T-75-37-05

CH1814, CH1828 and CH1830
International Telephone Line Interface Modules

INTRODUCTION

Products that are designed to connect directly to the telephone line such as modems, FAX machines or automated voice products must do so through a circuit called a DAA (Data Access Arrangement) approved by the government agency that controls the telephone system. These agencies are often called PTTs (Postal, Telephone and Telegraph). These agencies test products to assure that they meet or exceed the government specifications. This is necessary in order to protect the phone system and its users. Unfortunately, passing these tests and waiting for PTT approvals can take many months and significantly compromise the timely introduction of a product.

The Cermetek international telephone line interface components have been designed to accelerate this approval process. This does not mean that you can avoid the PTT approval process. However, if you properly select and then apply one of these components, your design time and the electrical testing portion of the approval process will be minimized.

DAA Selection

Although the CH1814, CH1828/CH1830 provide fundamental DAA functions, the CH1828/CH1830 also provides additional functions and a higher isolation rating.

CH1814 Fundamental DAA Functions

Line Termination and Impedance Matching
Surge and Isolation Protection
Ring Detection
On/Off-Hook Control
Dial Masking Provision

CH1828 Fundamental DAA Functions

Line Termination and Impedance Matching
Surge and Isolation Protection
Ring Detection
On/Off-Hook Control

FEATURES

- Modem speeds to V.32 PSTN, V.32 bis (CH1830 only)
- High voltage isolation and surge protection
- Designed to accelerate approval process
- Ring detection
- On/off-hook control
- Provisions for Pulse Dial Masking
- PC board mountable
- Pin compatible with domestic DAAs
- Supports European and international PTT requirements
- Compatible with all modem chip sets

CH1828 Fundamental DAA Functions (cont'd)

Internal Dial Masking
Internal 2-Wire to 4-Wire Signal Conversion
Higher Isolation Protection

CH1830

The CH1830 is electrically and functionally identical to the CH1828 with the following exceptions. The CH1830 is a high performance, high speed DAA data product used for full duplex modem applications above 4800 bps. While designed to give excellent response at 9600 baud and above, the DAA can also operate down to 300 baud. The CH1830 is ideal for international high speed modem applications such as V.32, V.33, and V.29 modems. It has the same pin footprint as the CH1828, except for pins 21/22, and is physically smaller in body size.

The later sections of this data manual will describe these functions in more detail. You will need to compare the specifications of the components with the requirements of the PTT for each country where you intend to market your products.

