MH88612K

Subscriber Line Interface Circuit
Preliminary Information

DS5066 ISSUE 3 April 1995

Ordering Information

MH88612K 30 Pin SIL Package

0∝C to 70∝C

Features

- Input impedance 600 Ω
- Transformerless 2-wire to 4-wire conversion
- Battery and ringing feed to line
- Off-hook and dial pulse detection
- Ring ground over-current protection
- Adjustable constant current feed
- Relay drive output with diode protection
- Power Denial
- Wide V_{BAT} Operating Range
- Tip/Ring Reversal

Applications

Line interface for:
- PABX
- Intercoms
- Key Telephone Systems
- Control Systems

Description

The SLIC provides a complete interface between a switching system and subscriber loop. Functions provided include battery feed, ringing feed and tip-ring reversal to the subscriber line, 2-Wire to 4-Wire hybrid interfacing, constant current feed and dial pulse detection. The device is fabricated as a thick film hybrid using various technologies.

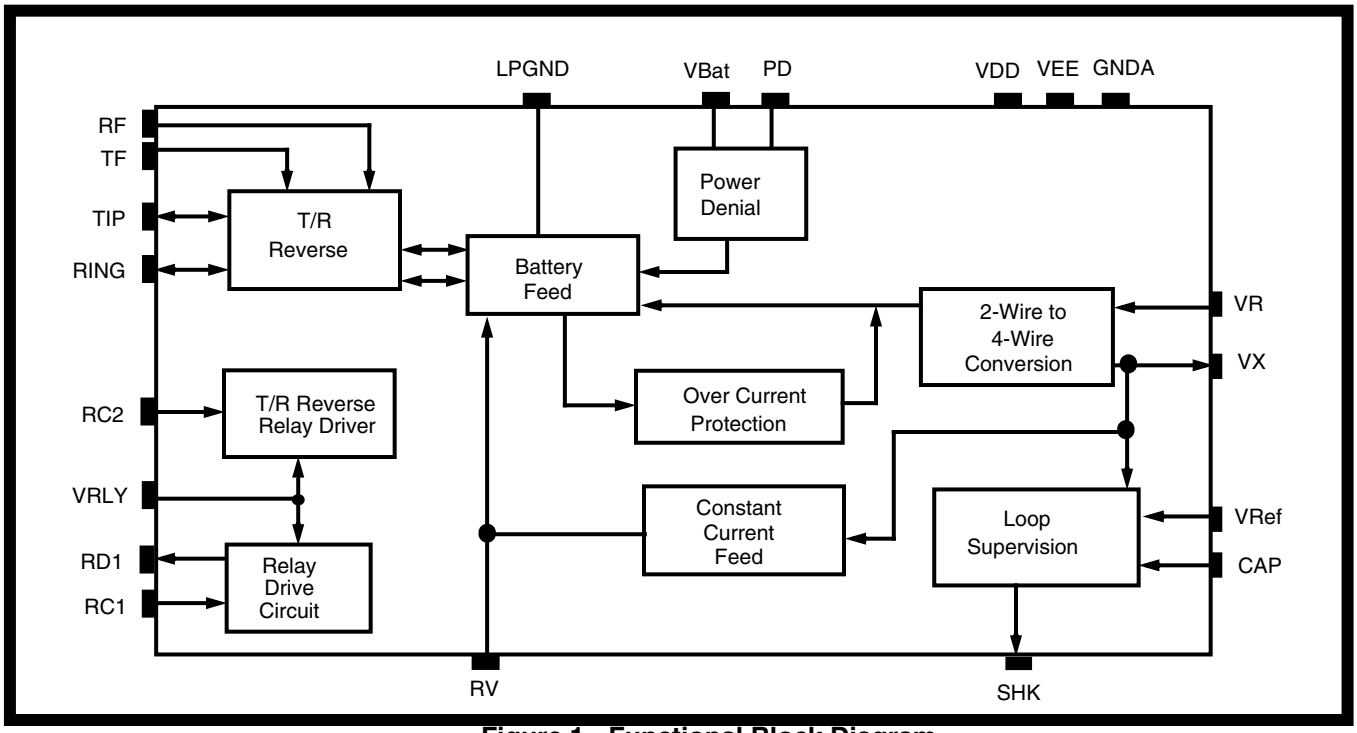


Figure 1 - Functional Block Diagram

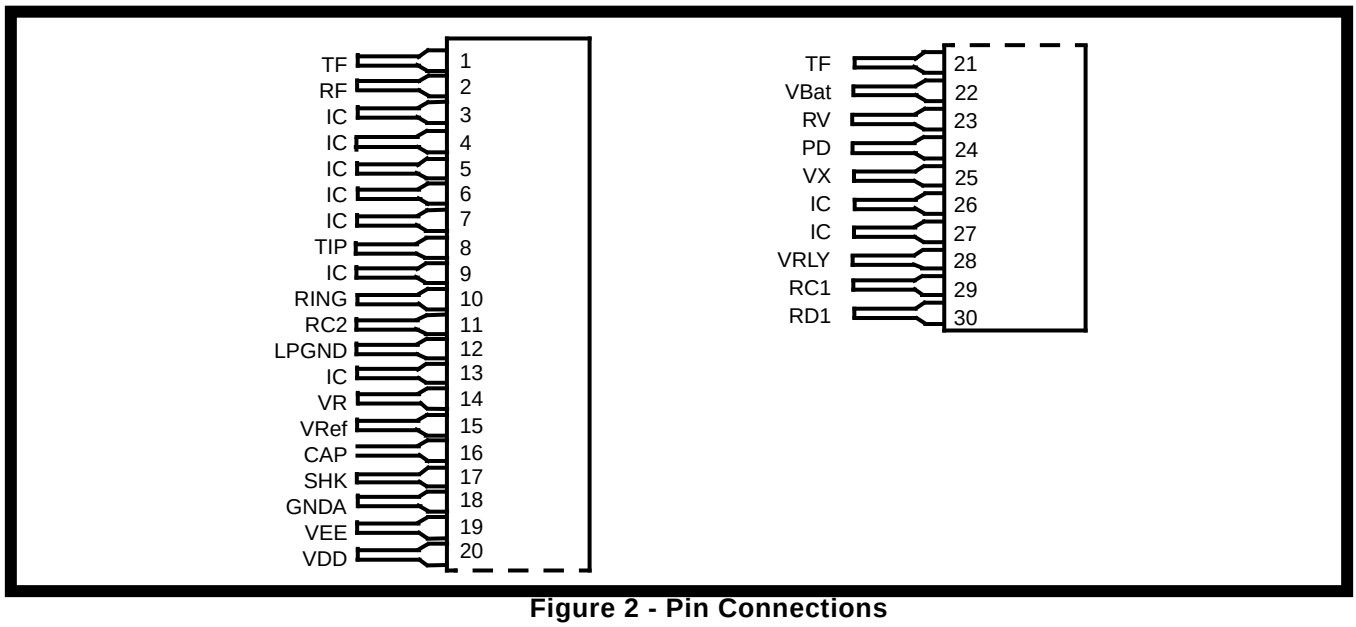


Figure 2 - Pin Connections

Pin Description

Pin #	Name	Description
1	TF	**Tip Feed.** Connects to external diode for protection. Internally connected to pin 21.
2	RF	**Ring Feed (Input)**. is normally connected to ring relay for negative battery feed voltage and ringing voltage input.
3	IC/NC	No Connections to be made to this pin, used for internal connection.
