

Telephone Line Status Detector

INTRODUCTION

The CH1808 Telephone Line Status Detector detects severed lines, the off-hook condition, remote disconnects and incoming call ringing. This device is ideal for security systems, alarm systems, or critical instrumentation products where it is essential that the line status be monitored. Because the CH1808 accesses the Public Switched Telephone Network (PSTN), it is FCC Part 68 approved. This approval is provided to the end user with conveyed registration. Each unit is delivered with a label to be mounted by the user on the host equipment indicating compliance with FCC Part 68 requirements.

The CH1808 operates on a single 5V supply and is housed in a single in-line package 1.4" long and 0.45" high. This package requires minimal PCB area. The CH1808 provides three logic outputs: Local Loop Monitor (LLM), Ring Indication (\overline{RI}), and Off-Hook Detect (\overline{OHD}). The LLM output becomes active when the CH1808 detects a loss of voltage resulting from a cut line or when another device goes off-hook on a shared line. The \overline{RI} becomes active when the telephone company Central Office (CO) applies a ringing signal to the PSTN line. The \overline{OHD} becomes active when current flow on the line is detected caused by the use of a shared handset. The \overline{OHD} can also be used to detect a remote line disconnect event.

PRINCIPLES OF OPERATION

Operation of the CH1808 can be characterized by the following functional blocks:

- Local loop voltage loss detect
- Ring detect
- Off-hook/current detect

Basic Operation. Figure 1 shows these blocks and their input and output functions. The PSTN wires extending from the users equipment to the CO are referred to as the local loop. This loop is connected to the CH1808 via the TIP and RING pins. Drawing current from the local loop signals to the CO that the equipment is off-hook. The off-hook condition occurs either when answering a call or when placing a call. When not drawing current, the equipment is said to be on-hook.

Local loop Voltage Loss Detection. A voltage is always present whether the telephone line is in use (i.e., off-hook) or idle (i.e., on-hook). The line voltage must be at least 18V to indicate an operational line.

FEATURES

- FCC Part 68 approved.
- Used on public switched telephone lines and "wet" leased lines.
- Detects off-hook on the local loop.
- Detects automatic off-hook for separate telsets.
- Detects a severed telephone cable; does not require polling.
- Detects incoming ringing.
- Optionally configured for remote off-hook detection.
- Requires minimum PCB area by using single in-line package (SIP).
- Operates at low power and uses a single +5V supply.

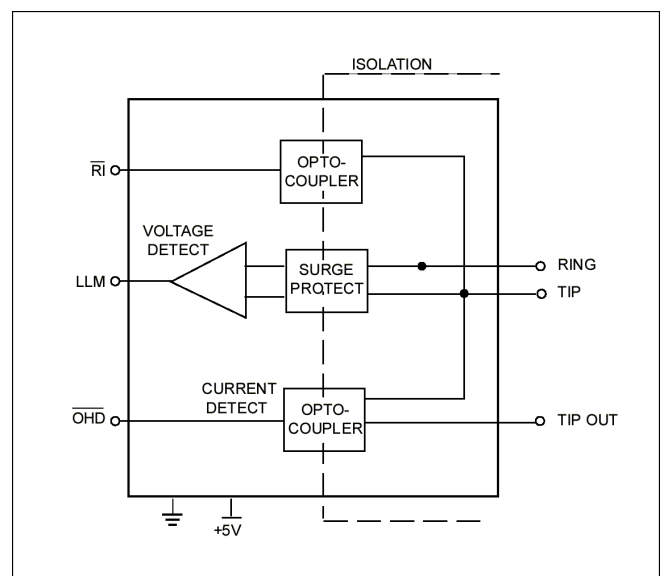


Figure 1. CH1808 Block Diagram.

All North American PSTN lines and most "wet" lease lines can use the Local Loop Voltage Loss Detect function. "Dry" leased lines may not be used with the CH1808 because there is no voltage present. When the line voltage between TIP and RING drops below 18V, the LLM output is driven high.

The LLM output has 45K Ω pull-up resistance to +5V and 2.2 μ F capacitance to ground. This is provided to filter out zero crossing pulses that occur during ringing. If the CH1808 output drive current is not sufficient, it is permissible to add a lower value resistor (not less than 1K Ω) in parallel between the output and the +5V pin, if the zero crossing pulses are not objectionable. If more drive current is needed while retaining zero cross

filtering, an external capacitor must be added to either match the existing RC time constant or to increase it.