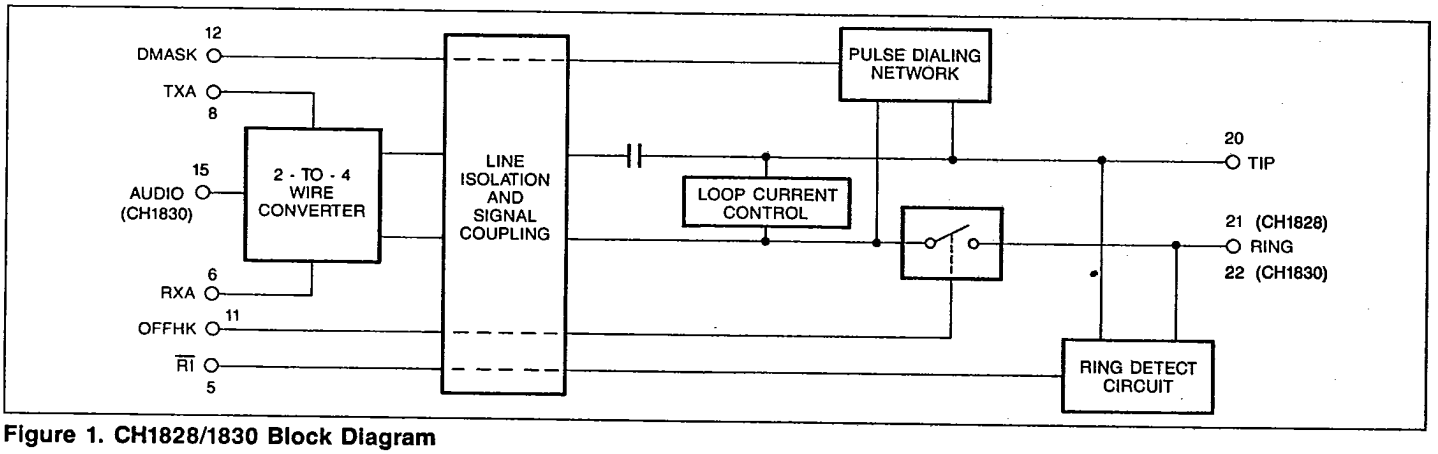


Figure 1. CH1828/1830 Block Diagram

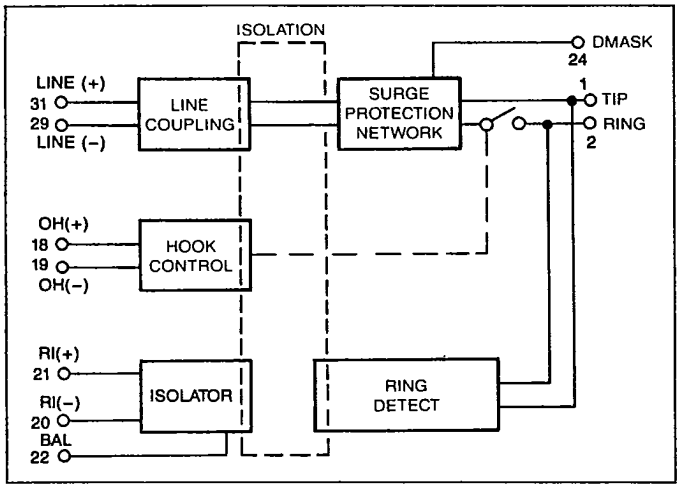


Figure 2. CH1814 Block Diagram

CH1828/CH1830 FUNCTIONAL DESCRIPTION

THE CH1828/CH1830 is designed to meet the high isolation voltage requirements of some PTTs, such as the U.K.'s Reinforced Barrier specified in BS6301. In addition to loop current control, ring detection, and signal coupling, the CH1828/CH1830 incorporates an internal compensation circuit for pulse dialing as well as a 2- to 4-wire converter circuit. These features make the CH1828/CH1830 easy to incorporate into your design with a minimum of additional components.

Figure 3 shows a typical application using the CH1828/CH1830. In many cases the control I/O is provided by either the modem or the UART.

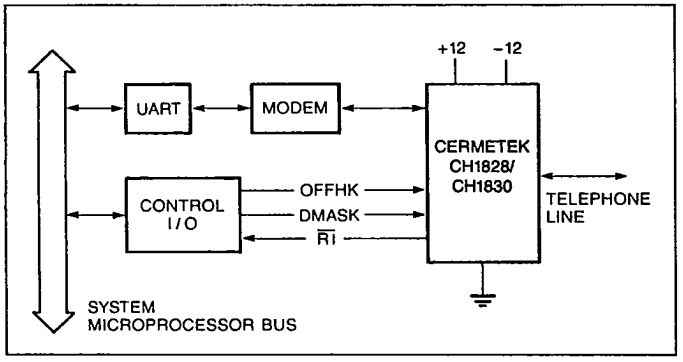


Figure 3. CH1828/CH1830 Typical Application

The operation of the CH1828/CH1830 DAA can be broken into four major functional blocks:

1) Ring Detection
2) Loop Control and Pulse Dialing
3) 2-wire and 4-wire Converter
4) Isolation

The following paragraphs describe each of these functional blocks. Refer to Figure 1.

Ring Detection

The ring detection circuit is designed to provide a normally HIGH output at $\overline{RI}$ unless ring voltage is present between Tip and Ring. The output goes LOW as long as the ring voltage is present, then returns to HIGH. This circuit is also designed to reject false ring indications due to pulse dialing by other devices on the same line (sometimes called anti-tapping).

To prolong the life of the loop current relay, it is best to assure the $\overline{RI}$ is HIGH before setting OFFHK to HIGH when answering a call.

Hook Control and Pulse Dialing

OFFHK determines whether the CH1828/CH1830 is ON HOOK or OFF HOOK. When OFFHK is HIGH, the CH1828/CH1830 is placed OFF HOOK. When this signal is LOW, the CH1828/CH1830 is ON HOOK. Except when dialing a call, DMASK should be held LOW.

By using the OFFHK and DMASK inputs together, the CH1828/CH1830 can pulse dial. First OFFHK must be set HIGH to enable loop current at Tip and Ring, then DMASK must be set HIGH and remain HIGH throughout the dialing process. Then OFFHK can be toggled to provide the dialing pulses on Tip and Ring. Typically pulse dialing requires a MAKE duration of nominally 33 ms and a MAKE/BREAK ratio of 67%+5%–4%. The pulsing rate must be 10±1 pulses per second. DMASK must remain HIGH until after the last pulse of the digit. See Figure 4.

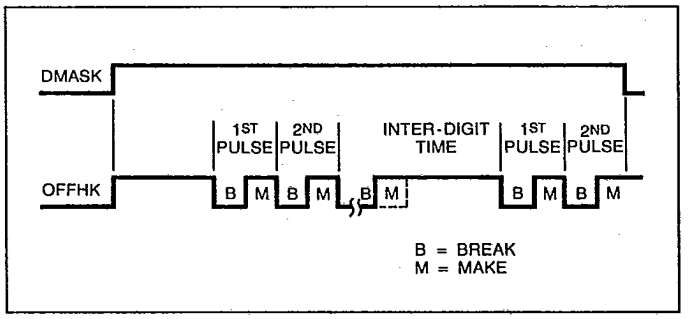


Figure 4. Pulse Dialing Diagram

2- to 4-Wire Converter

This block performs two functions. First it accepts single ended analog inputs from TXA and couples the signal onto Tip and Ring. The signal is attenuated by 10dB so that a 0dBm input at TXA will appear at Tip and Ring as a signal that is below –9dBm.

