MH88410
Line Interface Circuit
Advance Information

ISSUE 2 January 1994

Features

- FAX and Modem interface (V29/V22 bis)
- 600Ω network impedance
- Provides supplementary barrier to international PTT requirements
- Transformerless 2-4 Wire conversion
- Loop start operation
- Pulse and DTMF operation
- Line state detection outputs:
  - loop current/ringing voltage
- ±5V operation
- Differential input capability

Applications

Interface to Central Office for:

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

Ordering Information

MH88410 20-Pin SIL Package

0°C to 70°C

Description

The Mitel MH88410 Line Interface Circuit provides a complete audio and signalling link betwen audio equipment and a central office. The functions provided by the MH88410 include 2-4 Wire conversion, loop seizure, ring voltage and loop current detection. The device is fabricated as a thick film hybrid which incorporates various technologies for optimum circuit design, high voltage isolation and very high reliability.

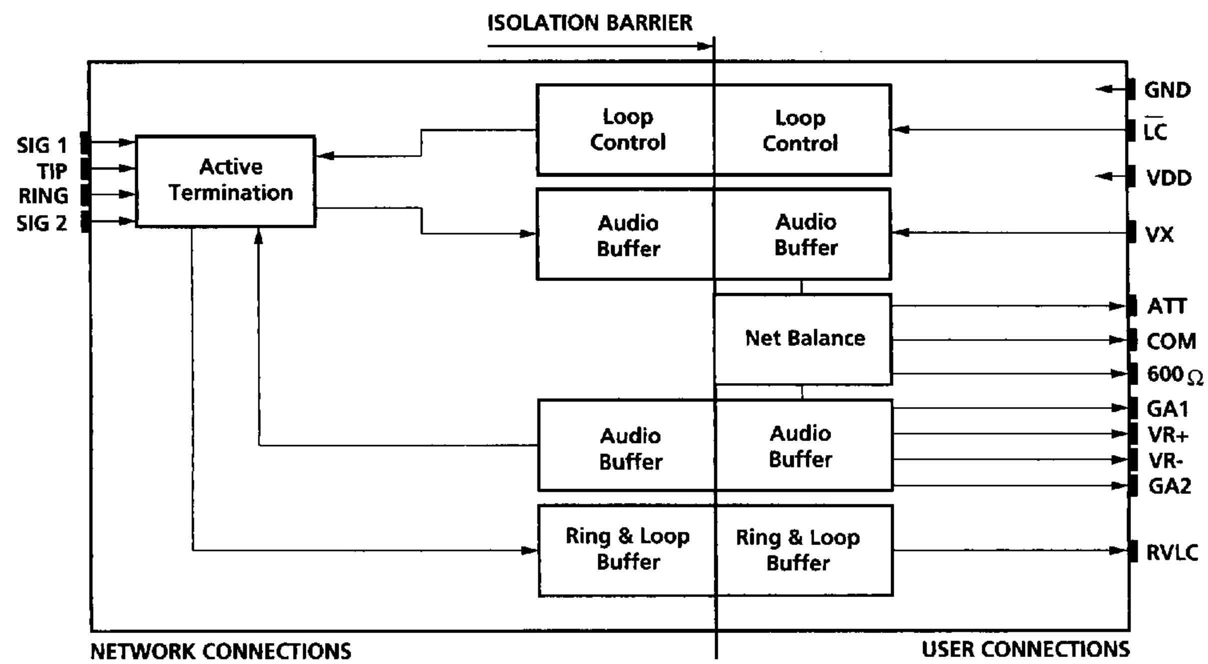


Figure 1 - Functional Block Diagram

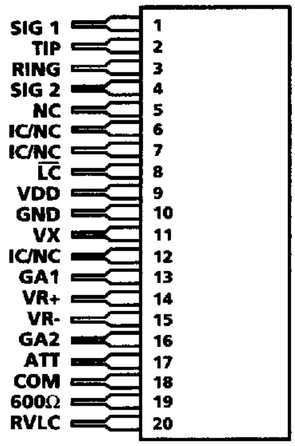


Figure 2 - Pin Connections

Pin Description

Pin #	Name	Description
1	SIG 1	**Signal 1.** Used when on-hook reception is required. Connects to the internal AC termination impedance of the interface. An appropriate value capacitor connects from the "Tip" lead to SIG 1 to provide a voice frequency path.
2	TIP	**Tip Lead.** Connects to the "Tip" lead of the central office through an optional relay contact. The central office "Tip" and "Ring" leads may be interchanged.
3	RING	**Ring Lead**. Connects to the "Ring" lead of the central office through an optional relay contact. The central office "Tip" and "Ring" leads may be interchanged.
4	SIG 2	**Signal 2.** Used when on-hook reception is required. Connects to the internal AC termination impedance of the interface. An appropriate value capacitor connects from the Ring lead to SIG 2 to provide a voice frequency path.
5	NC	**No Connection** should be made to this pin. For high voltage isolation requirements there is no pin or internal connection in this position.
6	IC/NC	**No Connection** should be made to this pin.
7	IC/NC	**No Connection** should be made to this pin.
8	$\overline{LC}$	**Loop Control (Input).** A logic low activates internal circuitry which provides a dc termination across TIP and RING. Used for seizing the line and dial pulsing.
9	VDD	**Positive Power Supply Voltage.** +5V.
10	GND	**Ground.** Normally connected to System Ground.
11	VX	**Transmit (Output).** 4-Wire ground (AGND) referenced audio output, biased at 2.5V. Outputs in off-hook mode only.
12	IC/NC	**No Connection** should be made to this pin.
13	GA1	**Gain Adjust 1.** This allows external gain adjustment by adding a resistor between VR+ and GA1.
14	VR+	**Receive (Input).** 4-Wire ground (AGND) referenced audio input, biased at 2.5V. $\overline{LC}$ must be activated low and loop current must be flowing.
