MH88622
Pair Gain SLIC
Advance Information

ISSUE 2 January 1994

Features

- Dual SLIC
- Ringing generation
- On hook transmission
- Transformerless 2-4 wire conversion
- Constant current feed
- Battery Feed to the line
- Tip Ring reversal capability
- Over current protection
- Off hook and dial pulse detection
- Logic interface for $\overline{SHK}$, RC, LR, ESE
- Metering injection
- Wide VBat operating range
- Minimum installation space

Applications

- Pair Gain
- CT2
- Cordless local loops

Ordering Information

MH88622-1, -2, -3, -4
40-Pin SIL Package

-40°C to 85°C

Description

The Mitel MH88622 is a dual subscriber interface circuit which provides a complete interface between the telephone lines and a dual codec, requiring a dual rail supply, battery and dc supply for ringing generation. The functions provided by the MH88622 include 2-4 Wire conversion, constant current line feed, signalling and control. The SLIC is manufactured using thick film hybrid technology which offers high voltage capability, relability and high density resulting in a significant area saving on the printed circuit board. A complete C.O. type solution can be implemented with minimal external components. Different variants are provided to meet different country line impedances.

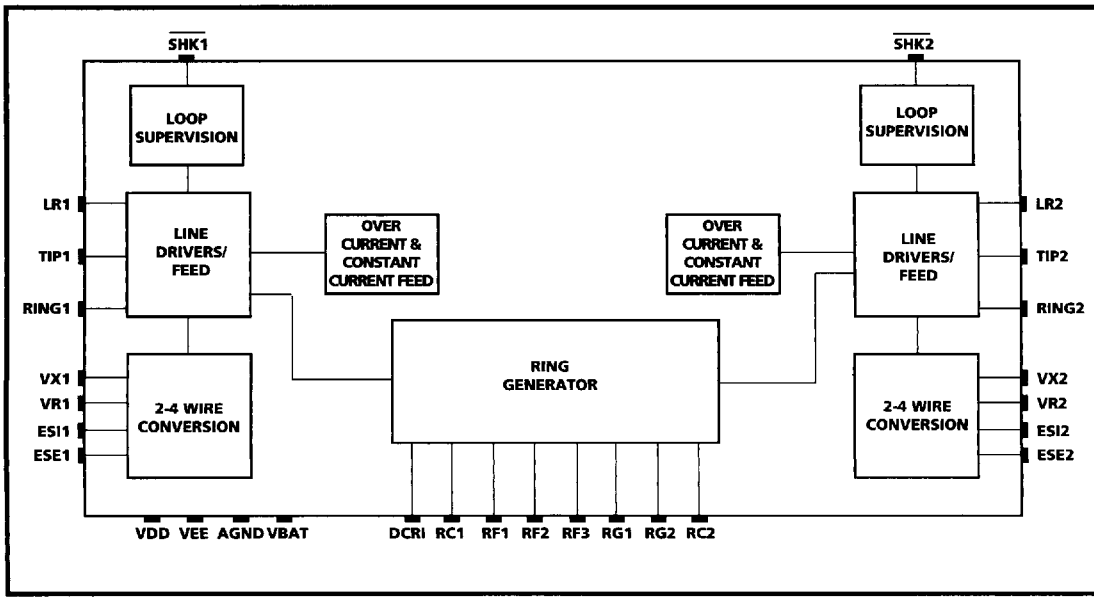

Figure 1 - Functional Block Diagram

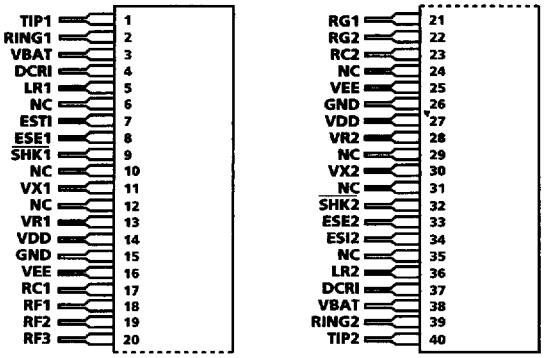

Figure 2 - Pin Connections

Pin Description

Pin	Name	Description
1	TIP1	**Tip Lead.** Connects to the "Tip" lead of subscriber 1
2	RING1	**Ring Lead.** Connects to the "Ring" lead of subscriber 1.
3	VBAT	**Battery Voltage.** Typically -24V dc is applied to this pin.
4	DCRI	**DC Ringing Voltage Input.** A continuous 140V dc is applied to this input to achieve 90Vrms ringing. This should be connected to Pin 37 of the hybrid on the pcb.
5	LR1	**Line Reversal.** A logic 1 applied to LRI will reverse the "Tip" & "Ring" feeding to subscriber 1. This pin has an internal pull down.
6	NC	**No Connection.** This pin should not be connected
7	ESI1	**External Signal Input (input).** A continuous signal is applied to this pin which will be applied differently to "Tip" & "Ring" of subscriber 1.
8	ESE1	**External Signal Enable (Input).** The external signal to subscriber 1 is controlled by a logic level applied to this pin.
9	$\overline{\text{SHK1}}$	**Off Hook Indicatlon (output).** A logic low output indicates when subscriber 1 equipment has gone off hook.
10	NC	**No Connection.** This pin should not be connected.
11	VX1	**Transmit (Output).** 4-Wire, (GND) referenced audio output for subscriber 1.
12	NC	**No Connection.** This pin should not be connected.
13	VR1	**Receive (Input).** 4Wire (GND) referenced audio input for subscriber 1.
14	VDD	**Positive Supply Voltage.** +5Vdc Connect to pin 27 of the hybrid on the pcb.
15	GND	**Ground.** Return path for VDD, VEE, VBAT & DCRI. This pin should be connected to pin 26 of the hybrid on the P.C.B.