This block's second function takes analog signals present on Tip and Ring, converts them to single ended analog and subtracts the TXA signal. Thus signals transmitted through the phone line are presented at RXA. The signal at RXA will contain a component of the TXA signal, but this component will be at least 12dB below the TXA signal level.

Isolation

To protect users and equipment from transients that may occur on the phone line, the CH1828/CH1830 maintains isolation between Tip and Ring signals and all other interface pins that will not break down under a voltage exceeding 4 KV_{rms}. This level of isolation exceeds the most stringent requirements of many PTTs for equipment connecting to the phone line.

Table 1
CH1828/CH1830 Interface Signals

PIN	NAME	FUNCTION
		AUDIO SIGNALS
6	RXA	**RECEIVE AUDIO** output. Analog signals appearing between Tip and Ring are coupled to this output. The RXA output is symmetrical with respect to ground and external AC coupling must be used if driving other than ground bias audio circuits.
8	TXA	**TRANSMIT AUDIO** input. Analog signals to be coupled through to the phone line. The hybrid circuit will reduce signals transmitted at TXA by at least 10dB. This input is D.C. coupled to the 2-wire to 4-wire conversion circuit.
15	AUDIO	**AUDIO OUTPUT** - Monitors audio signal on Tip and Ring. Used for call progress tone monitoring as input to speaker amplifier (CH1830 only)
20	TIP	Telephone line connection.
21	RING	Telephone line connection. (CH1828 only)
22	RING	Telephone line connection (CH1830 only)
		LOGIC SIGNALS
5	$\overline{RI}$	**RING INDICATE** output. This output is normally HIGH. It is LOW while ringing voltage appears between Tip and Ring.
11	OFFHK	**OFF HOOK** input. When this input is LOW, the telephone line loop current is broken. When HIGH, loop current is restored. When used in conjunction with DMASK, this input is also used to control pulse dialing.
12	DMASK	**DIAL MASK** input. For some PTTs it is necessary to alter the impedance at Tip and Ring while pulse dialing. When this input is LOW, the CH1828 is conditioned for normal operation. When HIGH, the CH1828 is conditioned for pulse dialing.
		POWER INPUTS
1	+12V	Positive Supply Input. +12 Volts DC ±10%
10	−12V	Negative Supply Input. −12 Volts DC ±10%
3, 4	GND	Signal and Power Common

CH1814 FUNCTIONAL DESCRIPTION

The CH1814 is a compact phone line interface designed to meet the requirements of many PTTs for isolation, ON/OFF Hook control, pulse dialing and ring detection. The basic elements of the CH1814 are shown in Figure 1.

Connection To The Host

Connection to the host can be made through user supplied circuitry similar to that shown in Figure 5. The interface signals to this circuitry are labeled:

TRXCAR - Transmit Carrier or Audio
RCVCAR - Receive Carrier or Audio
RI - Ring Indication
OH - On-Hook
GROUND - Common for all signals

This interface circuitry implements four separate functions:

1) 2- to 4-wire converter
2) Line On-Hook/Off-Hook Control
3) Ring Detector
4) Impedance correction during pulse dialing

2- to 4-Wire Converter

In most applications it is necessary to have separate transmit and receive audio paths. On the telephone line and at LINE(+)/LINE(−) of the DAA, the transmit and receive audio appear simultaneously. A circuit called a 2- to 4-Wire Converter is used to separate the two. The two op-amps and associated resistors at TRXCAR and RCVCAR provide this function. (Figure 5)

The transmit signal (TRXCAR) level is adjusted by the top op-amp and applied to the line matching resistor RM. RM=402 ohms is optimum for a 600 ohm phone line. The DAA couples this signal to the phone line. The combined transmit and receive signals appear at LINE(+). The lower op-amp subtracts the transmitted signal from the combined signals to leave only the received signal at RCVCAR. The accuracy of this subtraction process depends on how close to 600 ohms the phone line actually is. Generally a small amount of the TRXCAR signal will appear at RCVCAR. The ratio of the signal applied to the signal returned is called Trans-hybrid rejection. For phone lines that are 600 ohms ±30%, this circuit will yield a rejection of at least 10dB.

The 2- to 4-wire converter performance is defined by resistors R_1 through R_5. By correctly choosing these values, the transmit and receive path gain can be controlled in addition to its primary function which is transmit signal subtraction. They assume RM equals 402 ohms and also compensates for the DAA's inherent transmit and receive insertion loss.