15	VR-	**Receive (Input).** 4-Wire ground (AGND) referenced audio input, biased at 2.5V. $\overline{LC}$ must be activated low and loop current must be flowing.
16	GA2	**Gain Adjust 2.** This allows external gain adjustment by adding a resistor between VR- and GA1.
17	ATT	**ATT Network Balance.** Where AT&T compromise balance network is required this pin should be shorted to COM.

Pin Description, continued

Pin #	Name	Description
18	COM	**Common Network Balance.** This is the common pin for Network Balance circuitry.
19	600Ω	**600Ω Network Balance.** Where 600Ω balance network is required this pin should be shorted to COM.
20	RVLC	**Ring Voltage & Loop Current Detect (Output).** A logic low indicates that Loop current is detected. This occurs when the MH88410 is in the off-hook mode. The RVLC output pulses when the MH88410 is dial pulsing via the $\overline{LC}$ input. When the MH88410 is in the on-hook mode a pulsing output indicates that ringing voltage is across the Tip and Ring leads; the pulsing output frequency is twice the ringing frequency.

Functional Description

The MH88410 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.

Isolation Barrier

The isolation barrier is designed to meet regulatory requirements for a supplementary barrier of 1kVac. It provides full isolation of mains voltages up to 250V RMS and all telecom voltages.

External Protection Circuit

To meet regulatory high voltage requirements, an external protection circuit is required. The protection circuit shown in Figure 3 (Clamp Diodes PRO1) & fuse resistors are 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 $\overline{LC}$ (Loop Control) input. The termination is similar to a resistance of approximately 290Ω (loop current dependent). Internal isolation circuitry is used to switch the termination in and out of the loop. This is used for both seizing the line as well as generating dial pulses. The MH88410 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 MH88410 being in the off-hook mode.

The RVLC output pulses when the MH88410 is dial pulsing via the $\overline{LC}$ input.

In addition, when the MH88410 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 signal at tip and ring of the central office line into a transmit ground referenced signal at VX (Transmit) of the MH88410. It also converts the receive differential signal at VR (Receive) of the MH88410 into a balanced transmit signal at tip and ring of the central office line.

In full duplex operation, the TIP-RING signal consists of an audio signal from the central office as well as an audio signal due to the VR input. Consequently, both of these signals will appear 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 MH88410 is suitable to drive a COMBO II codec or a VLSI modem device.

Line Impedance

The MH88410 provides a fixed TIP-RING impedance which is 600Ω.

TIP-RING Drive Circuit

The audio signal at VR is converted to a balanced output signal at TIP-RING. 2-4 wire isolation is achieved when the $\overline{LC}$ input is activated, low, and loop current flowing.

