CONNECT 7200	1	X	X	X	X
14	CONNECT 12000	1	X	X	X	X
15	CONNECT 14400	1	X	X	X	X
16	CONNECT 19200	1	X	X	X	X

Figure 5. Schematic Illustrating Implementation of Voice Injection Feature.

Table 5A. Summary of Non-Extended Result Codes (Continuation).

Result Code Form		n is ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
17	CONNECT 38400	1	X	X	X	X
18	CONNECT 57600	1	X	X	X	X
19	CONNECT 115200	1	X	X	X	X
20	CONNECT 230400	1	X	X	X	X
22	Connect 75TX/1200RX	1	X	X	X	X
23	Connect 1200TX/75RX	4	4	4	4	X
24	DELAYED	4	4	4	4	X
32	BLACKLISTED	X	X	X	X	X
33	FAX	X	X	X	X	X
35	DATA					

Table 5B. CH1799 Extended Result Codes.

Result Code Form		n is ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
40	CARRIER	X	X	X	X	X
44	CARRIER 1200/75	X	X	X	X	X
45	CARRIER 75/1200	X	X	X	X	X
46	CARRIER 1200	X	X	X	X	X
47	CARRIER 2400	X	X	X	X	X
48	CARRIER 4800	X	X	X	X	X
49	CARRIER 7200	X	X	X	X	X
50	CARRIER 9600	X	X	X	X	X
51	CARRIER 12000	X	X	X	X	X
52	CARRIER 14400	X	X	X	X	X
53	CARRIER 16800	X	X	X	X	X
54	CARRIER 19200	X	X	X	X	X
55	CARRIER 21600	X	X	X	X	X
56	CARRIER 24000	X	X	X	X	X
57	CARRIER 26400	X	X	X	X	X
58	CARRIER 28800	X	X	X	X	X

Table 5B. CH1799 Extended Result Codes (Continuation).

Result Code Form		n is ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
59	CARRIER 16800	1	X	X	X	X
61	CARRIER 21600	1	X	X	X	X
62	CARRIER 24000	1	X	X	X	X
63	CARRIER 26400	1	X	X	X	X
64	CARRIER 28800	1	X	X	X	X
66	Compression: Class 5	X	X	X	X	X
67	Compression: V.24bis	X	X	X	X	X
69	Compression: None	X	X	X	X	X
76	PROTOCOL: NONE	X	X	X	X	X
77	PROTOCOL: LAPM	X	X	X	X	X
80	PROTOCOL: ALT	X	X	X	X	X
84	CONNECT 33600	X	X	X	X	X
91	CONNECT 31200	X	X	X	X	X

IMPORTNAT NOTE
This note applies to Tables 5A, 5B, and 5C. An "X" in a column indicates that the message (either the long form if verbose, or the value only for short form) will be generated when that particular value of "n" (shown at the top of the column) has been selected by the use of **ATXn**. A numeral indicates which less explicit message (verbose or short form) will be output for that X option.

Table 5C. CH2056 Extended Result Codes.

Result Code Form		n is ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
165	CONNECT 32000	X	X	X	X	X
166	CONNECT 34000	X	X	X	X	X
167	CONNECT 36000	X	X	X	X	X

Table 5C. CH2056 Extended Result Codes (Continuation).

Result Code Form		n is ATXn Command				
Terse or Short	Verbose or Long	0	1	2	3	4
168	CONNECT 38000	X	X	X	X	X
169	CONNECT 40000	X	X	X	X	X
170	CONNECT 44000	X	X	X	X	X
171	CONNECT 46000	X	X	X	X	X
172	CONNECT 48000	X	X	X	X	X
173	CONNECT 48000	X	X	X	X	X
174	CONNECT 50000	X	X	X	X	X
175	CONNECT 52000	X	X	X	X	X
176	CONNECT 54000	X	X	X	X	X
177	CONNECT 56000	X	X	X	X	X
178	CONNECT 23040	X	X	X	X	X
180	CONNECT 28000	X	X	X	X	X
181	CONNECT 29333	X	X	X	X	X
182	CONNECT 30667	X	X	X	X	X
183	CONNECT 33333	X	X	X	X	X
184	CONNECT 34667	X	X	X	X	X
185	CONNECT 37333	X	X	X	X	X
186	CONNECT 38667	X	X	X	X	X
187	CONNECT 41333	X	X	X	X	X
188	CONNECT 42667	X	X	X	X	X
189	CONNECT 45333	X	X	X	X	X
190	CONNECT 46667	X	X	X	X	X
191	CONNECT 49333	X	X	X	X	X
192	CONNECT 50677	X	X	X	X	X
193	CONNECT 53333	X	X	X	X	X
194	CONNECT 54377	X	X	X	X	X

Table 6A. Summary of Basic AT Commands.

