

**Features**

- FAX and Modem interface (V29/V22 bis)
- Variants match German, UK & 600Ω network impedances
- Provides reinforced barrier to international PTT requirements
- Transformerless 2-4 Wire conversion
- Loop start operation
- Pulse and DTMF operation
- Accommodates external monitor phone
- Line state detection outputs:
- -loop current/ringing outputs
- Single +5V operation, low idle power (5mW)
- Full Duplex
- Suitable for power down applications

**Applications**

Interface to Central Office for:

- DAA
- Modem
- FAX
- Answering Machine
- Terminal Equipment

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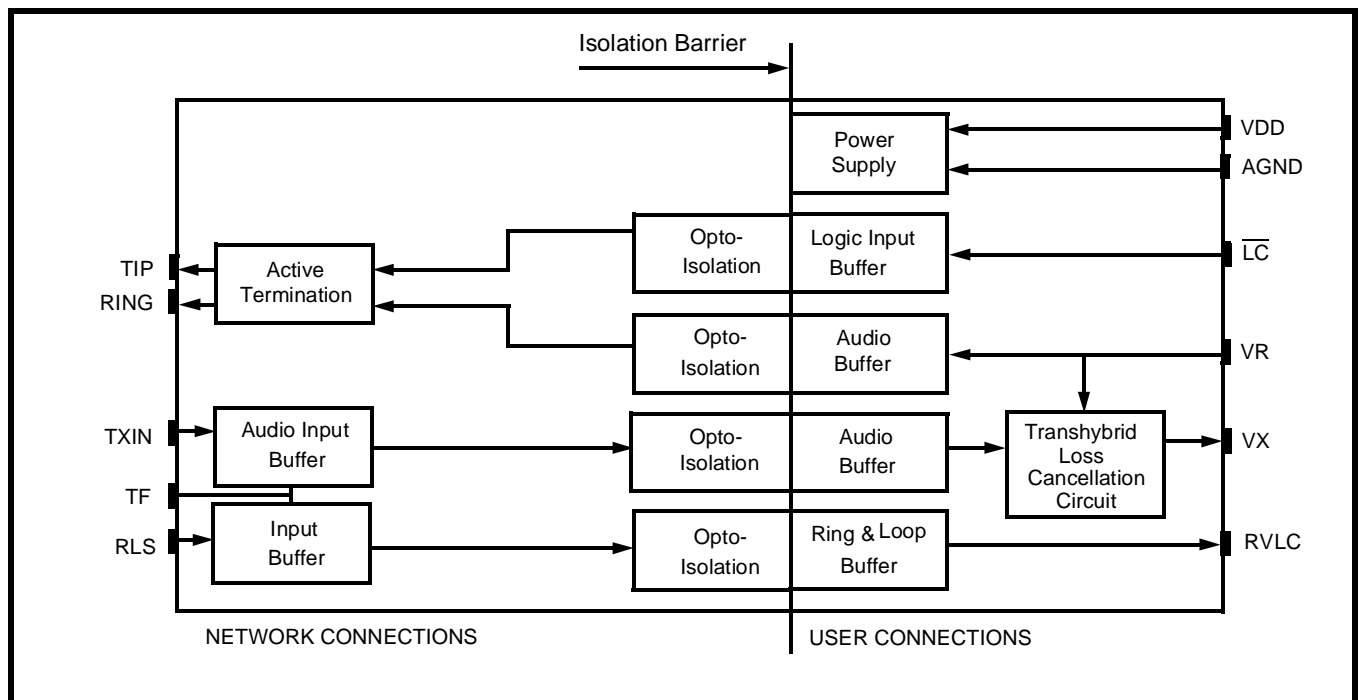
**Ordering Information**

MH88422-1	14 Pin DIL Package
MH88422-2	14 Pin DIL Package
MH88422-3	14 Pin DIL Package
Surface Mount Options are available by adding the Suffix "S"	

**Description**

The Mitel MH88422 Line Interface Circuit provides a complete audio and signalling link between audio equipment and central office. The functions provided by the MH88422 include 2-4 Wire conversion, loop seizure, ring voltage and loop current detection. The device is fabricated as thick film hybrid which incorporates various technologies for optimum circuit design, high voltage isolation and very high reliability.

Variants are provided to meet German (-1) and UK (-3) line impedance (see section on Line Impedances), as well as a 600Ω variants (-2).


**Figure 1 - Functional Block Diagram**

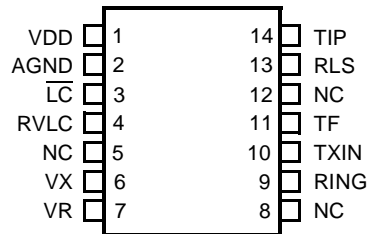


Figure 2 - Pin Connections

## Pin Description

Pin #	Name	Description
1	VDD	<b>Positive Power Supply Voltage.</b> +5V.
2	AGND	<b>Analog Ground.</b> 4-Wire Ground. Normally connected to System Ground.
3	$\overline{\text{LC}}$	<b>Loop Control (Input).</b> A logic low activates internal circuitry which provides a dc termination across Tip and Ring. Used for seizing the line and dial pulsing.
4	RVLC	<b>Ring Voltage and Current Detect (Output).</b> A logic low indicates that loop current is detected. The loop current can be due to the external monitor phone or the MH88422 in the off-hook mode. The RVLC output pulses when the external monitor phone is dial pulsing or when the MH88422 is dial pulsing via the $\overline{\text{LC}}$ input. In addition, when the MH88422 is on the on-hook mode, a pulsing output indicates ringing voltage across the Tip and Ring leads. The pulsing output frequency is twice the ringing frequency.
5	NC	<b>No Connection</b> should be made to this pin.
6	VX	<b>Transmit (Output).</b> 4-Wire ground (AGND) referenced audio output, biased at 2.5V. Outputs in off-hook mode only.
7	VR	<b>Receive (Input).</b> 4-Wire ground (AGND) referenced audio input, biased at 2.5V. $\overline{\text{LC}}$ must be activated low and loop current must be flowing.
8	NC	<b>No Connection</b> should be made to this pin.
9	RING	<b>Ring Lead.</b> Connects to the "Ring" lead of the central office through an optional relay contact. The central office "Tip" and "Ring" leads may be interchanged.
10	TXIN	<b>Transmit (Input).</b> Connects to the "Ring" lead of the central office through a coupling capacitor.
11	TF	<b>Tip Feed.</b> Connects to the "Tip" lead of the central office through an internal resistor and an optional external resistor.
12	NC	<b>No Connection</b> should be made to this pin.
13	RLS	<b>Ring Loop Sense (Input).</b> Sense node for ringing voltage detector and the loop current detector.
14	TIP	<b>Tip Lead.</b> Connects to the "Tip" lead of the central office through an optional relay contact. The central office "Tip" and "Ring" leads may be interchanged.