TIP-RING Receive Circuit
During the on-hook condition, the 600Ω termination can be accessed through SIG1 and SIG2 where coupling capacitors connect directly to TIP and RING. This provides an ac termination to the line for on-hook reception of voice band signals such as caller identification FSK modem signals. This is illustrated in Figure 4. In the off-hook condition, the line is terminated with the active dc resistance of 290Ω max, and the ac termination impedance of 600Ω is applied directly to the line.

Transmit Gain
Transmit gain (TIP-RING to VX) defaults to 0dB as indicated in the "AC Electrical Characteristics". For correct gain, the MH88410 input impedance must match the line impedance.

Receive Gain
Receive gain (VR to TIP-RING) defaults to 0dB as indicated in the "AC Electrical Characteristics". By connection of external resistors, however, between VR+ & GA1 and VR- & GA2 the received gain can be reduced, as illustrated in Figure 5.

Absolute Maximum Ratings*

	Parameter	Sym	Min	Max	Units
1	DC Supply Voltage	V_{DD}	-0.3	6	V
2	Storage Temperature	T_S	-55	+100	°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

	Characteristics	Sym	Min	Typ*	Max	Units	Comments
1	DC Supply Voltage	V_{DD}	4.5	5.0	5.5	V	
2	Operating Temperature	T_{OP}	0		70	°C	

* Typical figures are at 25°C with nominal ±5V supplies and are for design use only.

Loop Electrical Characteristics†

		Characteristics	Sym	Min	Typ*	Max	Units	Test Conditions
1		Ringing Voltage Detect	VR	40		150	V_{RMS}	
2		Ringing Frequency Detect	VF	15		68	Hz	
3		On-Hook 2-Wire Impedance			40k		Ω	1kHz
4		Operating Loop Current		10		90	mA	
5		Operating Loop Resistance				2300	Ω	V_{Bat}= -48V, I_{Loop} = 15mA
6		Off-Hook DC Resistance				290	Ω	@ 20mA EIA 464
7		Leakage Current (2-Wire to AGND)				20 10	μA mA	$100V_{DC}$ $1000V_{AC}$ rms 60Hz
8		Leakage Current on Hook (TIP to RING)				10	μA	$100V_{DC}$
9		DC Resistance T to R, T to GND, R to GND		50k			Ω	$100V_{DC}$ to $200V_{DC}$
10		Dial Pulse Break to Make ratio		8 52		11 64	pps %	
11		Ringer Equivalence Number		0.5	1	3	REN	

† Loop Electrical Characteristics are over recommended operating conditions unless otherwise stated.
* Typical figures are at 25°C and are for design use only.
Note 1: All of the above characteristics use a test circuit as per Figure 3.

DC Electrical Characteristics†

		Characteristics	Sym	Min	Typ*	Max	Units	Test Conditions
1		Supply Current	I_{DD}		15		mA	V_{DD}= -5.0V, I_{Loop}=40mA
2		Power Consumption	PC		75		mW	V_{DD}= -5.0V, I_{Loop}=40mA
3	RVLC	Low Level Output Voltage	V_{OL}			0.4	V	I_{OL} = 1.0mA
		High Level Output Voltage	V_{OH}	2.4			V	I_{OH}= 0.4mA
4	$\overline{LC}$	Low Level Input Voltage	V_{IL}			0.9	V	
		High Level Input Voltage	V_{IH}	3.5			V	
5		High Level Input Current	I_{IH}			0.6	mA	V_{IH}= 5.0V
		Low Level Input Current	I_{IL}			1	µA	V_{IL}= 0.0V

† DC Electrical Characteristics are over recommended operating conditions unless otherwise stated.
* Typical figures are at 25°C with nominal +5V supplies and are for design use only.