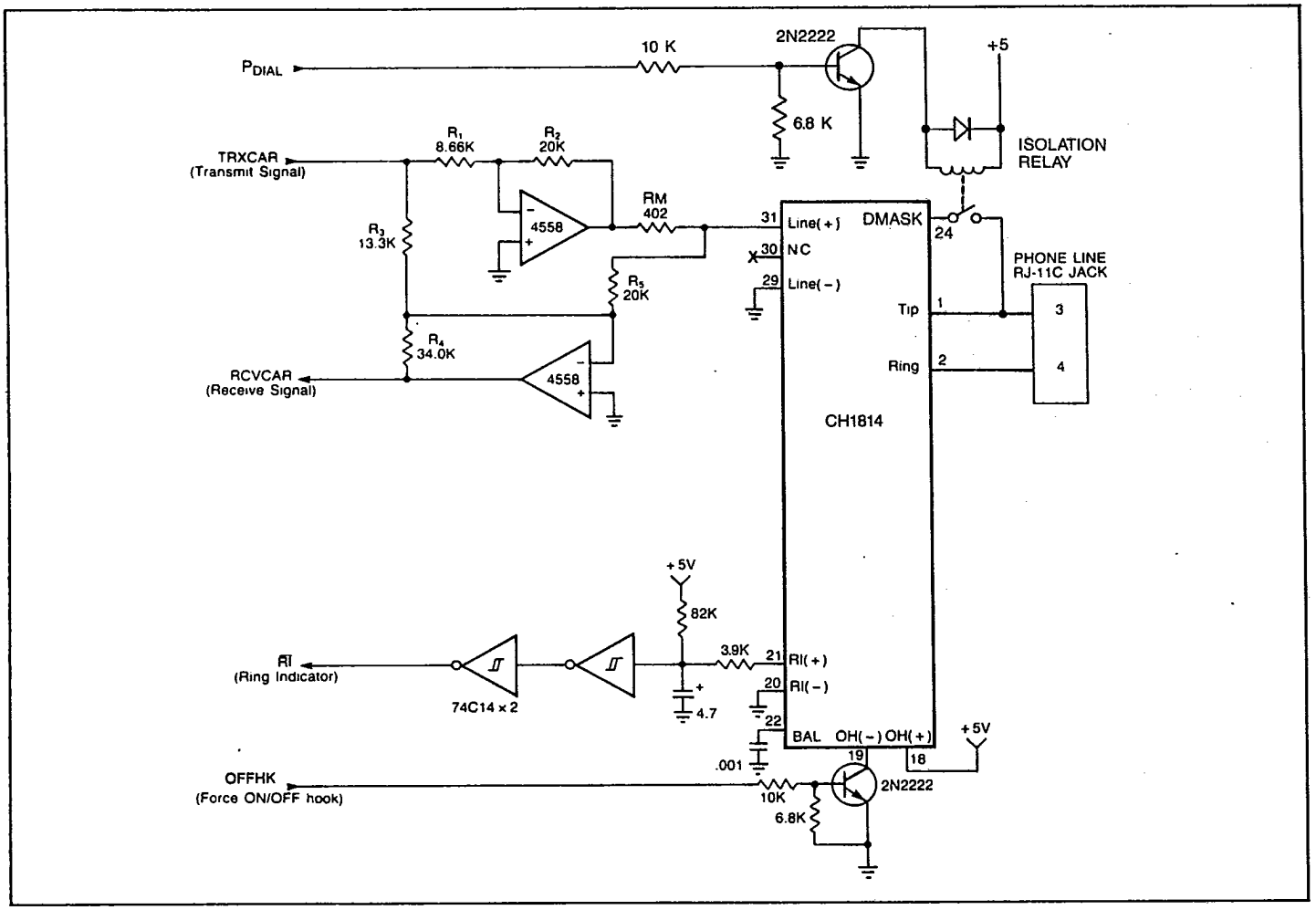


Figure 5. CH1814 Typical Application

Transmit Path Gain

$$\frac{VTIP/RING}{VTRXCAR} = \frac{R_2}{2.3 \bullet R_1} = Gtx$$

Receive Path Gain

$$\frac{VRCVCAR}{VTIP/RING} = \frac{R_4}{1.7 \bullet R_5} = Rtx$$

Transmit Signal Rejection

$$\frac{R_2 R_3}{R_1 R_5} = 1.53$$

To demonstrate the method we will solve the equations assuming a requirement for both transmit gain (Gtx) and receive gain (Grx) equal to 1.

This still leaves us with five unknowns and three equations. So we arbitrarily select values for R_2 and R_5.

R_2 = 20K ohms
R_5 = 20K ohms

Substituting these values into equations 1.0 and 2.0 and solving for R_1 and R_4 yields.

R_1 = 8.66K
R_4 = 34.0K

Rearranging equation 3 gives:

$$R_3 = \frac{1.53 \bullet R_1 \bullet R_5}{R_2}$$

or R_3 = 13.3K

It is recommended that these resistor values be rounded to the nearest 1% tolerance resistor value.