16	VEE	**Negative Supply Voltage.** -5Vdc. Connect to pin 25 of the hybrid on the pcb.
17	RC1	**Ringing Control (Input).** A logic level applied to this pin enables ringing to be differentially applied across Tip & Ring of subscriber 1.
18	RF1	**Ringing Frequency Node 1 (Input).** A passive component is to be connected between RFI & RF2 and will be used to determine the frequency of the ringing generator.
19	RF2	**Ringing Frequency Node 2 (input).** Two passive components will be connected to this pin from RFI & RF3, and will be used to determine the frequency of the ringing generator.
20	RF3	**Ringing Frequency Node 3 (Input).** A passive component is to be connected between RF2 & RF3 and wil be used to determine the frequency of the ringing generator.

Pin Description (continued)

Pin #	Name	Description
21	RG1	**Ringing Voltage Gain Node 1.** Connects to RG2 through a resistor to reduce the output ringing voltage. When left open circuit output ringing voltage is 90 Vrms
22	RG2	**Ringing Voltage Gain Node 2.** Connects to RG1 through a resistor to reduce the output ringing voltage. When left open circuit output ringing voltage is 90 Vrms
23	RC2	**Ringing Control (Input).** A logic level applied to this pin enables ringing to be differentially applied across Tip and Ring of subscriber
24	NC	**No connection.** This pin should not be connected.
25	VEE	**Negative Supply Voltage.** -5Vdc. This pin should be connected to pin 16 of the hybrid on the pcb.
26	GND	**Ground.** Return path for VDD, VEE, VBAT & DCRI. This pin should be connected to pin 15 of the hybrid on the pcb.
27	VDD	**Positive Supply Voltage.** +5Vdc. This pin should be connected to pin 14 of the hybrid on the pcb.
28	VR2	**Receive (input).** 4 wire, (GND) referenced audio input for subscriber 2.
29	NC	**No connection.** This pin should not be connected.
30	VX2	**Transmit (Output).** 4 wire (GND) referenced audio output for subscriber 2.
31	NC	**No connection.** This pin should not be connected.
32	$\overline{SHK2}$	**Off Hook Indication (output).** A logic low output indicates when subscriber 2 equipment has gone off hook.
33	ESE2	**External Signal Enable (Input).** The external signal to subscriber 2 is controlled by a logic level applied to this pin.
34	ESI2	**External Signal Input (Input).** A continuous signal is applied to this pin which will be applied differentially to "Tip" and Ring" of subscriber 2.
35	NC	**No connection.** This pin should not be connected.
36	LR2	**Line Reversal.** A logic 1 applied to LR1 will reverse the "Tip and Ring" feeding to subscriber 2. This pin has an internal pull down.
37	DCRI	**DC Ringing Voltage Input.** A continuous 120V dc is applied to this input to achieve 90Vrms ringing. This should be connected to pin 37 of the hybrid on the pcb.
38	VBAT	**Battery Voltage.** Typically -24V dc is applied to this pin.
39	RING2	**Ring Lead.** Connects to the "Ring" lead of subscriber 2.
40	TIP2	**Tip Lead.** Connects to the "Tip" lead of subscriber 2.