AC Electrical Characteristics†

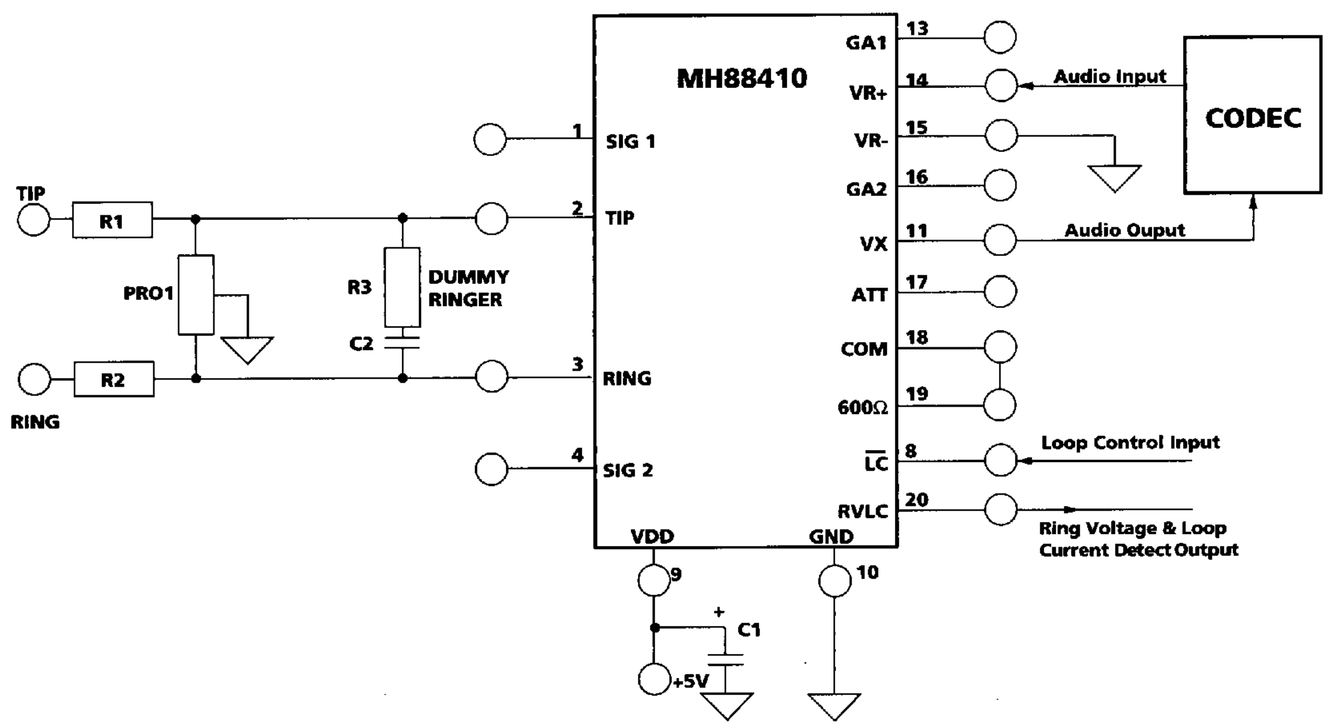
	Characteristics	Sym	Min	Typ‡	Max	Units	Test Conditions
1	Input Impedance VR			47k		Ω	
2	Output Impedance at VX			10		Ω	
3	Transmit Gain (2-wire to VX)			0		dB	Input 0.5V at 1kHz off-hook
4	Frequency Response Gain (relative to Gain @ 1 kHz)			±0.25		dB	300Hz to 3400Hz
5	Receive Gain (VR to 2-wire):			0		dB	Input 0.5V at 1kHz
6	Frequency Response Gain (relative to Gain @ 1 kHz)			±0.25		dB	300Hz to 3400Hz
7	Signal Output Overload Level						THD ≤1% @ 1kHz I_{Loop} = 15 to 40mA
	at 2-Wire			-3.0		dBm	V_{DD}=4.5V
				0.0		dBm	V_{DD}=5.0V
				+2.0		dBm	V_{DD}=5.5V
	at VX			-3.0		dBm	V_{DD}=4.5V
				0.0		dBm	V_{DD}=5.0V
				+2.0		dBm	V_{DD}=5.5V
8	Total Harmonic Distortion	THD					Input 0.5V at 1kHz
	at 2-Wire			0.5		%	DC loop = 1000Ω
	at VX			0.5		%	V_{DD}=5.0V
9	Power Supply Reject Ratio	PSRR					Ripple 0.1V, 1kHz on V_{DD}
	at 2-Wire			30		dB	
	at VX			30		dB	

† AC 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.
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.
Note 4: THD is measured with "A Weight" filter.