Ring Detector

The RI(+) and RI(−) are outputs from an open collector opto-isolator as shown in Figure 5. The RI(+), RI(−) and BAL present the raw ring detect indication. The circuitry shown converts this raw output to a signal called $\overline{RI}$. $\overline{RI}$ is normally HIGH. When the telephone company central office applies a ringing signal to the phone line, $\overline{RI}$ will go LOW for the nominally 2-second ring period and HIGH for the nominally 4-seconds between rings. This circuit also helps prevent false ring indication from noise on the phone line.

To reduce the component count, the circuit shown in Figure 6a can feed directly to a microprocessor input port and the signal debouncing can be done in software. The pulse frequency during the ring is twice that of the signal from the phone company central office (CO).

With either of these circuits a potential exists for false ring indications during pulse dialing of the DAA or by an extension phone on the same line. The Ring Detect signal should be ignored any time the DAA is OFF-HOOK and especially when pulse dialing.

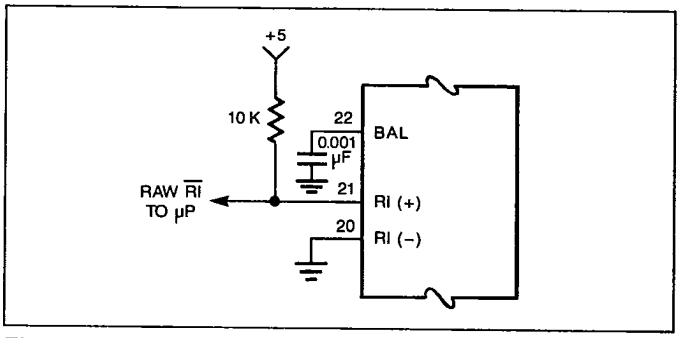


Figure 6a. Simple Ring Detect

Hook Control

The DAA will seize the 2-wire telephone line (go Off-Hook) when 4 to 6 volts are applied from OH(–) to OH(+). This allows ON/OFF Hook control from a single 5-volt supply via an inexpensive 2N2222 transistor, as can be seen in Figure 6b.

Operation from supplies higher than +5 volts can be accommodated by adding a current limiting resistor from OH(+) to the supply voltage. See Z_{onhk} under Electrical Specifications. A +12 volt supply configuration would require a 680 ohm limiting resistor.

Assertion of OFFHK HIGH takes the telephone line Off-Hook while assertion LOW places the line On-Hook.

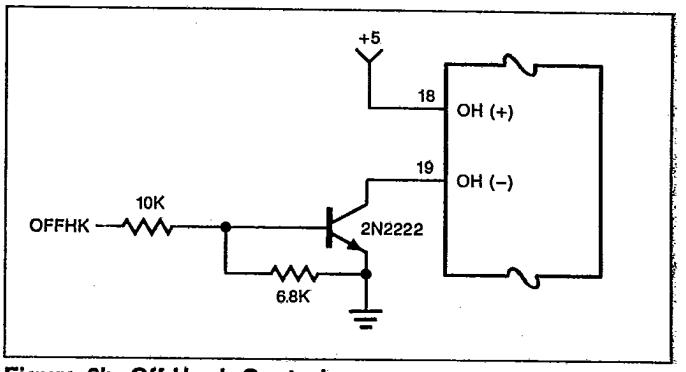


Figure 6b. Off-Hook Control

Pulse Dialing

The OH inputs can also be used to control pulse dialing. However, some PTTs require the DAA to present a different impedance to the phone line during pulse dialing. This change is controlled by a relay connected between DMASK and Tip as shown in Figure 5 where the relay is controlled by the input signal PDIAL. Normally PDIAL is held low. PDIAL is set HIGH before pulse dialing is started and held HIGH until after pulse dialing has been completed. See Figure 4.

Mounting the DAA

Cermetek's DAAs can be soldered directly to the host circuit board or installed in sockets. To avoid the problems of flux contamination, hand soldering is preferred to wave soldering. Many socket manufacturers offer socket strips that accept the 0.025 inch square pins on 0.10 inch centers. When using sockets, mechanical restraint of the DAA should be provided to keep the component seated through vibration and shock.

Table 2
CH1814 Pin Descriptions

PIN	NAME	FUNCTION
1 2	TIP RING	TIP and RING directly connect to the telephone line.
18 19	OH(+) OH(–)	OH(+) and OH(–) are hook switch inputs. Applying from 4 to 6 volts from OH(–) to OH(+) causes the DAA to take the telephone line off-hook. See Figure 6b.
20 21	RI(–) RI(+)	RI(+) and RI(–) are ring indication outputs. During phone line ringing, a LOW and HIGH impedance results from RI(+) to RI(–).
22	BAL	Balance for the ring indicator. An 0.001 µF ceramic disc capacitor should be connected from BAL to ground.
24	DMASK	Pulse Dial and Masking.
29 31	LINE(–) LINE(+)	Audio coupling path for telephone line.