4	IC/NC	No Connections to be made to this pin, used for internal connection.
5	IC/NC	No Connections to be made to this pin, used for internal connection.
6	IC/NC	No Connections to be made to this pin, used for internal connection.
7	IC/NC	No Connections to be made to this pin, used for internal connection.
8	TIP	Connects to the “Tip” lead of the telephone line.
9	IC/NC	No Connections to be made to this pin, used for internal connection.
10	RING	Connects to the “Ring” lead of the telephone line.
11	RC2	**Relay Control 2 (Input**). Active high to reverse Tip/Ring.
12	LPGND	**Loop Ground** is the system ground reference with respect to V_{Bat}. Normally tied with GNDA.
13	IC/NC	No Connections to be made to this pin, used for internal connection.
14	VR	**Voice Receive (Input)** is the 4-wire analog signal to the SLIC**.**
15	VRef	**Voltage Reference (Input).** to set the constant current feed to the subscriber line. Constant current feed can be adjusted by the input voltage on the V_{Ref}. This pin can also be grounded for normal 25mA loop current.
16	CAP	Connects external capacitor to ground for ring trip.
17	SHK	**Switch Hook Detect (Output).** Active high
18	GNDA	**Analog Ground (0V)**
19	VEE	**Negative Power Supply Voltage (-5V).**
20	VDD	**Positive Power Supply Voltage (+5V).**
21	TF	**Tip Feed**. Connect an external diode for protection. Internally connected to pin 1.
22	VBat	**Negative Battery Feed Supply Voltage** (-48V).