Functional Description

The SLIC uses a transformerless 2-4 wire converter for each subscriber which can be connected to a CODEC to interface the 2 wire subscriber loop to a time division multiplexed, (TDM) pulse code modulated, (PCM), digital link. For analog applications, the Tx & Rx of the 2-4 wire converter can be connected directly to an analog line or crosspoint switch such as the MT8816.

Powering of the subscriber line is provided through precision battery feed resistors on the hybrid. The thick film hybrid circuit also contains, control, signalling and status circuitry which combines to provide a complete functional solution which simplfies the manufacture of line cards in pair gain applications. This circuitry is illustrated in the functional block diagram in figure 1.

Approvals

FCC Part 68, CCITT, DOC CS-03, UL 1459, CAN/CSA-22.2 No. 225-M90 and ANSI/EIA/TIA-464-A are system level safety standards and performance requirements. As a component of a system, the MH88622 is designed to comply with the applicable requirements of these specifications.

Battery Feed

The SLIC is designed for a nominal battery voltage of -24Vdc and can provide the constant feed current for a 500Ω loop under this condition.

The interface is designed to be operated up to a maximum of 60Vdc battery feed voltage without damage, providing a maximum loop length of 2000Ω.

There is also a function on the SLIC that provides for the battery feed to be reversed enabling TIP-RING reversal.

Current Limit

Primary overcurrent protection is inherent in the current limiting feature of the battery feed circuit.

Current limiting is provided for both TIP and RING unbalanced conditions.

The maximum loop current limit is set internally on the interface and current limiting does not affect the longitudinal or the signal balance of the device.