## Functional Description

The MH88422 Line Interface Circuit is a COIC (Central Office Interface Circuit) used to interface FAX's Modems or user defined equipment to Central Office 2-Wire Analog Trunks.

## Opto-Isolation

The isolation barrier is designed to meet regulatory requirements for a reinforced barrier of 3kVac. It provides full isolation of mains voltages up to 250V RMS and all telecom voltages.

In order that this barrier is not bypassed a creepage/clearance distance of 6.4mm minimum must be maintained between wiring, pcb tracking, etc., connected to external circuitry on either side of the barrier. To make this requirement simpler, pins on the MH88422 connected to opposite sides of the barrier are on opposite sides of the package.

## External Protection Circuit

To meet regulatory high voltage requirement, an external protection circuit is required. The protection circuit shown in Figure 3 (Clamp Diode D1) is recommended.

## DC Loop Termination

The DC loop termination circuitry provides the loop with an active DC load termination when a logic low is applied to the LC (Loop Control) input. The termination is similar to a resistance of approximately 300Ω (loop current dependent). Internal optically isolated circuitry is used to switch the termination in and out the loop. This is used for both seizing the line as well as generating dial pulses. The MH88422 will not seize the line when powered down.

## Supervision Features

The supervision circuitry is capable of detecting ringing voltage and loop current as well as the status of an optional external monitor phone. The RVLC (Ring Voltage Loop Current Detect) output provides a logic low when loop current flows due to the external monitor phone or the MH88422 being in the off-hook mode.

The RVLC outputs pulses when the external monitor phone is dial pulsing or when the MH88422 is dial pulsing via the LC mode.

In addition, when the MH88422 is on-hook, a pulsing output indicates that ringing voltage is across the tip and ring leads; the pulsing output frequency is twice the ringing frequency. See Figure 3.

Ringing frequency may require external validation. An RC monostable is usually satisfactory for this purpose or this may also be achieved using software applications.

## 2-4 Wire Conversion

The 2-4 Wire conversion circuit converts the balanced full duplex signal at Tip and Ring of the central office line into a transmit ground referenced signal at VX (Transmit) of the MH88422. It also converts the receive ground referenced signal at VR (Receive) of the MH88422 into a balanced transmit signal at Tip and Ring of the central office line.

In full duplex transmission, the Tip-Ring signal consists of an audio signal from the central office as well as an audio signal due to the VR input. There is an internal cancellation circuit which prevents the VR signal appearing at the VX output. The degree to which the 2-4 wire conversion circuit minimizes the contribution of the VR signal at the VX output is specified as transhybrid loss (THL).

The MH88422 is suitable to drive a COMBO II codec or a VLSI modem device.

## Line Impedance

The MH88422 provides a fixed Tip-ring impedance which conforms to the following PTT requirements.

MH88422-1  $Z_{in} = 200 + 820 // 115nF$   
Germany

MH88422-2  $Z_{in} = 600\Omega$

MH88422-3  $Z_{in} = 370 + 620 // 310nF$   
UK

**Absolute Maximum Ratings\*** - All voltages are with respect to AGND unless otherwise specified.

	Parameter	Symbol	Min	Max	Units
1	DC Supply Voltage	$V_{DD}$	-0.3	6	V
2	Storage Temperature	$T_S$	-55	+80	°C
3	DC Loop Voltage	$V_{Bat}$	-100	+100	V
4	Ringing Voltage	$V_R$	-	120	$V_{RMS}$
5	Loop Current	$I_{Loop}$	-	90	mA

\* Exceeding these values may cause permanent damage. Functional operation under these conditions is not implied

**Recommended Operating Conditions.**

	Parameters	Sym	Min	Typ <sup>‡</sup>	Max	Units	Test Conditions
1	DC Supply Voltages	$V_{DD}$	4.5	5.0	5.5	V	
2	Operating Temperature	$T_{OP}$	0		70	°C	
3	Ringing Voltage	$V_R$		75		$V_{RMS}$	$V_{Bat}=-48V$

‡ Typical figures are at 25°C with nominal +5V supply and are for design aid only

**Loop Electrical Characteristics\***

	Characteristics	Sym	Min	Typ <sup>‡</sup>	Max	Units	Test Conditions
1	Ringing Voltage -1 Variant only	No Detect Detect $V_R$	27		20	$V_{RMS}$ $V_{RMS}$	Refer to FT2 1TR2 for test method
	Ringing Voltage All other Variants	No Detect Detect $V_R$	14		7	$V_{RMS}$ $V_{RMS}$	Externally Adjustable
2	Ringing Frequency		15		68	Hz	
3	On-Hook 2-wire Impedance			40k		$\Omega$	1kHz
4	Operating Loop Current		15		80	mA	
5	Operating Loop Resistance				2800	$\Omega$	$V_{Bat}=-48V, I_{Loop}=15mA$
6	Off-Hook DC Voltage	-1 Variant -2 Variant -3 Variant	6.0 6.0 4.0 4.0 6.0 6.0		9.6 15 6.0 7.8 9.0 12.5	V V V V V V	$I_{Loop}=25mA$ $I_{Loop}=42mA$ $I_{Loop}=15-20mA$ $I_{Loop}=26mA$ $I_{Loop}=25mA$ $I_{Loop}=42mA$
7	Leakage Current (2-Wire to AGND)				10	$\mu A$	$100V_{DC}$
8	Leakage Current on Hook (Tip to Ring)			9	10	$\mu A$	$V_{Bat}=-50V$
9	DC Resistance during dialling -1 variant only			200	220	$\Omega$	$I_{Loop}=20-40mA$
10	Dial Pulse Distortion	ON -1 Variant All other Variant OFF	0 +6 0	+2 +8 +2	+4 +10 +4	ms ms ms	

\* Loop Electrical Characteristics are over recommended operating conditions unless otherwise stated.

‡ Typical figures are at 25°C and are for design aid only.