Pin Description (Continued)

Pin #	Name	Description
23	RV	**Ring Feed Voltage** connects to (RF) through a normally closed ring relay.
24	PD	**Power Denial (Input).** A logic high will isolate the battery voltage to tip/ring.
25	Vx	**Voice Transmit (Output).** is the 4-wire analog signal from the SLIC.
26	IC/NC	No connections to be made to this pin, used for internal connection.
27	IC/NC	No connections to be made to this pin, used for internal connection.
28	VRLY	**Relay Voltage Supply (+5V).** This pin is used to power the on board relay.
29	RC1	**Relay Control 1 (Input).** Active high. Normally used for ringing.
30	RD1	Open collector sinks current when RC1 is at logic high.

Functional Description

The SLIC performs a transformerless 2-wire to 4-wire conversion of the analog signal. The 2-wire circuit is the balanced line going to the subscriber loop, while the 4-wire circuit is the audio signal going to and from devices such as the voice codec or switching circuit. The SLIC also provides a switch hook (SHK) status output which goes high when the telephone is set off-hook.

Constant Current Feed

The SLIC employs a complex feedback circuit to supply a constant feed current to the line. This is done by sensing the sum of the voltages across the internal feed resistors and comparing it to an input reference voltage (V_{Ref}) that determines the constant feed current. If V_{REF} is externally grounded, the constant current is set at 25mA. For a constant current setting between 18mA and 30mA. V_{Ref} can be set between 8.75 Vdc and -6.35 Vdc. The relationship is defined by the equation:

$$I_{Loop} = 25 - \frac{V_{Ref}}{1.25} \text{ mA } (\pm 2 \text{ mA})$$

Switch Hook Detection

When the DC current exceeds an internal threshold level, the switch hook (SHK) will go high. If the loop resistance is so high that V_{BAT} can no longer supply the required amount of loop current as determined by constant current supply circuit, the output of the switch hook (SHK) will go low to indicate that the loop resistance is too high and the line is on hook.

Ringing And Ring Trip Detection

In Figure 3 a ringing signal (e.g., 90 Vrms +-48 Vdc is applied to the line by disconnecting (RV) from (RF), and connecting the ringing voltage at (RF) by use of the relay K1. An internal clamp diode is provided between VRLY and RD1.

The SLIC can detect an off-hook condition during ringing but there is a large AC component which must be filtered out to give a true off-hook condition at SHK.

A 1.0µF capacitor connected from (Cap) to ground will provide adequate attenuation when ringing is applied. Once an off-hook condition has been detected a logic high should be applied to (RC) which will activate the relay (K1) to disconnect the ringing voltage from (RF) and reconnect to (RV). At that time SLIC will revert to constant current feed operation.

For applications requiring Dial Pulse Detection the Capacitor connection to ground should be controlled such that the capacitor is only connected during ringing. During off-hook conditions (closed loop), the capacitor should be switched out. This can be performed using a transistor, relay to system drive output of a codec. Applying GNDA to the Ring Trip Filter Control pin will switch in the filter, whilst removing GNDA, (with the switch in a tristate condition), will switch out the filter.

For applications using DTMF signalling, the capacitor can be permanently connected to ground.

Tip/Ring Reverse

The MH88612K provides a Tip/Ring reversal relay driver. To activate the internal relay to reversal Tip and Ring apply a logic input to RC2.

Current Limit

The Tip or Ring may be accidentally shorted to ground. In such a case, current will only flow through the feed resistor. This high current will be sensed

and reduced by the current limit circuit to a lower value to protect the internal circuitry.