When using the LLM circuit, external leakage and capacitance on the TIP and RING input must be minimized. Differential leakage in excess of 0.1µA may appear as a CO battery voltage to the CH1808. This could result in the CH1808 failing to detect a cut line. Similarly, capacitance on the TIP and RING lines in excess of 0.1µF could delay a cut line detection for tens of seconds. Potential sources of capacitance include devices that share the local loop such as modems and extension telephones.

Ring Detection. The CO signals an incoming call by placing a ring signal on the local loop. The CH1808 monitors the loop for this signal. The Ring Indication output \overline{RI} is normally HIGH. When the CH1808 detects ringing, the \overline{RI} output follows the ringing cycle. It is set LOW during the 2-second (typical) ring period and is restored to HIGH for the 4 seconds (typical) between rings.

False Ring Indication may occur during pulse dialing or when any device being monitored is off-hook. Therefore, \overline{RI} should be ignored whenever \overline{OHD} is active or whenever pulse dialing is taking place.

Off-Hook/Current Detection. The CH1808 supports a telephone handset connection via the TIP OUT and RING Pins. The CH1808 will provide a logic compatible indication to the host when an attached telephone is taken off-hook. The Off-Hook Detect, \overline{OHD} , will be active LOW any time the handset is removed from the telephone cradle. Because pulse dialing is achieved by repeatedly switching the telset on and off-hook, the \overline{OHD} will mirror this pulse by switching LOW and HIGH at a rate of 10 pulses per second (typical).

NOISE SUPPRESSION

The CH1808 interfaces to the PSTN line and, as such, is subject to transients produced by electrical discharge and ring voltage transitions. This may cause momentary false status change indications. While some suppression is built into the CH1808 and is adequate for most applications, additional external capacitance on the outputs may be required. Any added capacitance should be determined by appropriate analysis and testing in the particular application. Cermetek suggests that the outputs be level detected as opposed to edge detected to minimize the false indications on excessively noisy lines.

APPLICATIONS

The following are typical CH1808 applications.

Off-Hook Detect. The CH1808 can be used to deactivate a shared line TESLET device when on off-hook condition is detected in a remote device. In Figure 2, the CH1808 activates a relay which disconnects Telset 1 from the TELCO TIP line when Telset 2 is off-hook. The relay is activated when \overline{OHD} goes low.

Ring Detection. The CH1808 may be used to create a conditioned envelop wave form of the incoming ring signal. Referring to the circuitry shown in Figure 3, the 4.7µF capacitor suppresses the \overline{RI} return to HIGH during zero-crossing of the ring pulse and holds \overline{RI} to approximately 0.2V. The comparator circuit maintains a steady output when \overline{RI} is active. A NAND Gate may be substituted for the comparator circuit.

Alternatively, the \overline{RI} output from the CH1808 may be applied directly to a microprocessor input port and \overline{RI} signal debouncing can be performed with software. Note that the \overline{RI} signal frequency during ringing is twice that of the incoming ringing signal provided by the CO. The CO signal is typically 20Hz but older CO systems range from 15.3Hz to 68Hz.

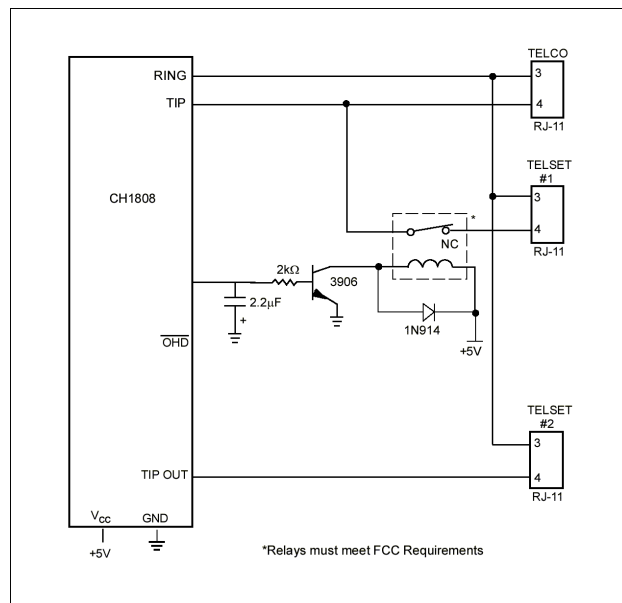


Figure 2. Dual Telset Control.