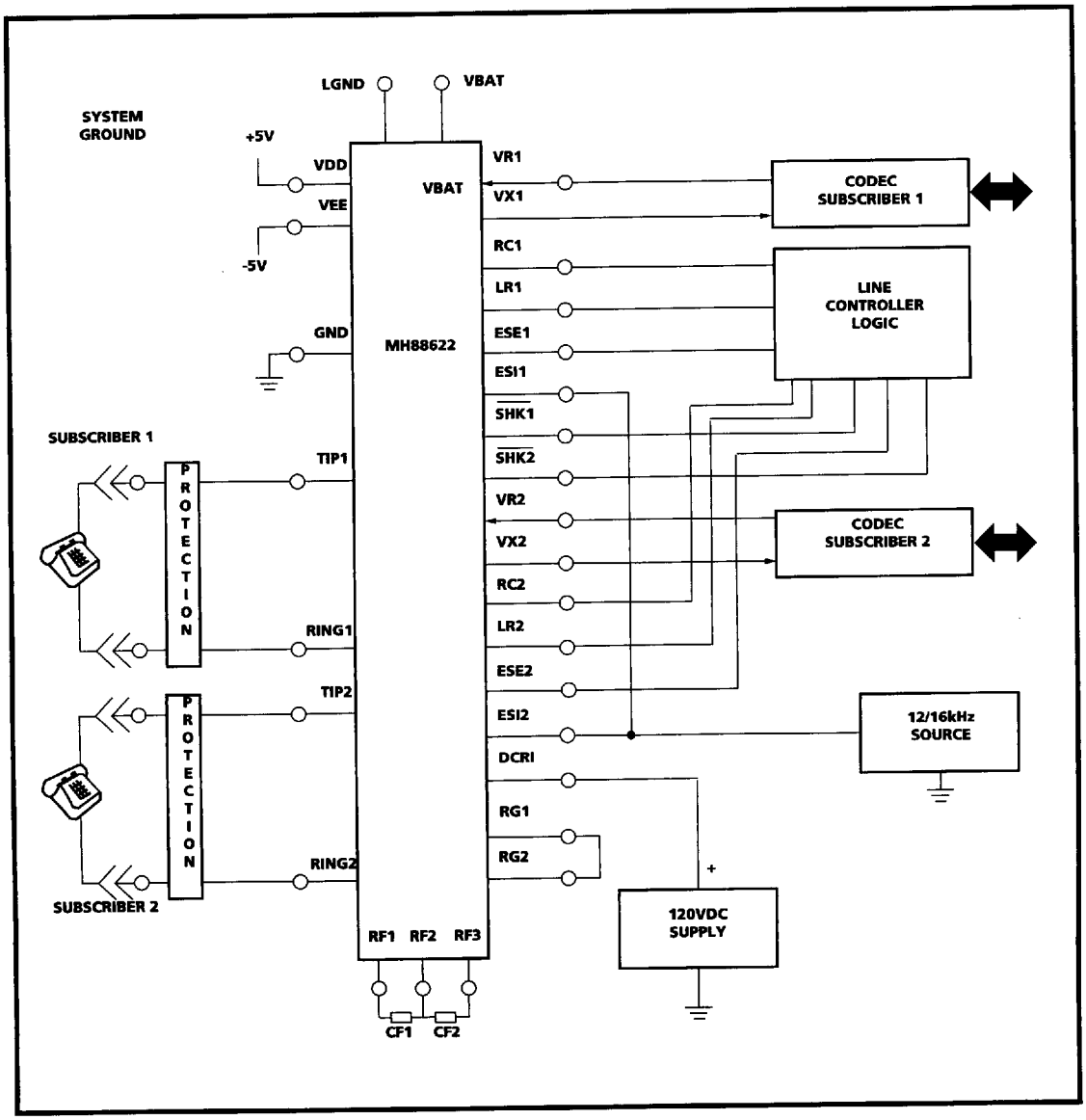

Figure 3 - Loop Start SLIC Configuration Applications Circuit

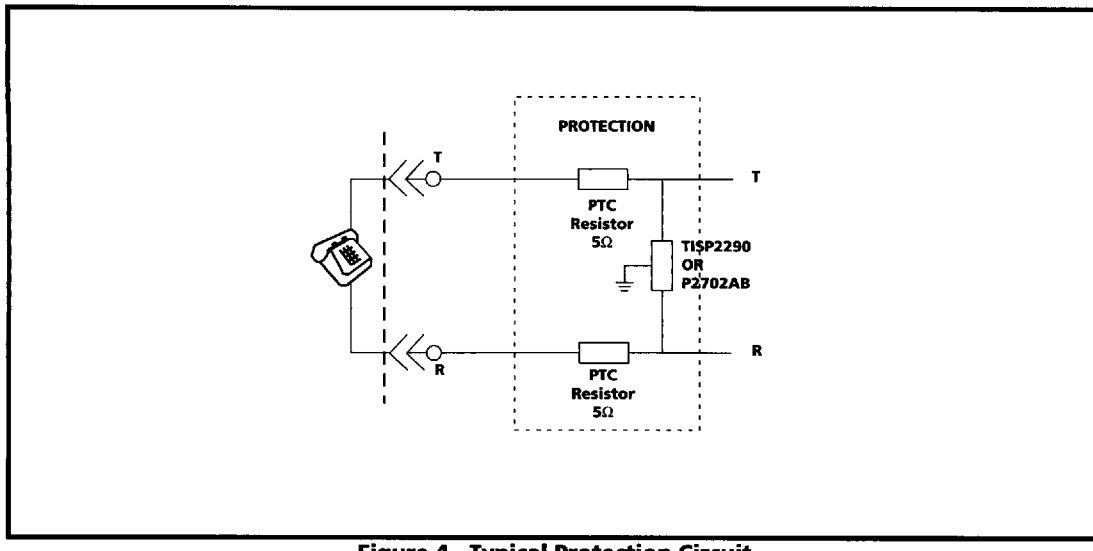

Figure 4 - Typical Protection Circuit

Receive and Transmit Audio Path

The audio signal of the 2 wire side is sensed differentially across the feed resistors and is passed on to a second differential amplifier stage in the 2-4 wire conversion block. This block sets the transmit gain on the 4 wire side and cancels signals originating from the receive input before outputting the signal to the codec.

Two Wire Port Termination Impedance

The AC termination impedance of the 2W port, is set using active feedback paths to give the desired relationship between the line voltage and the line current. The loop current is sensed differentially across the two feed resistors and converted to a single ended signal. This signal is fed back to the TIP/RING driver circuitry such that impedance in the feedback path gets reflected to the two wire port. The MH88622's TIP-RING impedance (Zin) is set to for each variant.

Transmit and Receive gain

The transmit and receive gain of the MH88622 is internally set when the line termination impedance is correctly matched.

Internal Ringing Generator

The MH88622 offers an on board ringing generator requiring only two external passive components and a dc voltage source to produce a sine wave of between 17Hz to 68Hz.

A 1.5Vrms signal is amplified internally by a user programmed amount and is applied to TIP and RING leads in a balanced configuration. The programmable gain must be set using RGI and RG2 to ensure that distortion of the ringing signal does not occur, this is dependent upon the battery voltage, VBat, and the dc voltage source for the ringing generator, VDCRI. With VBat = -24Vdc and VDCRI = +120Vdc and the ringing voltage = 90Vrms RG1 and RG2 should be left open circuit. By adding an external resistor between RG1 and RG2 it is possible to reduce the ringing voltage applied by the driver section to TIP and RING.

The dc voltage source should be continuously applied to the MH88622. The ringing voltage will only be applied to the subscriber line when a logic 1 is applied to the RC pin of the relevant subscriber.

12/16KHz Meter Pulse