Note 1: All of the above characteristics use a test circuit as per Figure 3.

DC Electrical Characteristics<sup>†</sup>

	Characteristics	Sym	Min	Typ <sup>‡</sup>	Max	Units	Test Conditions
1	Supply Current	$I_{DD}$		3		mA	$V_{DD} = -5.0V$ , Idle state
2	Power Consumption	PC		15		mW	$V_{DD} = -5.0V$ , Idle state
3	Low Level Output Voltage High Level Output Voltage	$V_{OL}$ $V_{OH}$	2.4		0.4	V V	$I_{OL} = 4mA$ $I_{OH} = 0.4mA$
4	Low Level Input Voltage High Level Input Voltage	$V_{IL}$ $V_{IH}$	2.0		0.8	V V	
5	Low Level Input Current High Level Input Current	$I_{IH}$ $I_{IL}$			60 60	$\mu A$ $\mu A$	$V_{IH} = 5.0V$ $V_{IL} = 0.0V$

<sup>†</sup> DC Electrical Characteristics are over Recommended Operating Conditions unless otherwise stated.

<sup>‡</sup> Typical figures are at 25°C with nominal  $\pm 5V$  supplies and are for design aid only.

AC Electrical Characteristics<sup>†</sup> - MH88422 All Variants

	Characteristics	Sym	Min	Typ <sup>‡</sup>	Max	Units	Test Conditions
1	Input Impedance VR			47k		$\Omega$	
2	Output Impedance at VX			10		$\Omega$	
3	Receive Gain (VR to 2-wire)			3.5		dB	Input 0.5V at 1kHz
4	Frequency Response Gain (relative to Gain @ 1kHz)			0 0		dB dB	300 Hz 3400 Hz
5	Signal Output Overload Level						THD $\leq 5\%$ @ 1kHz $I_{Loop} = 15$ to 40mA
	at 2-Wire		+2.0	+3.0		dBm	$V_{DD} = 4.5V$ to 5.5V
	at VX		+2.0	+3.0		dBm	
6	Total Harmonic Distortion at 2-wire at VX	THD		1.2 1.2		% %	Input -10dB at 1kHz DC loop = 25mA $V_{DD} = 5.0V$
7	Power Supply Reject Ratio at 2-wire at VX	PSRR		30 30		dB dB	Ripple 0.1V, 1kHz on $V_{DD}$
8	Transhybrid Loss	THL		20		dB	Input -3.5dBm, 1kHz at $V_R$

<sup>†</sup> Electrical Characteristics are over Recommended Operating Conditions unless otherwise stated.

<sup>‡</sup> Typical figures are at 25°C and are for design aid only.

Note 1: All of the above characteristics use a test circuit as per Figure 3.

Note 2: All of the above test conditions use a test source impedance which matches the device's impedance.

Note 3: dBm is referenced to 600 $\Omega$  unless otherwise stated.

AC Electrical Characteristics<sup>†</sup> - MH88422-1

	Characteristics	Sym	Min	Typ <sup>‡</sup>	Max	Units	Test Conditions
1	2-Wire input Impedance (200Ω + 820Ω //115nF)	Zin		900		Ω	@ 1kHz
2	Return Loss at 2-Wire (200Ω + 820Ω //115nF)	RL	20 20 20	22 24 26		dB dB dB	300-500Hz 500-2500Hz 2500-3400Hz
3	Longitudinal to Metallic Balance		40 55 53	65 60 60		dB dB dB	50-300Hz 300-1000Hz 1000-4000Hz
4	Idle Channel Noise at 2-Wire At VX	Nc		-72 -72	-58	dBmp dBmp	
5	Transmit Gain (2-Wire to VX)			-0.4		dB	Input 0.5V @ 1kHz Off -Hook
6	Frequency Response Gain (relative to gain @ 1kHz)			-0.6 -0.6		dB dB	300Hz 3400Hz

<sup>†</sup> Electrical Characteristics are over Recommended Operating Conditions unless otherwise stated.

<sup>‡</sup> Typical figures are at 25°C and are for design aid only.

AC Electrical Characteristics<sup>†</sup> - MH88422-2

	Characteristics	Sym	Min	Typ <sup>‡</sup>	Max	Units	Test Conditions
1	2-Wire Input Impedance (600Ω)	ZIn		600		Ω	@ 1kHz
2	Return Loss at 2-Wire (Reference 600Ω)	ERL SFRL	20 14	20 18		dB	500-2500Hz 200-3200Hz
3	Longitudinal to Metallic Balance Metallic to Longitudinal Balance		58 53 60 40	60 55		dB dB dB dB	200-1000Hz 1k-3kHz 200-1000Hz 1k-4kHz
4	Idle Channel Noise at 2-Wire at VX	Nc		13 13	20	dBnC dBnC	
5	Transmit Gain (2-Wire to Vx)			-0.4		dB	Input 0.5V @ 1kHz Off- Hook
6	Frequency Response Gain (relative to gain @ 1kHz)			-0.6 -0.6		dB dB	200Hz 3400Hz

<sup>†</sup> Electrical Characteristics are over Recommended Operating Conditions unless otherwise stated.

<sup>‡</sup> Typical figures are at 25°C and are for design aid only.

AC Electrical Characteristics<sup>†</sup> - MH88422-3

	Characteristics	Sym	Min	Typ <sup>‡</sup>	Max	Units	Test Conditions
1	2-Wire Input Impedance (370Ω + 620Ω // 310nF)	Zin		700		Ω	@ 1kHz
2	Return Loss at 2-Wire (370Ω + 620Ω // 310nF)	RL	18	20		dB	200-2400Hz
3	Longitudinal to Metallic Balance		50	60		dB	300-3400Hz
4	Idle Channel Noise at 2-Wire at VX	Nc		-80 -80	-70 -68	dBmp dBmp	
5	Transmit Gain (2-Wire to Vx)			-0.4		dB	Input 0.5V @ 1kHz Off-Hook
6	Frequency Gain (relative to gain @ 1kHz)			-0.6 -0.6		dB dB	300Hz 3400Hz

<sup>†</sup> AC Electrical Characteristics are over Recommended Operating Conditions unless otherwise stated.

<sup>‡</sup> Typical figures are at 25°C and are for design aid only.

Note 1: All of the above characteristics use a test circuit as per Figure 3.

Note 2: All of the above test conditions use a test source impedance which matches the device's impedance.