AC Electrical Characteristics†

	Characteristics	Sym	Min	Typ‡	Max	Units	Test Conditions
1	2-Wire Input Impedance	Zin		600		Ω	
2	Return Loss at 2-Wire	RL	20			dB	200 - 3400Hz
3	Longitudinal to Metallic Balance		66			dB	@ 200Hz
			61			dB	@ 600Hz
			60			dB	@ 1000Hz
			51			dB	@ 2000 - 4000Hz
	Metallic to Longitudinal Balance		60			dB	@ 200 - 1000Hz
			40			dB	@ 1000 - 4000Hz
4	Idle Channel Noise	Nc					
	at 2-Wire				13	dBrnc	
	at VX				15	dBrnc	

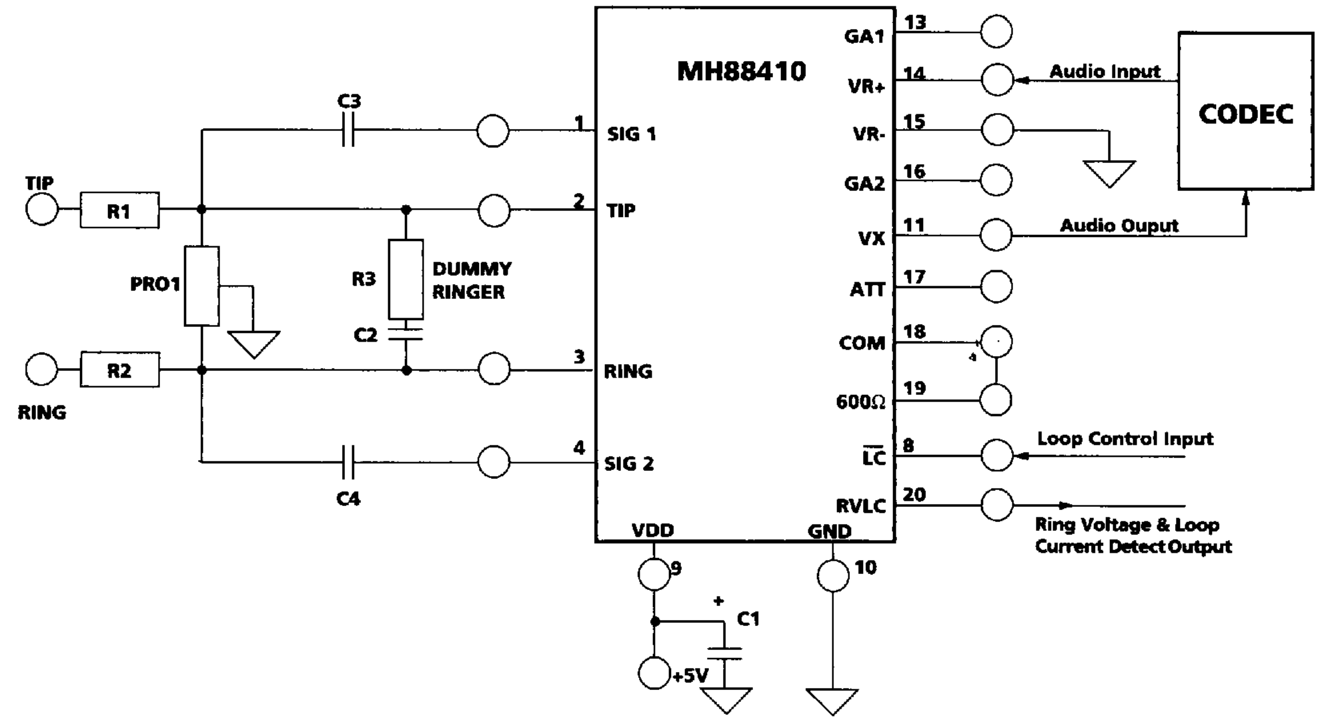
† AC Electrical Characteristics are over recommended operating conditions unless otherwise stated.
* Typical figures are at 25°C and are for design aid only.
Note 1: All of the above test conditions use a test source impedance which matches the device's impedance.
Note 2: dBm is referenced to 600Ω unless otherwise stated.
Note 3: THD is measured with a "C Weight" filter.



Note:
Calls are set up and cleared down in this mode by the external controller. It turns on the loop via Loop Control, dialling by pulsing loop control (or via DTMF tones) and clearing down by turning Loop Control off.