The MH88622 provides control of an external signal path to the driver. A 12/16 KHz continuous signal is applied to the ESI pin. Control of the ESE input allows the metering signal to be transmitted to the line.

Off-Hook and Dial Pulse Detection

The $\overline{SHK}$ pin goes Low when the DC-loop current exceeds a specified level. The threshold level is internally set by the bias voltage of the switch-hook detect circuitry.

Dial pulses can be detected by monitoring the interruption rate at the $\overline{SHK}$ pin. These dial pulses would be debounced by the system's software.

Ring Trip Detection

The interface permits detection of an Off-Hook condition during ringing. If the subscriber set goes Off Hook when the ringing signal has been applied, the DC loop current flow will be detected within approx. 100msecs and the SHK output will go Low. The ringing is automatically disabled by the internal hardware.

Longitudinal Balance

The longitudinal balance specifies the degree of common mode rejection in the 2 to 4 wire direction. Precision laser trimming of internal resistors in the hybrids ensures good overall longitudinal balance.

The interface circuitry can operate in the presence of induced longitudinal currents of up to 40mA rms at 60Hz.

DTMF

The DTMF tones are transmitted and received at the 4 wire port.

High Voltage Capability

Inherent in the thick film process is the ability of the substrate to handle high voltage. The standard Mitel thick film process provides dielectric strengths of greater than 1000 VAC or 1500 VDC. The thick film process allows easy integration of surface mount components such as the high voltage bipolar power transistor line drivers. This allows for simpler, less elaborate and less expensive protection circuitry required to handle high voltage transients and fault conditions caused by lightning, induced voltages and power line crossings

On hook Transmission

The MH88622 provides for on-hook transmission which supports features such as Automatic Number Identification (ANI). The ANI information is a FSK signal originating from and sent by the C.O. during the off period of the ringing voltage being sent to the subscribers set. The signal is present during the off period between the first and second ring. The subscribers set decodes the FSK signal and displays the calling party's number.