Note 3: dBm is referenced to 600Ω unless otherwise stated.

### TIP-RING Drive Circuit

The audio input ground (AGND) referenced signal at VR, biased at 2.5V, is converted to a balanced output signal at Tip-Ring. 2-4 wire isolation is achieved through the use of optocouplers when the LC input is activated, low, and loop current flowing.

### TIP-RING Receive Circuit

The differential audio signal at Tip-Ring is converted to a ground (AGND) referenced signal, biased at 2.5V, at the VX output. 2-4 Wire isolation is achieved through the use of optocouplers. The receive circuit operated when LC is low and loop current is flowing

### Transmit Gain

Transmit Gain (Tip-Ring to VX) is fixed as indicated in "AC Electrical Characteristics".

However, by adding external resistors to the VX output, the Transmit Gain can be reduced as shown in Figure 5. To limit the output current drawn, the minimum recommended resistance to ground is 2kΩ.

Overall Transmit Gain =

$$-0.4 \text{ dB} + 20\log (R4 / (R4 + R3))$$

The output impedance of the VX output is about 10Ω, therefore, with two external 1kΩ resistors configured as per Figure 5, this will result in 6dB of attenuation for a total gain of -6.4dB. For correct gain, the MH88422 input impedance must match the line impedance.

### Receive Gain

Receive Gain (VR to Tip-Ring) is fixed as indicated in "AC Electrical Characteristics". However, by adding a single external resistor in series with the VR input, the Receive Gain can be reduced.

Overall Receive Gain =

$$3.5\text{dB} + 20\log (47\text{k}\Omega / (47\text{k}\Omega + R_{\text{ext}})),$$

The input impedance of the VR input is 47kΩ, therefore, an external 100kΩ resistor in series with this input will result in 10dB of attenuation for a total gain of -6.5dB.

For correct gain, the MH88422 input impedance must match the line impedance.