Table 3
CH1828/1830 Electrical Specifications*
T_A = 0°C to 55°C UNLESS OTHERWISE SPECIFIED

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
LOGIC						
Input high	V_{IH}	IH = 0.2mA	3.0			V
Input low	V_{IL}	IL = −10μA	−.3		.8	V
Output high	V_{OH}	I_{OH} = .2mA	3	4.5	5.0	V
Output low	V_{OL}	I_{OL} = 3.2mA	0.0	.3	.4	V
Telephone Line Interface Return Loss	L_{RET}	600 Ohm line termination	14			dB
Transmit Level	V_{TRX}	Measured @TRXCAR 3 sec. average	.695	.73	.774	V_{RMS}
Transmit Insertion loss	G_{TRX}	Measured @2kHz	9	10		dB
Receive Insertion loss	G_{RCV}	Measured @2kHz		0		dB
Trans-hybrid loss (CH1828)	G_{TH}	600 Ohms ±30% between TIP and RING	12	15		dB
Trans-hybrid loss (CH1830)			15	18		dB
On-Hook Impedance	Z_{ONHK}	OFFHK - 0 Volts	10			MOhms
Loop Current	I_{LOOP}	From TIP to RING (OH = 5 volts)	20		60	mA
Receive Output Impedance	Z_{RCN}	Measured @RCVCAR		75		Ohms
Transmit Input Impedance	Z_{TRX}	Measured @TRXCAR	14			KOhms
Power Supply Current	I_{CH}	+12V ±10%, OFFHK - High			50	mA
	I_{CL}	−12V ±10%			20	mA
Isolation	V_I	Tip and Ring to all other pins	4000			V_{RMS}
BABT Certificate Number	CR/0058 (CH1828)	Application note available for BABT approval				

*Parameters are specified for BABT. Other versions of CH1828/CH1830 are available for other international telephone authorities.