Loop Length

The MH88622 can accommodate loop lengths of up to 2000Ω minimum (including the subscriber equipment). This corresponds to approximately 6km using 26AWG twisted pair or 12km using 24AWG twisted pair.

Absolute Maximum Ratings* - Voltages are with respect to AGND.

	Parameter	Sym	Min	Max	Units
1	Supply Voltages - Referenced to	V_{EE}	+0.3	-15	V
	V_{SS} (GND	V_{DD}	-0.3	+15	V
		V_{DCRI}	-0.3	+180	V
		V_{Bat}	-60	0.3	V
2	Operating Temperature	T_{AMB}	-40	+85	°C
3	Storage Temperature	T_S	-55	+125	°C

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

DC Electrical Characteristics†

		Characteristics	Sym	Min	Typ*	Max	Units	Test Conditions
1	SUPPLY	Operating Supply Voltages	V_{EE}	-4.5	-5	-5.5	V	
			V_{DD}	4.5	5	5.5	V	
			V_{DCRI}	110	120	160	V	
			V_{BAT}	-60	-24	-20	V	
2		Operating Supply Currents	I_{EE}		30		mA	On-Hook
			I_{DD}		30		mA	On-Hook
			I_{DCRI}		15		mA	Ringing (REN = 1) Idle
			I_{Bat}		5		mA	
3	INPUTS	High Level Input Voltage LR, TC, ESE	V_{IH}	4.5			V	
4		Low Level Input Voltage LR, TC, ESE	V_{IL}			0.5	V	
5		High Level Input Current LR, TC, ESE	I_{IH}			700	µA	
6		Low Level Input Current LR, TC, ESE	I_{IL}			10	µA	
7	OUTPUTS	High Level Output Current $\overline{SHK}$	I_{OH}		4		mA	
8		Low Level Output Current $\overline{SHK}$	I_{OL}		4		mA	
9		High Level Output Voltage $\overline{SHK}$	V_{OH}	4.5	5	5.5	V	
10		Low Level Output Voltage $\overline{SHK}$	V_{OL}	0	0.1	0.7	V	
11		Constant Current Line Feed	I_{Loop}		30		mA	
12		Maximum Operating Loop	R_L			500	Ω	@ 30mA -24V
						1500	Ω	@ 30mA -48V inclusive of telephone set
13		Power Consumption	P_C				mA	

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

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AC Electrical Characteristics† - Voltages are with respect to GNDA unless otherwise stated.

	Characteristics	Sym	Min	Typ‡	Max	Units	Test Conditions
1	Gain VR TO 2-wire Gain relative to Gain @ 1kHz			0 ±0.15		dB	Input 1.0Vrms 1kHz @ VR, ZLoad = 600Ω 300 - 3.4kHz
2	Gain 2-wire to VX Gain relative to Gain @ 1kHz			-6 ±0.15		dB	Input 3dBm 1kHz across Tip & Ring 300 - 3.4kHz
3	Off-Hook Detect Threshold			10		mA	
4	Transhybrid Loss		22			dB	200 - 3.4kHz
5	Ringing Signal Voltage		40			V_{rms}	Min 65Vdc differential between DCRI & VBat
6	Ringing Frequency		17		68	Hz	
7	Ringing Capability		4			REN	1750Ω impedance @ 20Hz min
8	Power Supply Rejection Ratio V_{Bat} V_{DD}/V_{EE} V_{RS}	PSRR		 30 30 30		dB	Ripple 0.1VPP 1kHz
9	2-wire Return Loss		20	30		dB	Input 0.5Vrms 1kHz across Tip & Ring ZLoad 600Ω
10	Longitudinal to Metallic Balance		58	60		dB	Input 0.5Vrms 200Hz
11	Input ac impedance (2-wire) -1 variant (600Ω) -2 variant (220Ω + 820Ω // 115nF) -3 variant (370Ω + 620Ω // 310nF) -4 variant (200Ω + 680Ω // 100nF)	ZIN		 600 900 700 823		Ω	1kHz @ 2-wire
12	Input Impedance @ VR			230		kΩ	
13	Output Impedance @ VX			10		Ω	
14	Total harmonic Distortion at VX at Tip or Ring	THD		 1.0 1.0		 % %	 Input 6dBm @ 2-wire Input 1V at VR
15	Common Mode Rejection Ratio 2-wire to VX	CMRR	40			dB	Input 0.5V, 1kHz @ metallic output voltage
16	Idle Channel Noise at VX at 2-wire	Nc		 12 8		dBrnC	