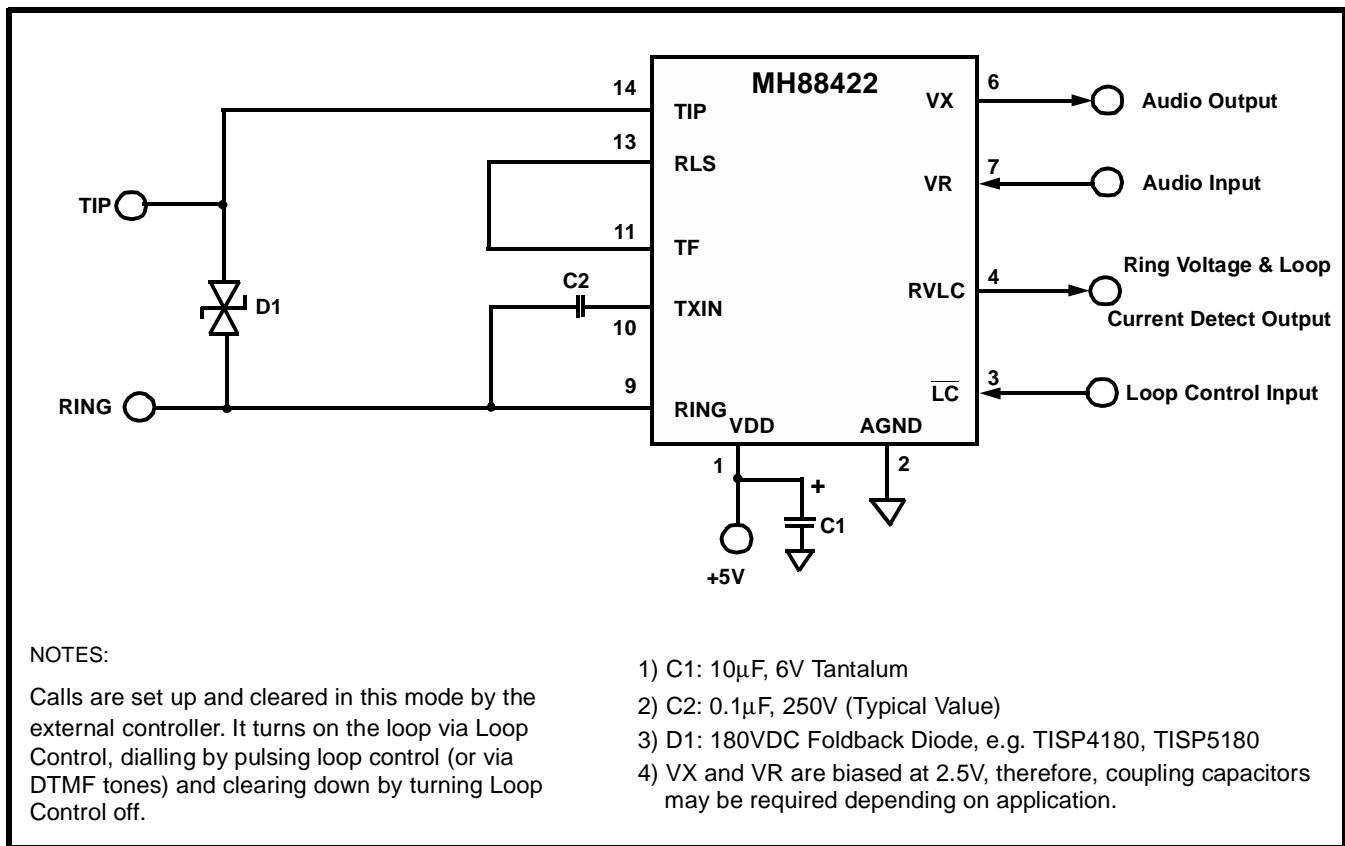


Figure 3 - Typical Application Circuit

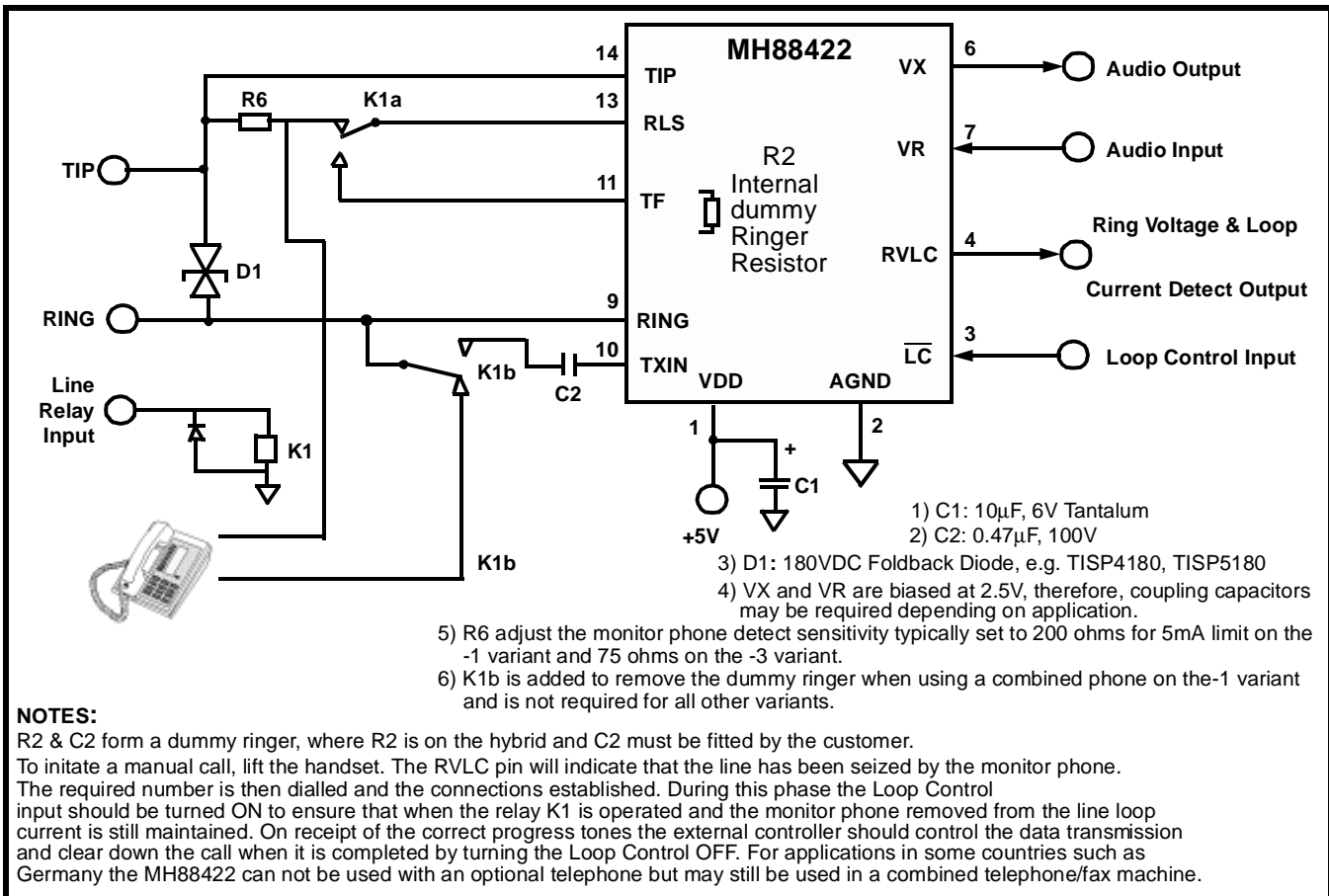


Figure 4 - Typical Application Circuit with Dummy Ringer and Monitor Phone