1) R1: 5Ω, 5%, Fuse resistor.
2) R2: 5Ω, 5%, Fuse resistor.
3) C1: 10µF, 6V Tantalum
4) PRO1: 240VDC protector
5) R3: 10kΩ, 5%.
6) C2: 1.0µF, 250V, 5%

Figure 3 - Typical Application Circuit - 600Ω Network Balance



Note:
Calls are set up and cleared down in this mode by the external controller. It turns on the loop via Loop Control, dialling by pulsing loop control (or via DTMF tones) and clearing down by turning Loop Control off.

1) R1: 5Ω, 5%, Fuse resistor.
2) R2: 5Ω, 5%, Fuse resistor.
3) C1: 10μF, 6V Tantalum
4) C3, C4: 0.047μF, 250V
5) PRO1: 240VDC protector
6) R3: 10kΩ, 5%.
7) C2: 1.0μF, 250V, 5%

Figure 4 - Typical Application Circuit - On-Hook Reception, 600Ω Network Balance

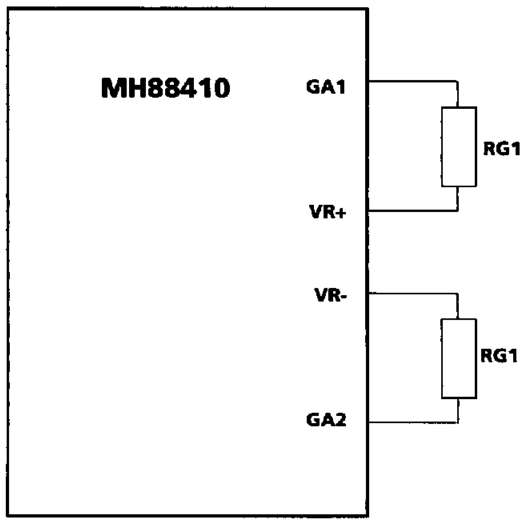


Figure 5 - Receive Gain Adjustment

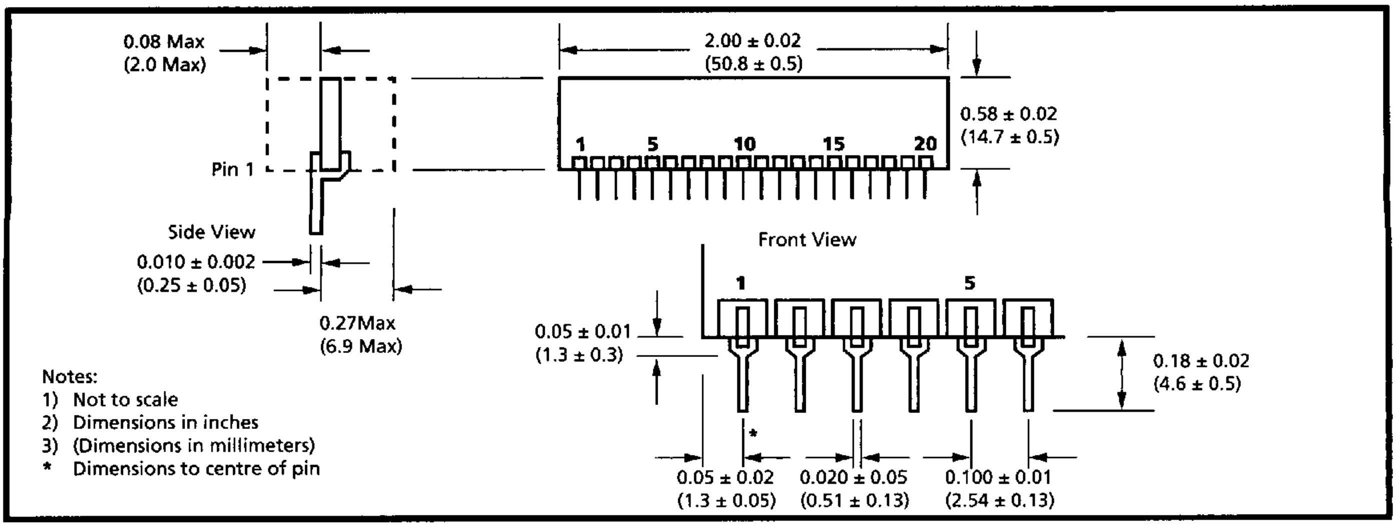


Figure 6 - Mechanical Data