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

Voltages are with respect to ground (VSS), TA = 25°C unless otherwise stated.
Test condicitons unless noted, VDD = 5V, VRS = 140V, VBat = 24V

AC Electrical Characteristics† - Voltages are with respect to GNDA unless otherwise stated.

	Characteristics	Sym	Min	Typ*	Max	Units	Test Conditions
1	On-Hook Transmission Signal Input Level Gain			 6	2.0	V_{rms} dB	VBat = -48V T-R load = 10kΩ min ZLoad
2	External Signal Output Level		1.75	2.2		V_{rms}	VBat = 48V T-R load = 200Ω ZLoad
3	$\overline{SHK}$/Rise Time Fall Time	t_R t_F		1 1		ms ms	Dial Pulse Dectection
4	Analog Signal Overload Level @ Tip & Ring				4	dBm	@ 1kHz
5	Ring Trip Delay			100		ms	
6	Absolute Gain Variation			±.15		dB	0dBm @ T-R 1kHz
7	Relative Gain, reference to 1kHz			±.1		dB	300Hz - 3.4kHz

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

Notes: Impedance set to variant impedance.
Test condition uses a Zin value as specified by variant number.
Test conditions use a transmit and receive gain set to 0dB default and a Zin value of 600Ω unless otherwise stated.

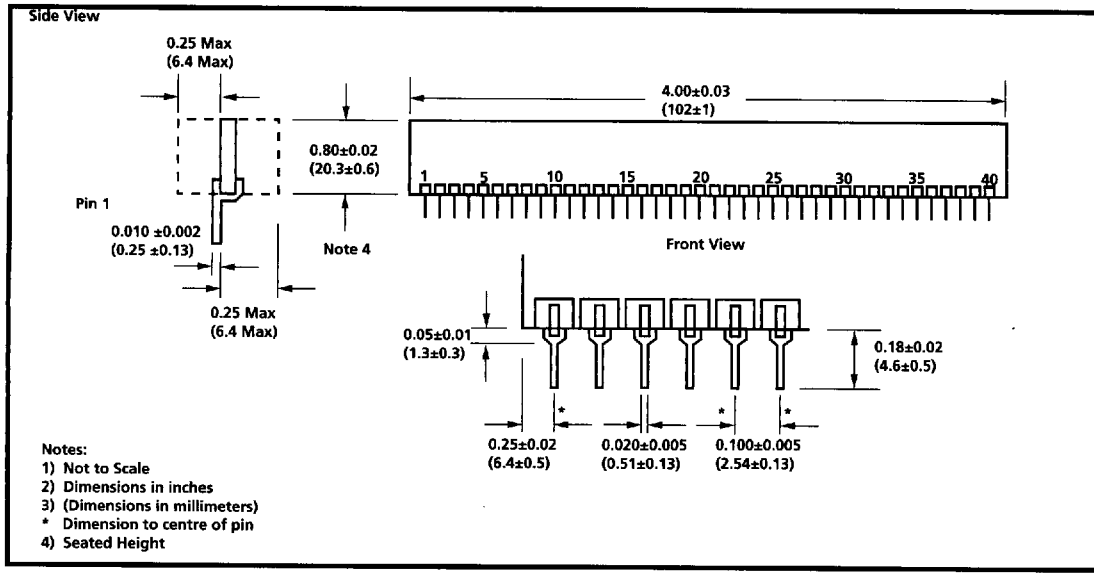

Figure 5 - Mechanical Data