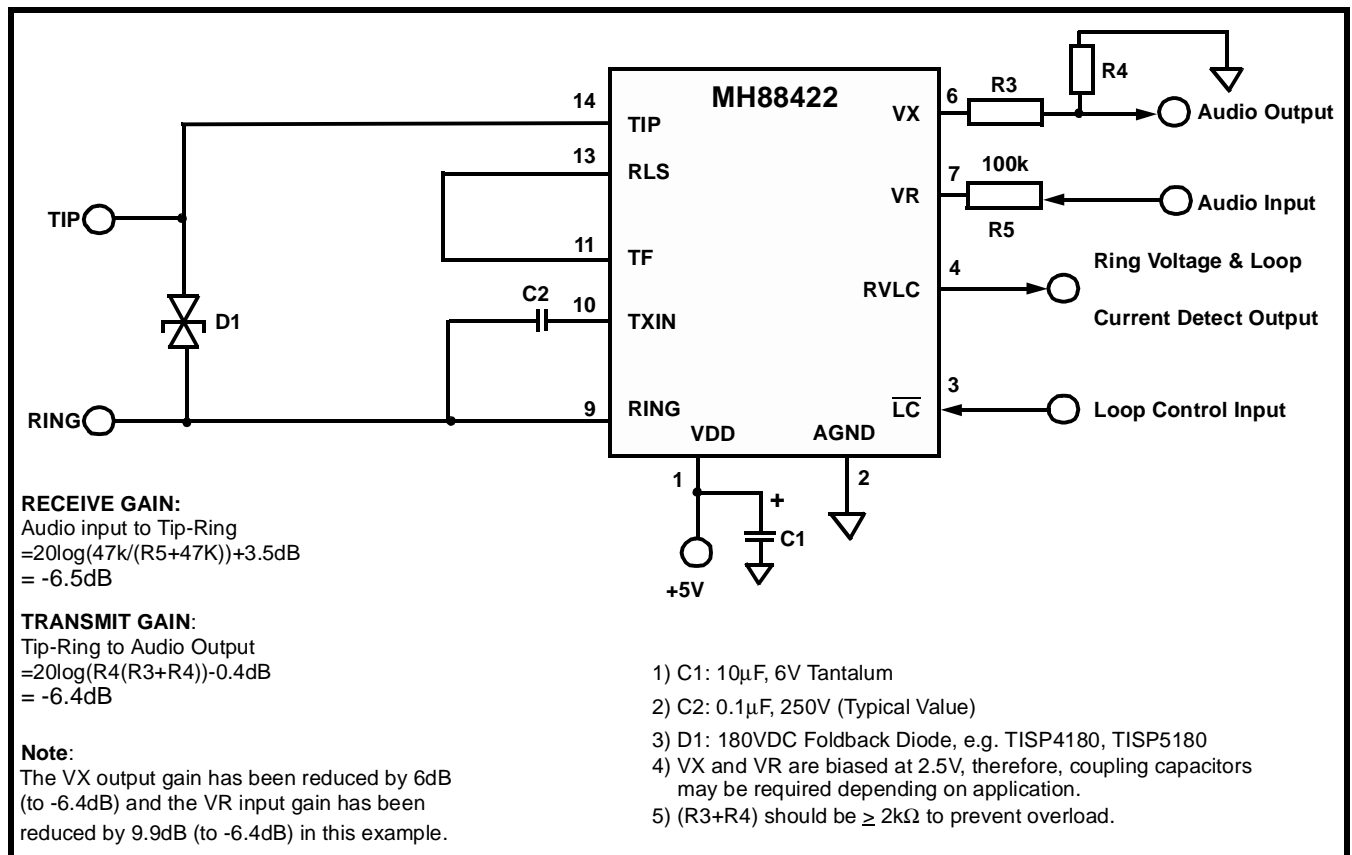


Figure 5 - Typical Application Circuit for Gain Adjustment

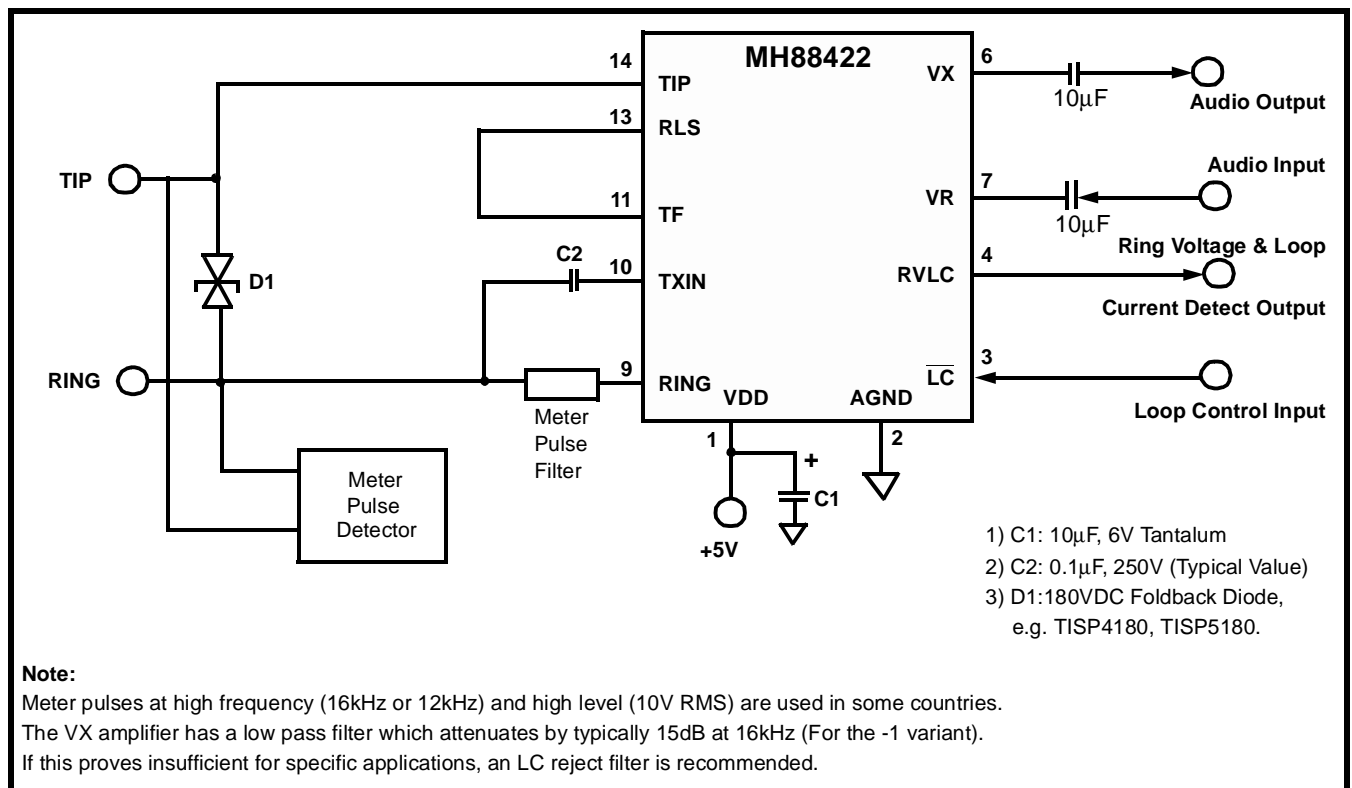


Figure 6 - Typical Application Circuit with Meter Pulse Filter and Coupling Capacitor