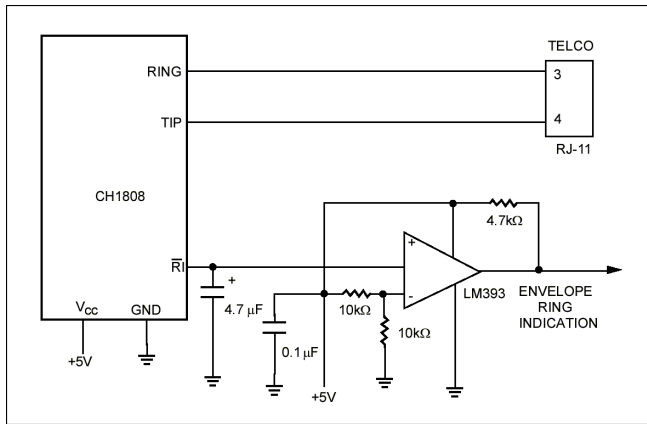


Figure 3. Ring Indicator Envelope Filter.

Remote Disconnect Detect. The Off-Hook Detect circuit may be utilized to signal when a remote call has terminated. To use the CH1808 in this mode, connect the user equipment to RING and TIP OUT as shown in Figure 4.

During a telephone call, the $\overline{\text{OHD}}$ pin is driven LOW. Once the CO detects a disconnect, the CO intentionally removes the loop current momentarily. This event can be used to signal the disconnect. The loss of loop current usually occurs within 10 to 12 seconds of the disconnect and persists for 800 to 1,000ms. The $\overline{\text{OHD}}$ output, detecting the loss of current, is driven HIGH during this event.

DESIGN CONSIDERATIONS FOR FCC CONFORMANCE

The CH1808 includes interface circuits that couple to the PSTN line and provide FCC required isolation and protection. The following guidelines should be followed to maintain FCC compliance:

1. CH1808 must be mounted away from hazardous voltages.
2. Connecting the CH1808 to PSTN lines should be made through a standard RJ-11 jack or other approved connector device.
3. Circuit board traces to the CH1808 TIP, RING, and TIP OUT pins must have a spacing to adjacent traces exceeding 0.10 inch. TIP, RING, and TIP OUT traces should have a nominal width of 0.020 inches.
4. TIP, RING, and TIP OUT traces should be as short as possible to prevent coupling with other signals. Mount the CH1808 close to the PSTN line connection.
5. No additional circuitry shall be connected between the CH1808 and the PSTN line's RJ-11C jack except as shown in Figure 4.
6. The FCC registration label included with the CH1808 must be affixed to the outside of the host product.

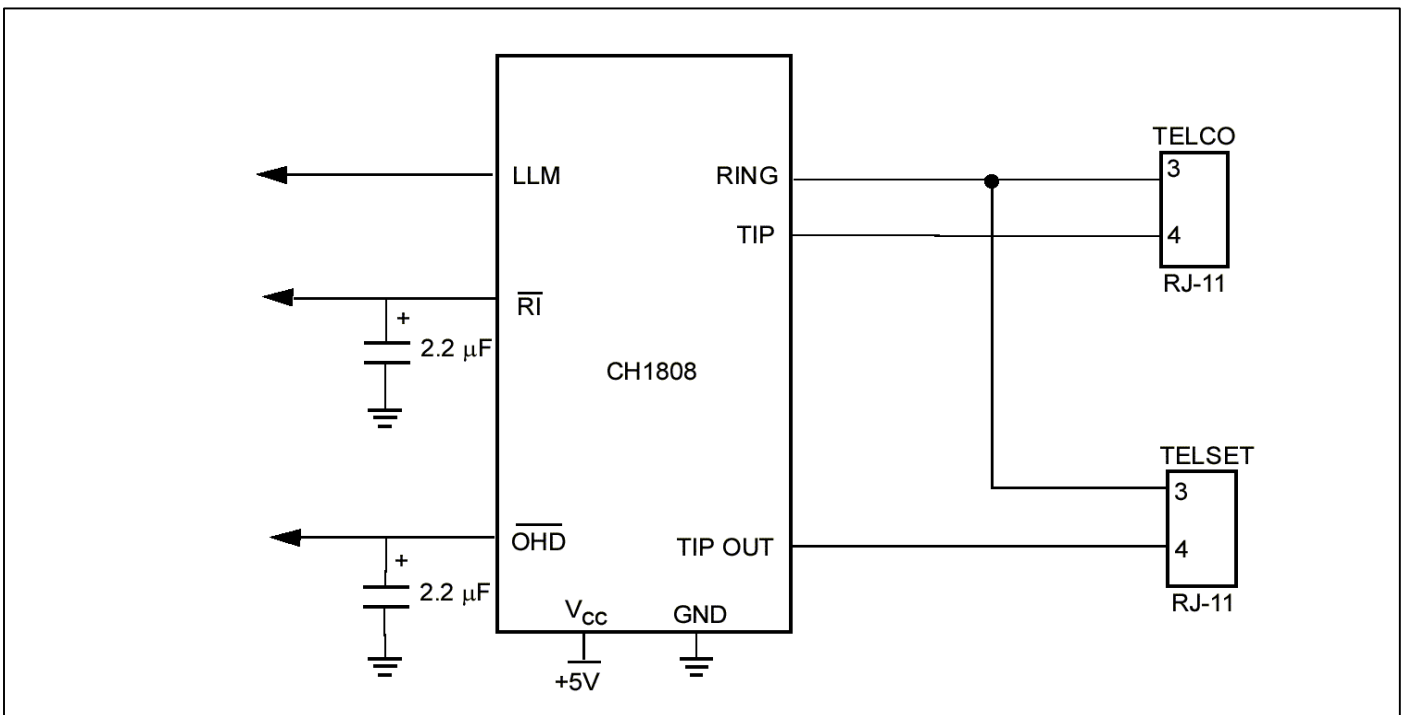


Figure 4. Disconnect Detect for Telset Unit connected to TIPOUT and RING.

USER MANUAL

The following information should be included in the host product user manual.

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 USOC RJ-11C or (USOC RJ45S). Connection to the telephone company provided coin service (CO implemented systems) is prohibited. Connection to party line service is subject to state tariffs.

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

If you have any questions about your telephone line, such as how many pieces of equipment you can connect to it, the telephone company will provide this information upon request.

In certain circumstances, it may be necessary for the telephone company to request information from you concerning the equipment you have connected to your telephone.

Upon request by the telephone company, provide the FCC registration number and the ringer equivalence number (REN) of the equipment connected that is connected to your line; both of these items are listed on the equipment label. The sum of all the RENs 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 usable on a given line.

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

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

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 such specifications and/or inspections will be provided to the FCC within 30 days of their request for same.

Table 1. CH1808 Pin Descriptions.

Pin	Name	I/O	Function
1	RING	I/O	Telco/Telset Port. Direct connection to the RING lead of a telset and RING lead of the telephone line through a standard RJ11 jack. PSTN or two-wire "wet" leased line connection required.
2	TIP	I/O	Telco Port. Direct connection to the TIP lead of the telephone line through a standard RJ11 jack. PSTN or two-wire "wet" leased line connection required.
3	TIP OUT	I/O	Telset Port. Direct connection to the TIP lead of a telset.
4	OHD	O	Off-Hook Detect. Active LOW when telset device is connected to TIPOUT and RING. When the telephone handset is removed from its cradle, OHD is driven LOW. Once active, OHD will momentarily be driven HIGH after disconnect of telset connected to TIPOUT and RING.
5, 9, 10	GND	I	Ground. Signal and power common ground. Pins 5, 9, and 10 are internally connected.
6	RI	O	Ring Indication. Active LOW. RI is driven LOW during the 2 second (typical) ring period and HIGH during the 4 seconds(typical) between rings. RI is otherwise HIGH (i.e., when no ring is present).
7	V _{CC}	I	+5V: Positive Supply. This supply is +5.0VDC \pm 10%.
8	LLM	O	Local Loop Monitor. Active HIGH. LLM is driven HIGH when the local loop is severed or when another device on the local loop is off-hook.

Table 2. CH1808 Electrical Specifications.

$$V_{CC} = +5V \pm 10\%$$

$$T_A = 0^\circ \text{ to } 55^\circ\text{C UNLESS OTHERWISE SPECIFIED}$$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
LOGIC						
Output high	V _{OH}	IOH = 40mA	2.4			V
Output low	V _{OL}	IOL = 1.0mA			0.4	V
TELEPHONE LINE INTERFACE						
Line Resistance	R _L	Tip to Ring	7			M ohms
Input Resistance	R _I	Tip or Ring to any other pin	30		1500	M ohms
Surge Protection		Conforms to all FCC Part 68 surge, hazardous voltage, and leakage requirements				V
LLM Threshold Voltage	V _{LLM}	Voltage across Tip and Ring	16	18	20	V
LLM Detection Time	I _D	CX = 0.001 μ F (Tip or Ring to GND) VCX = 50V (Tip to Ring)		1		sec
OHD Threshold Current	I _D	Current from Tip to Tip Out		5	10	mA
Loop Current	I _{LOOP}	Current from Tip to Tip Out	2		100	mA
Ring Detect Threshold		15.3 to 68Hz	20		130	V _{rms}
Leakage Current	I _L	Leakage to Tip to Ring	40		0.1	mA
POWER						
Leakage Current	I _{CC}	Supply Voltage = +5V		2	5	mA

Table 3. Summary of CH1808 Family of Products.

Model	Summary of Features	Operating Temperature
CH1808	FCC Part 68 Approved	0°C to +70°C

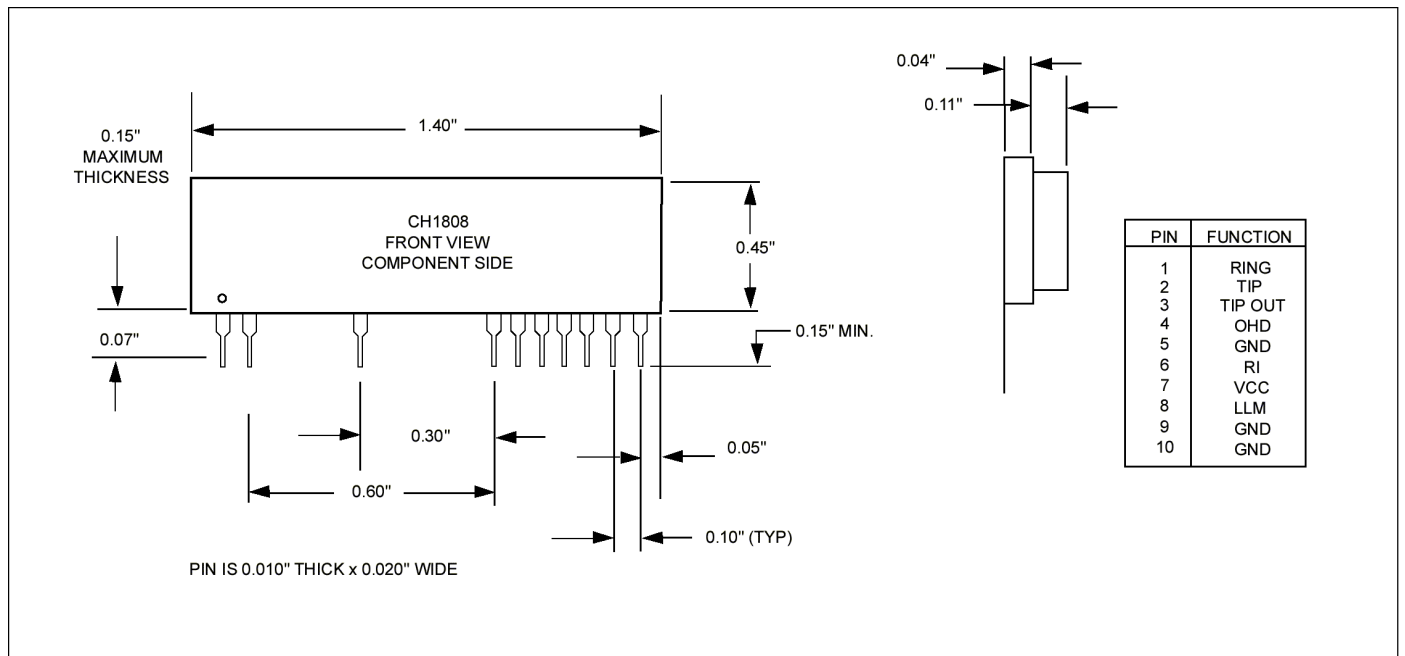


Figure 5. CH1808 Physical Dimensions and Pin Functions.

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