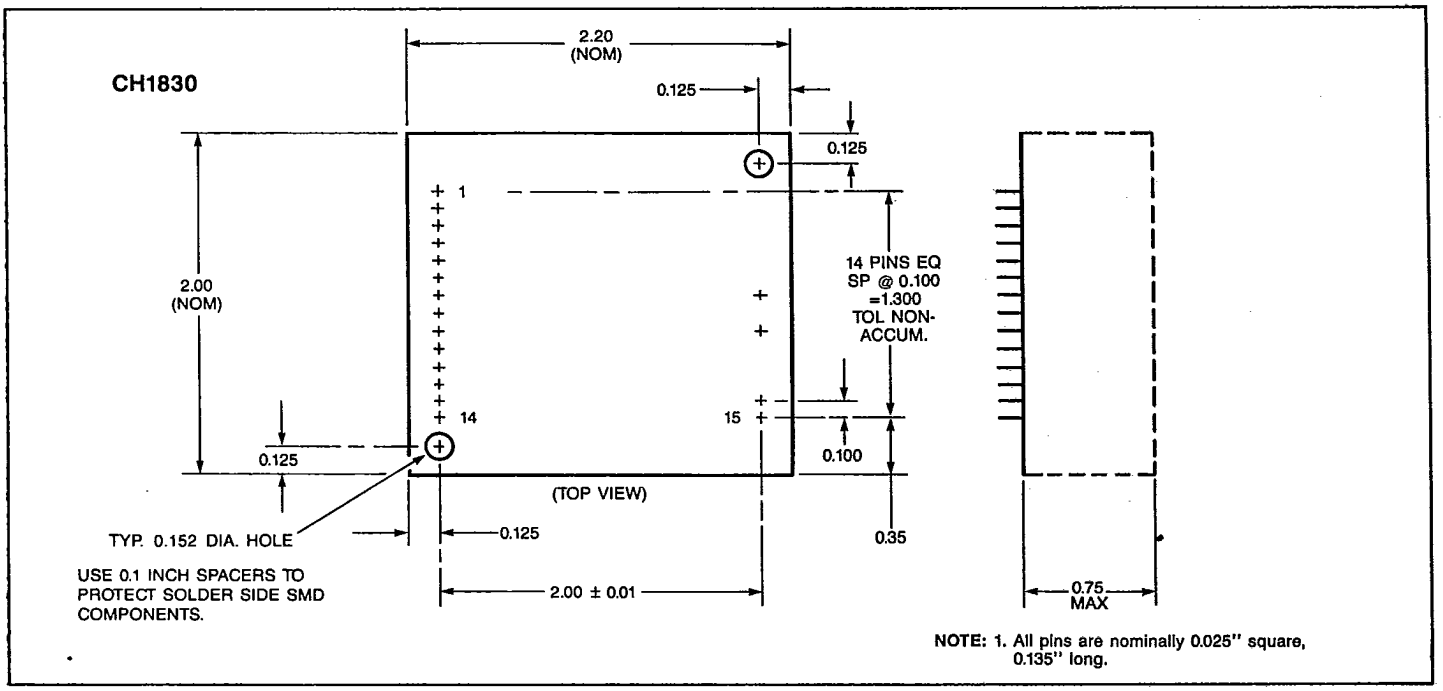


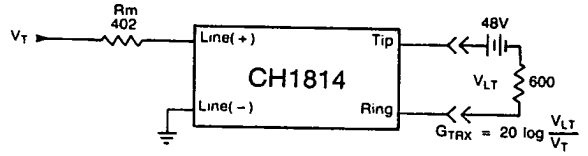
Figure 7. CH1830 Physical Dimensions

Table 4

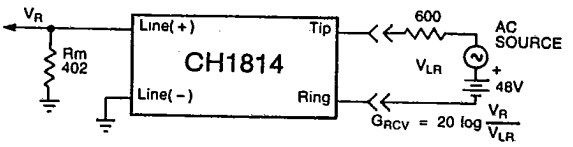
CH1814 Electrical Specifications

T_A = 0°C to 55°C UNLESS OTHERWISE SPECIFIED

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Transmit Insertion loss	G_{TRX}	Z_{LINE} = 600 Ω R_M = 402 Ω Test Circuit 1	6.0	7.2	8.4	dB
Receive Insertion loss	G_{RCV}	R_M = 402 Ω Test Circuit 2	3.4	4.6	5.8	dB
On-Hook Impedance	Z_{ONHK}		10			MOhms
Off Hook Loop Current	I_{LOOP}		20		100	mA
Line Match Resistor	R_m			402		Ohms
Hook Switch Control Impedance				500± 10%		Ohms
On-Hook Voltage		Measured between OH(+) and OH(–)	0.0		0.5	V
Off-Hook Voltage		Measured between OH(+) and OH(–)	4.0		6.0	V
Ring Detect Output Leakage	$I_{LEAKAGE}$	V_{CE} = 10V			50	nA
	I_{ON}	V_{CE} = 30V			100	mA
	V_{SAT}	I = 0.5 mA			0.3	V
Ring Detect Duty Cycle		15.3 to 68 Hz	50	75		% On
Ring Detect Threshold		15.3 to 68 Hz	23			V_{RMS}
Isolation Voltage	V_I	Tip and Ring to all other pins	1500			V_{RMS}
BABT Certificate Number	CR/0055	Application note available for BABT approval				



TEST CIRCUIT 1



TEST CIRCUIT 2

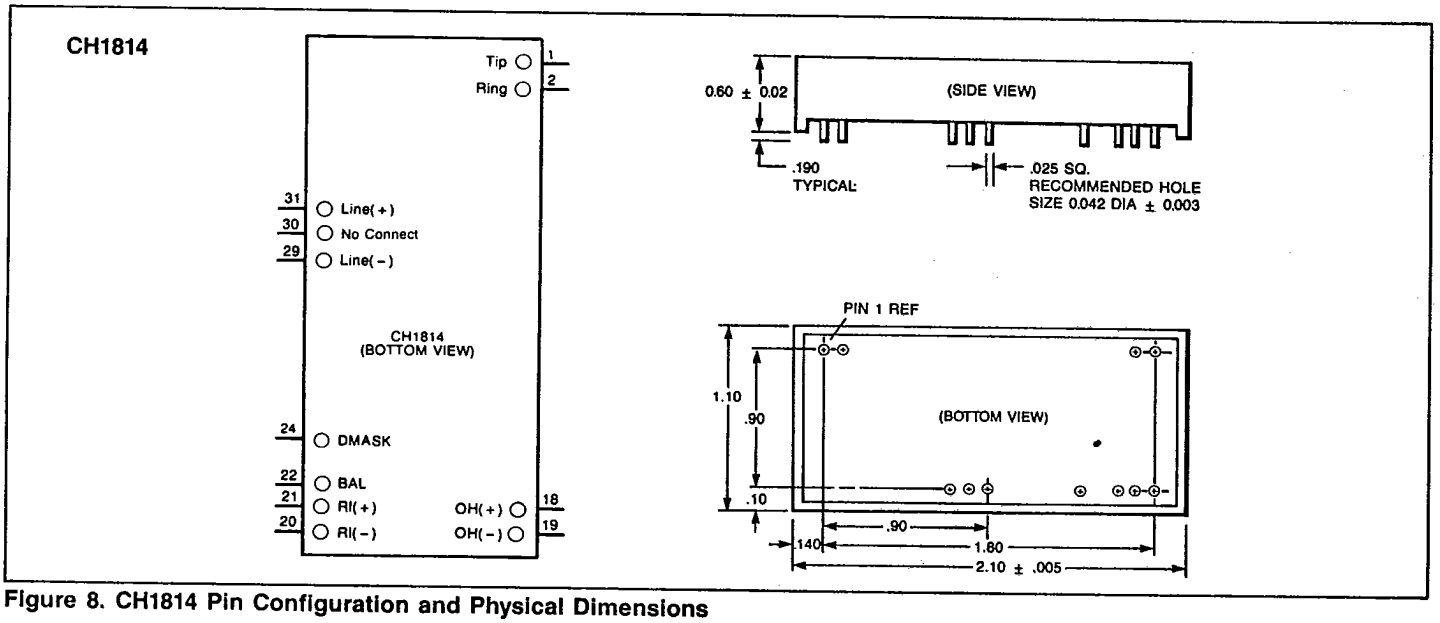


Figure 8. CH1814 Pin Configuration and Physical Dimensions

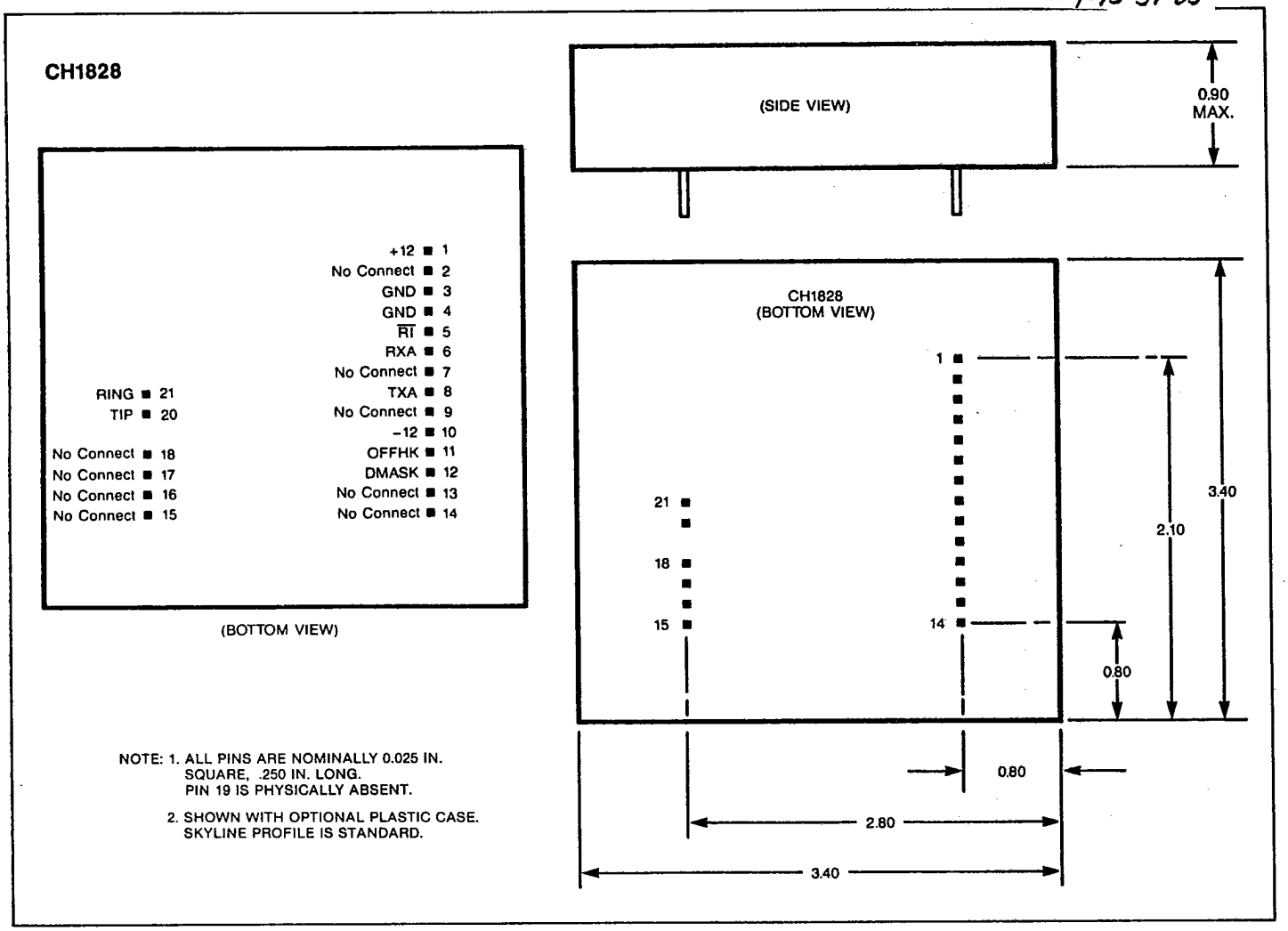


Figure 9. CH1828 Pin Configuration and Physical Dimensions