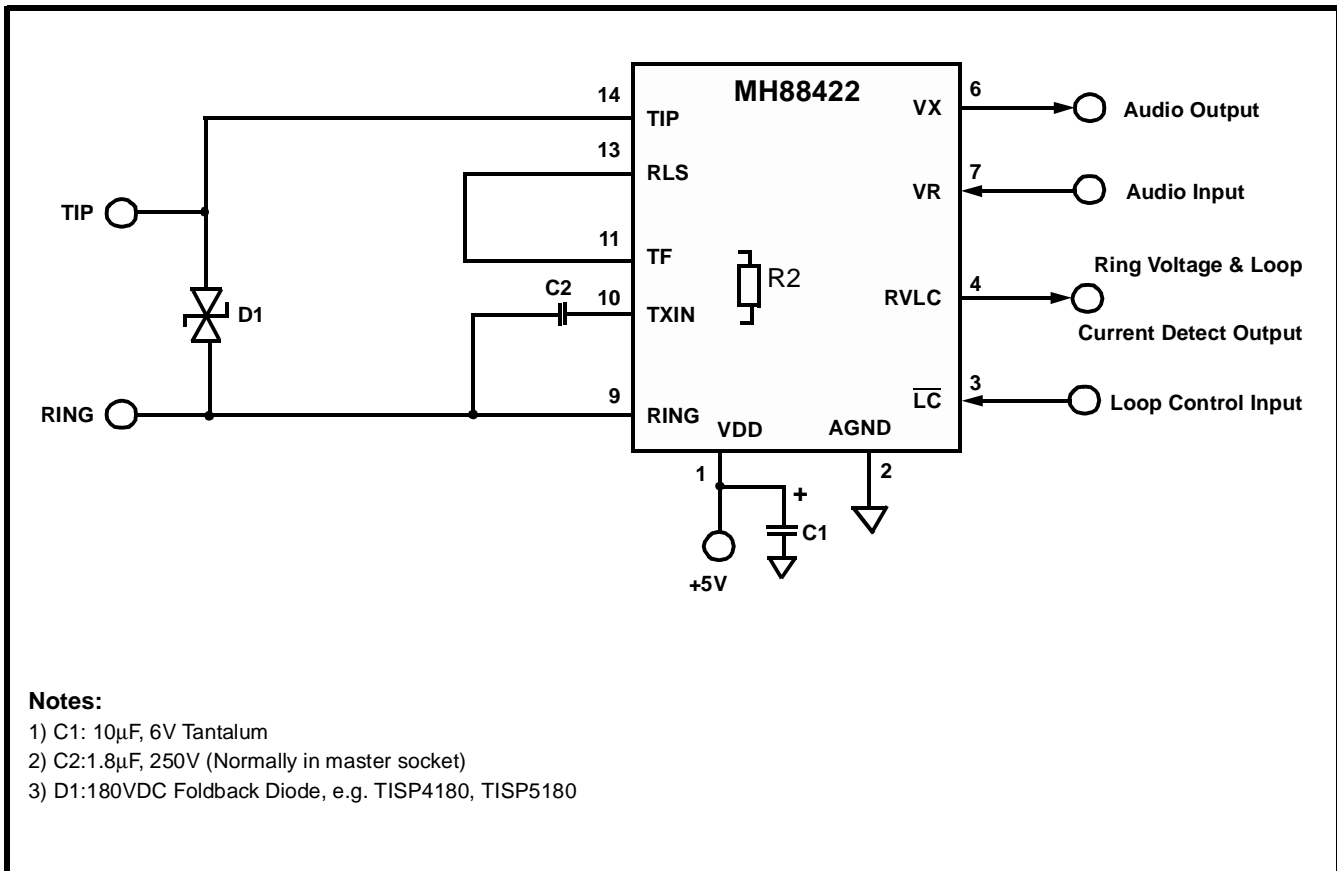


Figure 7 -Typical Application Circuit showing UK Dummy Ringer Circuit.