Command	Function
A/	Re-execute command
A	Go off-hook and attempt to answer call
B0	Select V.22 connection at 1200kbps
B1	Sect Bell 212A connection at 1200kbps
C1	Return OK message
Dn	Dial modifier P Pulse Dial T Touch Tone Dial W Wait for Dial Tone ; Return to Idle State @ Wait for Quiet Answer Command ! Flash Hook , Pause 0-9/ABC Dial Digits/Characters & wait for credit card dial tone ^ Toggles calling tone L Redial last number * Star digit – tone dialing S=n Dial the number and store in Directory, n= 0 to 3
E0	Turn off command echo
E1	Turn on command echo

Table 6A. Summary of Basic AT Commands (Continuation).

Command	Function
H0	Initiate a hang-up sequence
H1	If on-hook, go off-hook and enter command mode
L0	Set low speaker volume
L1	Set low speaker volume
L2	Set medium speaker volume
L3	Set high speaker volume
M0	Turn Speaker off
M1	Turn Speaker on during hand shaking and turn speaker off while receiving carrier
M2	Turn Speaker on during hand shaking and while receiving carrier
M3	Turn Speaker off during dialing and receiving Carrier and turn speaker on during answering
N0	Turn off auto-mode detection
N1	Turn on auto-mode detection
O0	Go on-line
O1	Go on-line and initiate a retrain sequence
Q0	Allow result codes to DTE
Q1	Inhibit result codes to DTE
Sn	Select S-Register as default
Sn?	Return the value of S-Register n
Sn=v	Set default S-Register as default
V0	Report short form (terse) result codes
V1	Report long form (verbose) result codes
W0	Report DTE speed
W1	Report line speed, EC protocol and DTE speed
W2	Report DCE speed
X0 to X4	Report basic call progress result codes, i.e. OK, CONNECT<RING, NOCARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER and ERROR
Y0	Disable long space disconnect before on-hook
Y1	Enable long space disconnect before on-hook
Z0, Z1	The modem performs soft reset. Restore stored profile 0 or 1 after warm reset
&C0, &C1	Force DCD active regardless of the carrier state or allow DCD to follow the carrier state
&D0	Modem ignores DTR. (Default)
&D1	Modem assumes command state
&D2	Modem hangs up, assumes command state and disables auto-answer
&D3	Modem assumes initialization state

Table 6B. Summary of Basic AT Commands.

Command	Function
&F0	Restore Factory configuration 0
&F1	Restore Factory configuration 1
&G0	Disable guard tone
&G1	Disable guard tone
&G2	Enable 1800 Hz guard tone
&K0	Disable DTE/DCE flow control
&K3	Enable RTS/CTS DTE/DCE flow control
&K4	Enable XON/XOFF DTE/DCE flow control
&K5	Enable transparent XON/XOFF flow control
&K6	Enable both RTS/CTS & XON/XOFF flow control

Kn	**CONTROLS BREAK HANDLING DURING THREE STATES**
When modem receives a break from the DTE:	
\K0, 2, 4	Enter on-line command mode, no break sent to the remote modem
\K1	Clear buffer
\K3	Send break to remote modem immediately
\K5	Send break to remote modem in sequence with tranmitted data
When modem receives \b in on-line command state:	
\K0, 1	Clear buffers & send break to remote modem
\K2, 3	Send break to remote modem
\K4, 5	Send break to remote modem in sequence with tranmitted data
When modem receives a break from remote modem:	
\K0, 1	Clear data buffers and send break to DTE
\K2, 3	Send break immediately to DTE
\K4, 5	Send break with received data to DTE

\N0	Select normal speed buffered mode
\N1	Select direct mode
\N2	Select reliable mode
\N3	Select auto reliable mode
\N4	Force LAPM mode
\N5	Force MNP mode
\V0	Connect messages are controlled by the command settings X, W, and S95
\V1	Connect messages are displayed in the single line format
+MS	Select modulation

ERROR CORRECTING COMMANDS

%C0	Disable data compression
%C1	Enable MNP 5 data compression
%C2	Enable V.42bis data compression

Command	Function
%C3	Enable both V.42bis and MNP 5 compression
\A0	Set maximum block size in MNP to 64
\A1	Set maximum block size in MNP to 128
\A2	Set maximum block size in MNP to 192
\A3	Set maximum block size in MNP to 256
\Bn	Send break of n x 100 msec
&M0	Select direct asynchronous mode
&P0	Set 10pps pulse dial with 39%/61% make/break
&p1	Set 10pps pulse dial with 33%/67% make/break
&P2	Set 20pps pulse dial with 39%/61% make/break
&P3	Set 20pps pulse dial with 33%/67% make/break
&Q0	Select direct asynchronous mode
&Q5	Modem negotiates an error corrected link
&Q6	Select asynchronous operation in normal mode
&V	Display current configuration
&W0	Store the active profile in NVRAM profile 0
&W1	Store the active profile in NVRAM profile 1
&Y0	Recall stored profile 0 upon power up
&Y1	Recall stored profile 1 upon power up
&Zn=x	Store dial string x (to 31) to location n (0-3)
%E0	Disable line quality monitor and auto retrain
%E1	Enable line quality monitor and auto retrain
%E2	Enable line quality monitor and fallback

MNP10 COMMANDS

-K0	Disable MNP 10 extended services
-K1	Disable MNP 10 extended services
-K2	Disable MNP 10 extended services

FAX CLASS 1

+FCLASS=n	Service Class
+FAE=n	Data/fax auto answer
+FRH=n	Receive data with HDLC framing
+FRM=n	Receive data
+FRS=n	Receive silence
+FTH=n	Transmit data with HDLC framing
+FTM=n	Transmit data
+FTS=n	Stop transmission and wait

Table 7.   S-Register Summary.

| Register	Function	Range	Units	Saved	Default
S0	Rings to Auto-Answer	0-255	Rings	*	0
S1	Ring Counter	0-255	Rings		0
S2	Escape Character	0-255	ASCII	*	43
S3	Carriage Return Character	0-127	ASCII		13
S4	Line Feed Character	0-127	ASCII		10
S5	Backspace Character	0-255	ASCII		8
S6	Wait Time for Dial Tone	2-255	Seconds		2
S7	Wait Time for Carrier	1-255	Seconds		50
S8	Pause Time for Dial Delay Modifier	0-255	Seconds	*	2
S9	Carrier Detect Response Time	1-255	0.1 seconds	*	6
S10	Carrier Loss Disconnect Time	1-255	0.1 seconds	*	14
S11	DTMF Tone Duration	50-255	0.001 seconds	*	95
S12	Escape Prompt Delay	0-255	0.02 seconds	*	50
S13	Reserved	---	---	---	---
S14	General Bit Mapped Options Status	---	---	---	138 (8Ah)
S15	Reserved	---	---	---	---
S16	Test Mode Bit Mapped Option Status (&T)	---	---	---	0
S17	Reserved	---	---	---	---
S18	Test Timer	0-255	Seconds	*	0
S21	V.24/General Bit Mapped Options Status	---	---	---	52 (34h)
S22	Speaker/Results Bit Mapped Options Status	---	---	---	117 (75h)
S23	General Bit Mapped Options Status	---	---	---	62 (3Dh)
S24	Reserved	---	---	---	---
S25	Delay to DTR Off	0-255	Sec or 0.01 sec	*	5
S26	RTS-to-CTS Delay	0-255	0.01 seconds	---	1
S27	General Bit Mapped Options Status	---	---	---	73 (49h)
S28	General Bit Mapped Options Status	---	---	---	0
S30	Disconnect Inactivity Timer	0-255	10 seconds	---	0
S31	General Bit Mapped Options Status	---	---	---	94 (C2h)
S32	XON Character	0-255	ASCII	---	17 (11h)
S33	XOFF Character	0-255	ASCII		19 (13h)
S34-S35	Reserved	---	---		---
S36	LAPM Failure control	---	---	*	7
S37	Line Connection Speed	---	---	*	0
S38	Delay before Forced Hang up	0-255	Seconds		20
S39	Flow Control bit Mapped Options Status	---	---	*	3
S40	General Bit Mapped Options Status	---	---	*	104 (68h)
S41	General Bit Mapped Options Status	---	---	*	195 (C3h)
S42-S45	Reserved	---	---		---
S46	Data Compression Control	---	---	*	138
S48	V.42 Negotiation Control	---	---	*	7
S82	LAPM Break Control	---	---		128 (40h)
S86	Call Failure Reason Code	0-255	---		---
S95	Result Code Messages Control	---	---	*	0
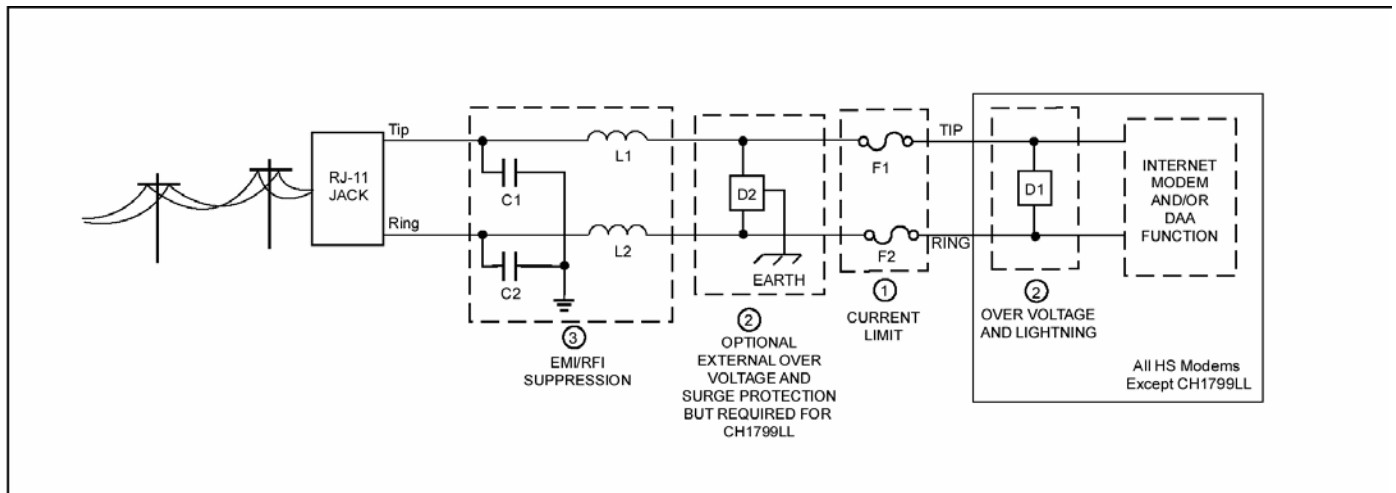
Figure 6.   PSTN Line Interface for all HS Modems.

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 Polyfuse (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 contained within all HS Modems except the CH1799LL (see Figure 6). No additional external components are required to maintain conveyed FCC Part 68 approval for all HS Modems (excluding the CH1799LL).
   B. For CH1799LL, the required surge protection (identified as D1 in dashed Box 2) must be supplied externally. The purchaser must include some form of surge protection as described herein to maintain conveyed FCC Part 68 approval. Refer to Application Note # 130 for a list of recommended suppliers.

   C. In most environments, 2 terminal surge suppressors (300V sidactor or equivalent) are adequate. For severe environments, use an external 3 terminal device with an earth ground. DO NOT USE MOUs or transorbs this purpose.

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.

Table 8. HS Modem Electrical Specifications.

Symbol	Characteristic	Min.	Typ.	Max.	Units
V_{CC}	Positive Supply Voltage	4.5	5.0	5.5	V
I_{CC} Off Hook (CH1794)	Nominal Operating Current @ V_{CC} = 5.5V when modem is Off Hook		115.0		mA
I_{CC} Off Hook (CH1799)	Nominal Operating Current @ V_{CC} = 5.5V when modem is Off Hook		185.0		mA
V_{IH}	High Level Input Voltage*	2.0			V
V_{IL}	Low Level Input Voltage*			0.8	V
VT+	Positive Hysteresis Threshold for RESET Pin		2.5		V
VT-	Negative Hysteresis Threshold for RESET Pin		0.5		V
V_{OH}	High Level Output (I_{OH} = 0.5 mA)*	2.4			V
V_{OL}	Low Level Output (I_{OL} = 1.6 mA)*			0.6	V
I_{IN}	Input Leakage Current ($\overline{TXD}$, $\overline{DTR}$, RTS)			100	μA
I_{OH}	Input Current ($\overline{RST}$)			500	μA
C_p	Capacitive Load ($\overline{TXD}$, $\overline{DTR}$, RTS)			10	pF
	Capacitive Load ($\overline{RST}$)			8	pF

Test conditions: VCC = 5V ± 10%, Temp = 0°C to 70°F (unless otherwise stated).

***Output Load = 50 pF ± one TTL.**

Table 9. HS Modem Electrical Specifications.

Parameter	Min.	Typ.	Max.	Units	Comments
Off Hook Impedance	20			Ohm	
Trans Hybrid Loss		25		dB	600 Ohm, RXA, TXA
Ring Voltage Loop	110V		250V	V_{PP}	On 48VDC line voltage for sustained periods
Line Loop Current – (Off Hook)		20	100	mA	Does not apply to CH1799LL
Return loss @ 1000 Hz		15		dB	600 Ohm
Ring Frequencies		40		Hz	
Receiver Insertion Gain	-0.5	0.0	+0.5	dB	
Transmit Power		-9.5		dBm	600 Ohm – Data Mode
First Character After Reset	1.0			sec	Delay
Inter Character Delay	20	50		msec	Between all command characters
Command Delay	100	200		msec	Between all AT command characters*
Minimum Reset Pulse Duration	10			msec	If user supplied

* Note: Must wait for modem response before issuing new command.

Table 10. Analog Characteristics.

Name	Type	Characteristic	Value
SPK	O(DF)	Minimum Load	300 Ohms
		Maximum Capacitive Load	0.01µf
		Output Impedance	10 Ohms
		Output Voltage	2.5 ± 1.6V
		D.C. Offset	<20mV

Table 11. Summary HS Modem Family of Products.

Model	Summary of Features	Operating Temperature
CH1794	Full Function, 14.4kbps, FCC Part 68 Approved, UL 1950 Listed	0°C to + 70°C
CH1794ET	Full Function, 14.4kbps, FCC Part 68 Approved, UL 1950 Listed	-40°C to +85°C
CH1799	Full Function, 33.6kbps, FCC Part 68 Approved, UL 1950 Listed	0°C to + 70°C
CH1799ET	Full Function, 33.6kbps, FCC Part 68 Approved, UL 1950 Listed	-40°C to +85°C
CH1799LL	Full Function, 33.6kbps, FCC Part 68 Approved, UL 1950 Listed	0°C to + 70°C
CH1799TBR	Full Function, 33.6kbps, FCC Part 68 Approved, UL 1950 Listed, TBR21 Compliant	0°C to + 70°C
CH1799ETBR	Full Function, 33.6kbps, FCC Part 68 Approved, UL 1950 Listed, TBR21 Compliant	-40°C to +85°C
CH2056	Full Function, 56.0kbps, FCC Part 68 Approved, UL 1950 Listed	0°C to + 70°C
CH2056ET	Full Function, 56.0kbps, FCC Part 68 Approved, UL 1950 Listed	-40°C to +85°C
CH2056TBR	Full Function, 56.0kbps, FCC Part 68 Approved, UL 1950 Listed, TBR21 Compliant	0°C to + 70°C
CH2056ETBR	Full Function, 56.0kbps, FCC Part 68 Approved, UL 1950 Listed, TBR21 Compliant	-40°C to +85°C

PACKAGE CONNECTION TABLE

PIN #	Function	PIN #	Function
1	RING	12	N/C
2	TIP	13	$\overline{DTR}$
3	T1	14	$\overline{DSR}$
4	NC	15	$\overline{RI}$
5	SPK	16	$\overline{CTS}$
6	NC	17	$\overline{DCD}$
7	NC	18	NC
8	NC	19	VCC
9	NC	20	GND
10	TXD	21	RST
11	RXD	22	$\overline{RTS}$

NOTES:
1. All dimensions are inches.
2. Case dimensions are nominal + 0.02 inches.
3. Pin length is nominal + 0.03 inches.
4. Cermetek recommends that 0.04 inch diameter plated through holes are used with 0.060 inch diameter pads.
5. Pin spacing are nominal.
6. Low Profile (0.550 inches maximum) case available 8/1/01 upon special request.

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