Receive Gain

The power denial function is a feature of the MH88612C which allows for powering down of the subscriber loop. A logic high input applied to the power denial pin effectively removes the battery voltage from the loop driver circuitry. The resulting I_{Loop} is negligible and power consumption is minimised. The power denial function is useful for disabling a loop which may have a ground fault. This pin should be held low when not in use.

Applications

Component List

R1 = 1/4 W, ± 10%, 200Ω
R2 = 1/4 W, ± 5%, 470Ω
C1 = Cap. elec., 1.0µF, ± 10%, 25V
D1,D2,D3,D4 = Diode Rect., 200V, 1A, IN4003
K1 = Relay E/M, 5 or 6V, 1 form C

Decoupling capacitors (Cap. Cer 0.1µF, 50% + 20%) should be added to V_{DD}, V_{EE}, V_{Bat}, V_{Ref} and V_{RLY}

Options RV1, RV2 = 160V Vrms, 250V, 10J

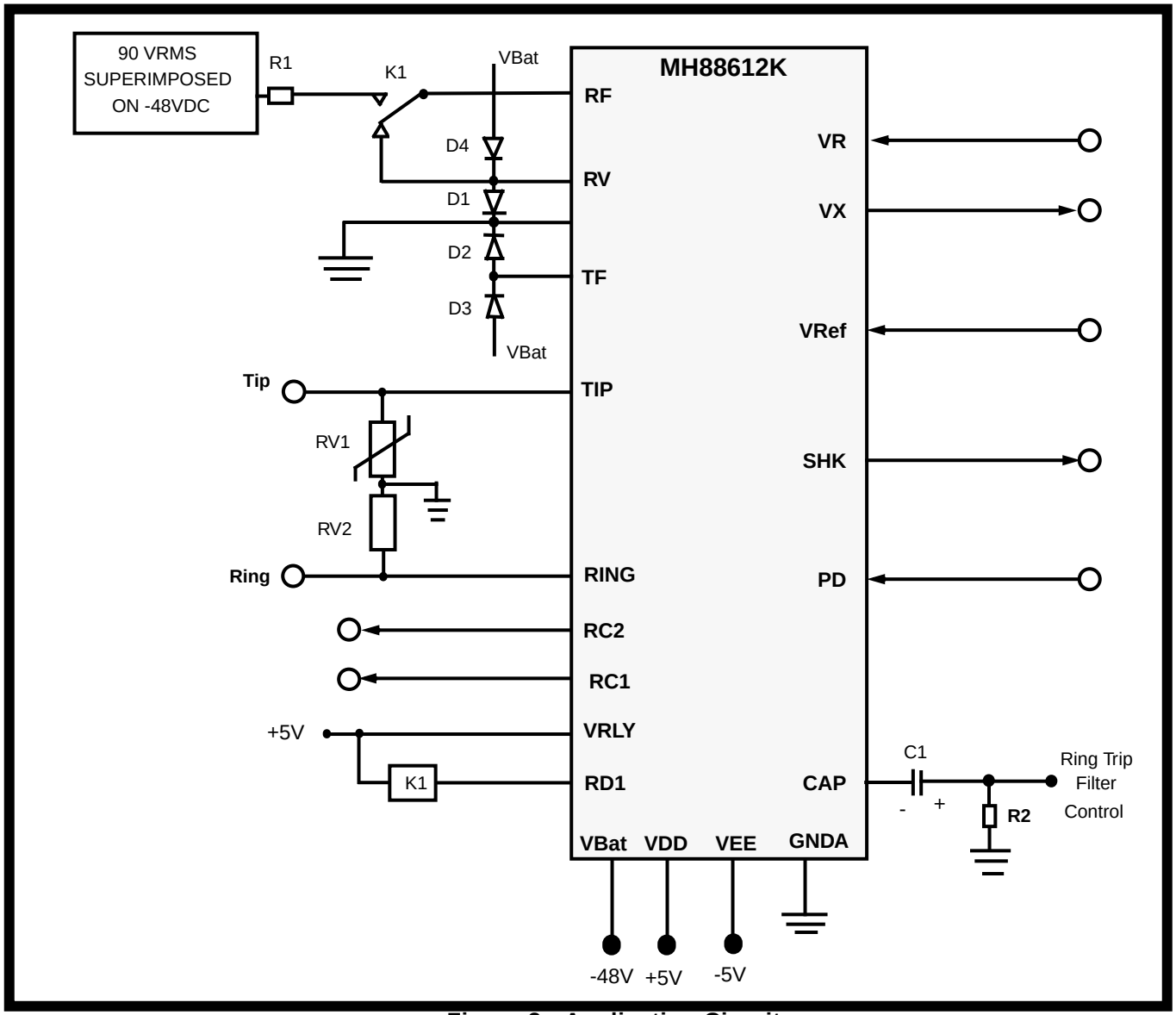


Figure 3 - Application Circuit

Absolute Maximum Ratings*

	Parameter	Symbol	Min	Max	Units
1	DC Supply Voltage	V_{DD} V_{EE} V_{Bat}	-0.3 +0.3 0.3	+15 -15 -60	V V V
2	Storage Temperature	T_{STG}	-40	100	°C
3	Package Power Dissipation	P_D		2	W

* 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	Operating Supply Voltage	V_{DD}	4.75	5.0	5.25	V	
		V_{EE}	-4.75	-5.0	-5.25	V	
		V_{Ref}		0		V	Adjustable
		V_{Bat}	-27	-48	-60	V	
		V_{RLY}		5		V	
2	Operating Temperatures	T_O	0		70	˚C	

† Typical figures are at 25˚C and are for design aid only.

DC Electrical Characteristics* - Voltages are with respect to GNDA unless otherwise stated.

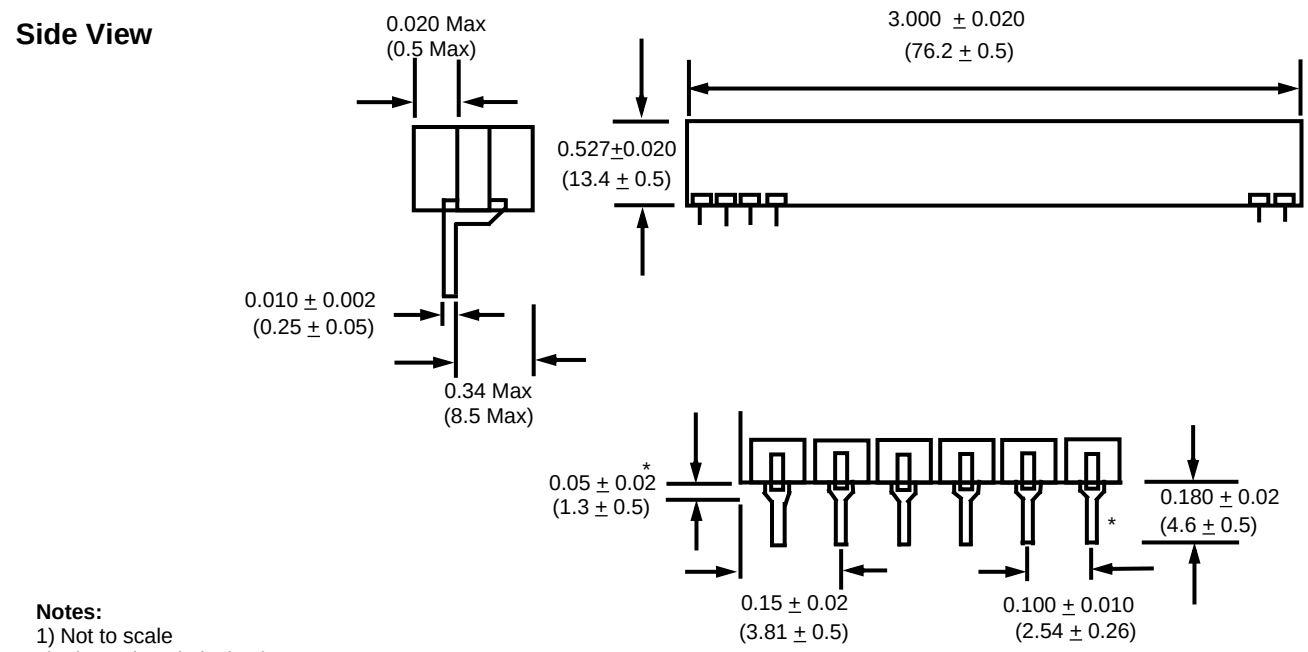
	Characteristics	Sym	Min	Typ†	Max	Units	Test Conditions
1	Supply Current V_{DD} V_{EE} V_{Bat}	 I_{DD} I_{EE} I_{BAT}		 5.8 -2.6	 500	 mA mA µA	 PD = Logic high
2	Power Consumption	P_C		210 1410		mW mW	Standby Active
3	Constant Current Line Feed	I_{Loop}	23	25	27	mA	V_{Ref} = GNDA, V_{Bat} = -48V
4	Adjustable Loop Current Range Operating Loop Resistance	I_{Loop}	18		30	mA	Adjustable with Ext. V_{Ref} Input, V_{Bat} = -48V
5	Ring Ground Over-Current	R_{Loop}			1200	Ω	V_{Bat} = -28V @ I_{Loop} = 18mA, R_{Loop} includes telephone set
6	Protection Off-Hook Detect				40	mA	
7	Output Low Voltage (On-hook) Output High Voltage (Off-hook) Off- Hook Detect	 V_{OL} V_{OH}	 0 2.7		 0.4 5.25	 V V	Active high logic
8	Output Low Current (on-hook) Input High Current. (off-Hook) RC1,RC2, PD Control Inputs	 I_{OL} I_{OH}			 8 -400	 mA µA	
9	Input Low Volt. (no activation) Input High Volt. (activation) RC1, RC2, PD control Inputs	 V_{IL} V_{IH}	 2.0		 0.7	 V V	Active high logic
10	Input Low Current (no activation) Input high current (activation)	 I_{IL} I_{IH}			 -50 50	 µA µA	

* DC Electrical Characteristics are over recommended operating supply voltages.
† Typical figures are at 25°C with nominal ±5V supplies and are for design aid only.

AC Electrical Characteristics

	Characteristics	Sym	Min	Typ*	Max	Units	Test Conditions
1	Ringing Voltage	V_{RING}	40 17	80	110 25	V_{rms} Hz	Superimposed on V_{BAT} = -48V
2	Ringer Equivalence Number	REN			3		
3	Ring Trip Detect time			100	125	ms	
4	Input AC Impedance 2-wire	Z_{in}		600		Ω	
5	Input Impedance at V_R			100		kΩ	
6	Output Impedance at Vx			10		Ω	
7	Gain 2-wire to Vx Gain relative to Gain @ 1kHz			-1.0 ±0.1		dB	Input 3 dBm, 1kHz across Tip and Ring, 300-3400
8	Gain VR to 2-wire Gain relative to Gain @ 1kHz			-1.0 ±0.25		dB dB	(Input 1.0 V_{rms} 1kHz at V_R Z_{Load} = 600Ω 300-3400 Hz)
9	2-wire Return Loss over 300-3400Hz		20	30		dB	Input 0.5 V_{rms} 1kHz across Tip and Ring, Z_{Load} = 600Ω
10	Transhybrid Loss over 300-3400 Hz	THL	35	50		dB	Input 0.5V V_{rms} at VR Z_{Load} = 600Ω
11	Longitudinal to Metallic Balance		50	55		dB	Input 0.5 V_{rms}
12	Total Harmonic Distortion at Vx at Tip and Ring	THD		0.1 0.1	1.0 1.0	% %	Input 3dBm, 1 kHz across Tip and Ring, Input 1.0 V_{rms} 1kHz at V_R
13	Common Mode Rejection Ratio 2-wire to Vx	CMRR	40	50		dB	Input 0.5 Vrms, 1KHz
14	Idle channel Noise (at Vx)	Nc			12	dBrnC	C- Message
15	Power supply rejection ratio V_{DD} V_{EE} V_{BAT}	PSRR	 30 30 30	 35 40 60		 dB dB dB	1 V_{PP} ripple, 1kHz on V_{DD} V_{EE}, V_{BAT}, measure at Vx and across Tip and Ring

* Typical figure are at 25°C and are for design aid only: not guaranteed and not subject to production testing.



Notes:
1) Not to scale
2) Dimensions in inches).
3) (Dimensions in millimetres).
*Dimensions to centre of pin & tolerance non accumulative.

Figure 4 - Mechanical Data



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