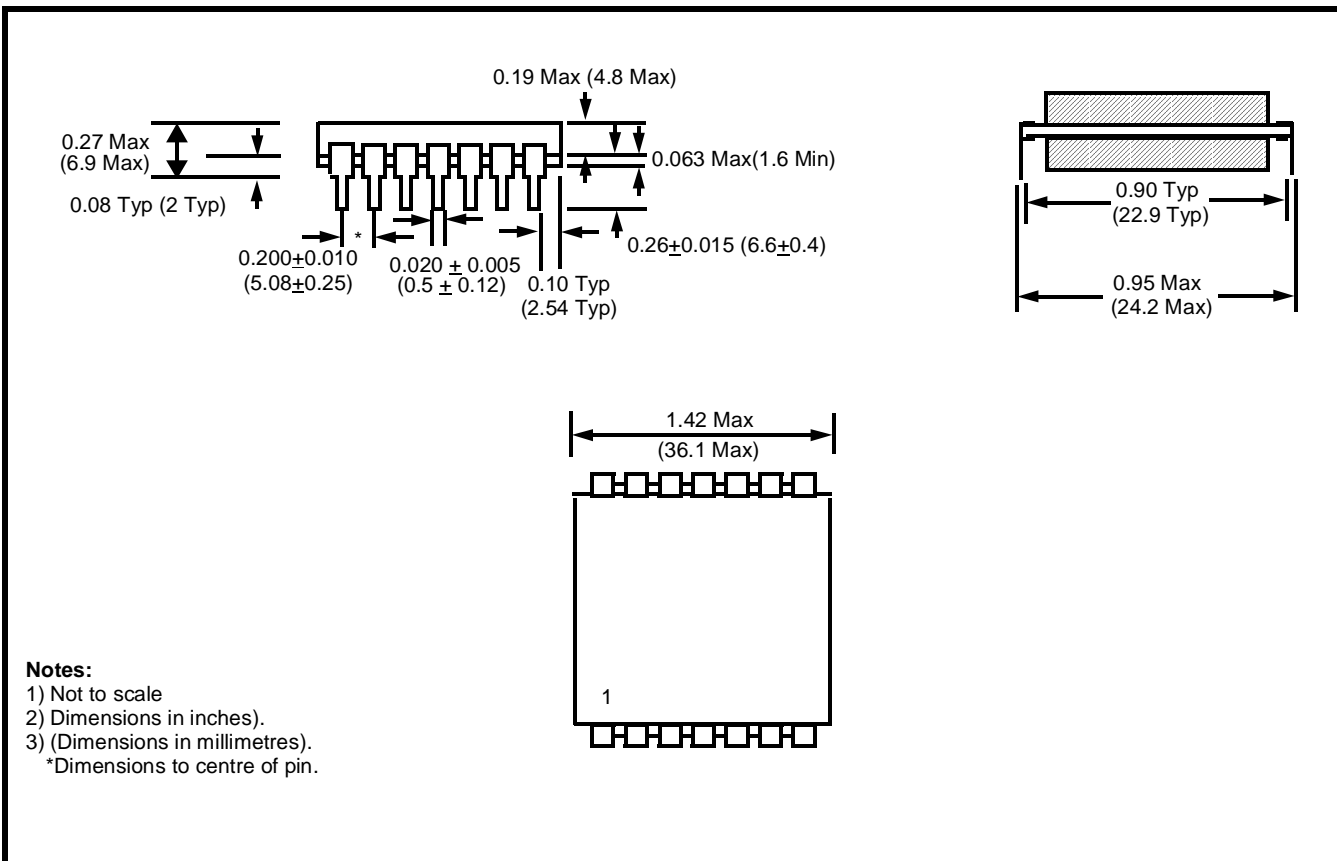


Figure 8 - Mechanical Data for 14 Pin DIL Hybrid

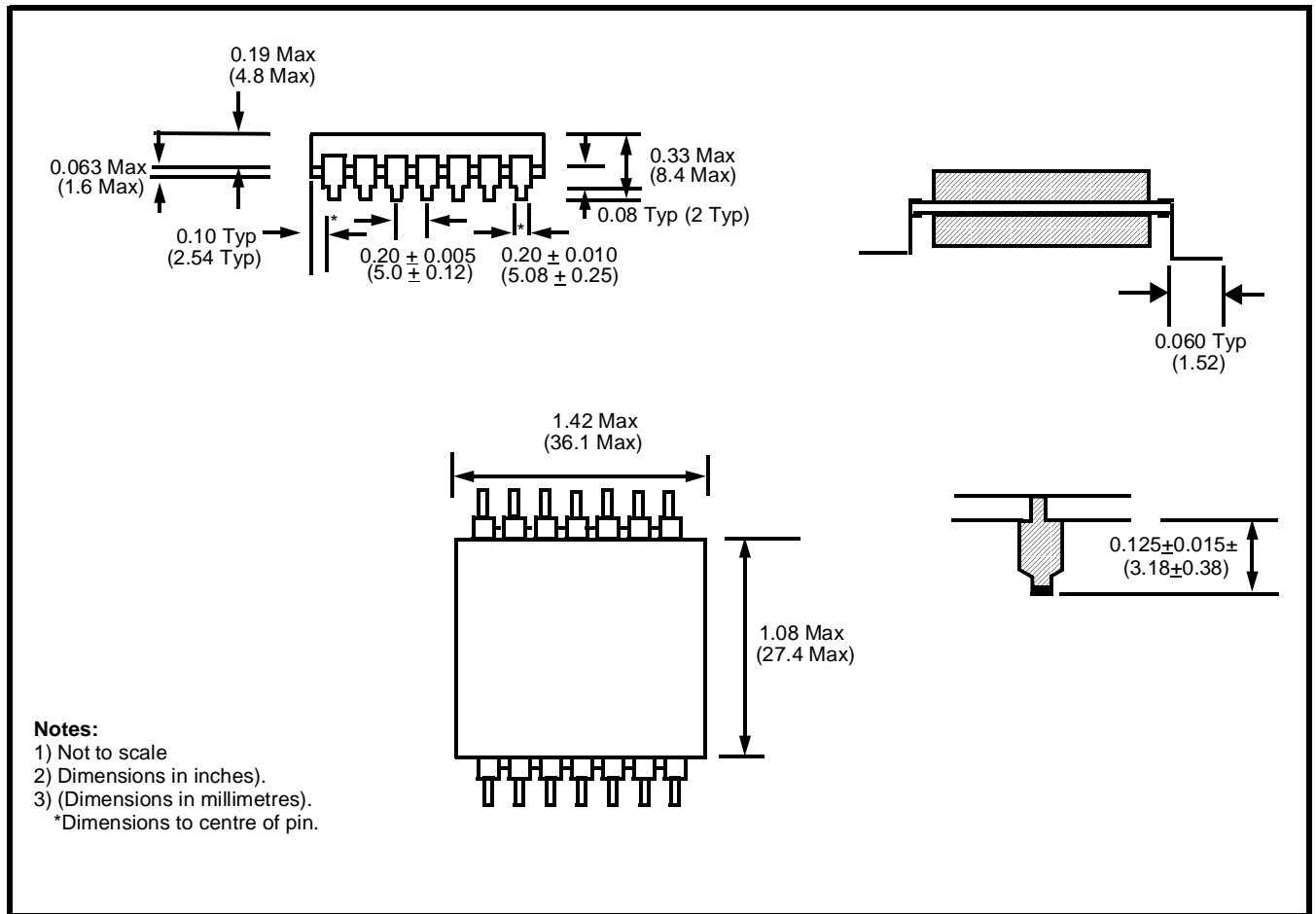


Figure 9 - Mechanical Data for 14 Pin Surface Mount Hybrid

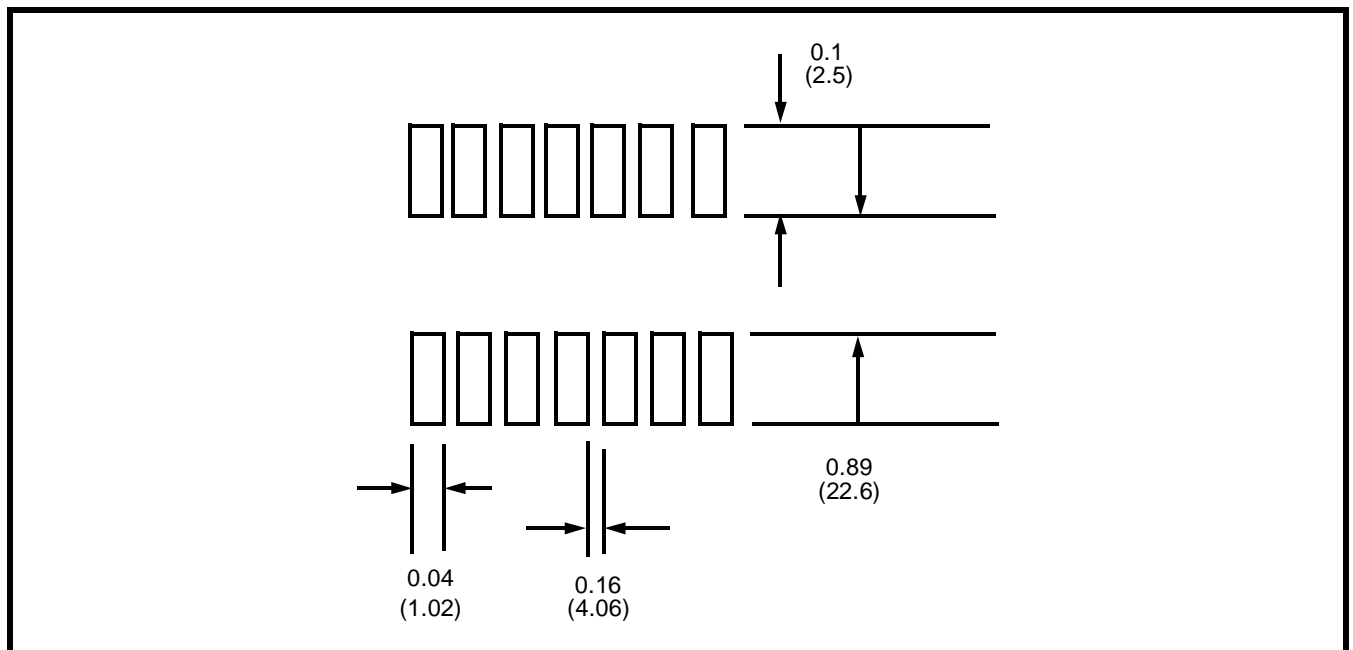


Figure 10 - Recommended Footprint for 14 Pin Surface Mount Hybrid

Notes: