Subscriber Line Interface Circuit (SLIC)

Data Sheet

August 2006

Features

- Transformerless 2-wire to 4-wire conversion
- Battery and ringing feed to line
- Off-hook and dial pulse detection
- Ring ground over-current protection
- Constant current feed with constant voltage foldover
- Relay driver
- Power Denial
- Wide Operating Range
- Pin for pin compatible 600R and 900R variants

Applications

Line interface for:

- PABX
- Intercoms
- Key Telephone Systems
- Control Systems

Ordering Information

MH88612BV-K1 20 Pin SIL* Boxed
*Pb Free Matte Tin

0°C to 70°C

Description

The SLIC provides a complete interface between a switching system and a subscriber loop. Functions provided include battery feed and ringing feed to the subscriber line, 2-Wire to 4-Wire hybrid interfacing, constant current feed with constant voltage foldback, and dial pulse detection. The device is fabricated using thick film hybrid technology in a 20-pin single in-line package.

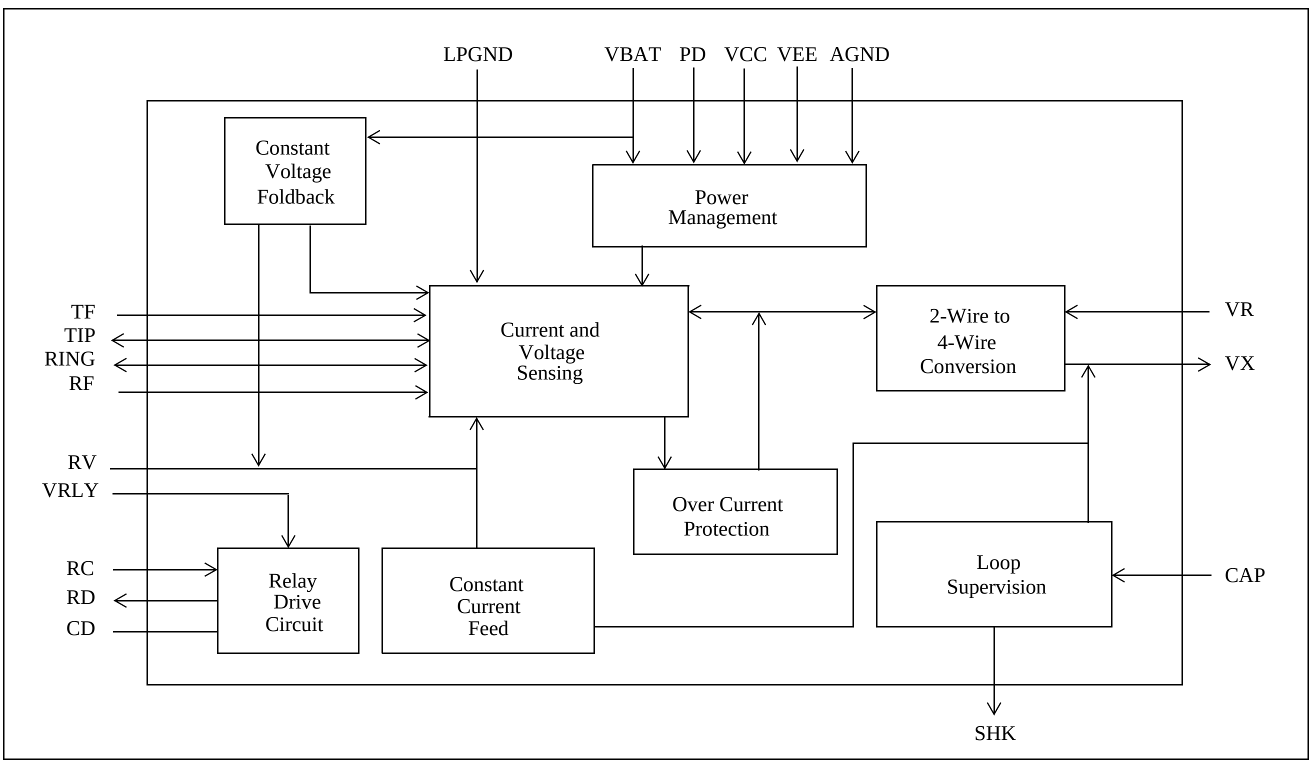


Figure 1 - Functional Block Diagram

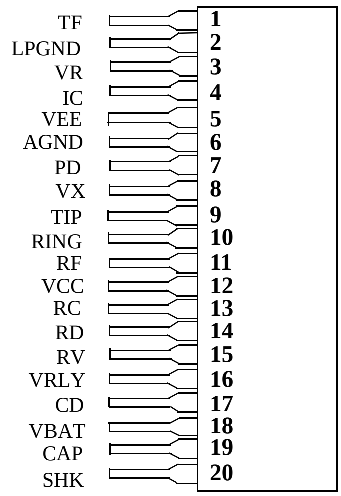


Figure 2 - Pin Connections

Pin Description

Pin#	Name	Description
1	TF	**Tip Feed.** Connects to external diode for protection
2	LPGND	**Loop Ground**. Is the system ground reference with respect to VBAT. Normally connected to AGND.
3	VR	**Voice Receive (Input).** The 4 wire analog signal to the device.
4	IC	**Internal Connection.** No connection should be made to this pin
5	VEE	**Negative Power Supply Voltage (-5 V).**
6	AGND	**Analog Ground.** Connects to System Ground (Earth).
7	PD	**Power Denial (Input)**. A logic high will isolate the battery voltage to Tip/Ring.
8	VX	**Voice Transmit (Output)**. The 4-wire analog signal from the device.
9	TIP	**Tip Lead**. Connects to the "Tip" lead of the telephone line.
10	RING	**Ring Lead.** Connects to the "Ring" lead of the telephone line.
11	RF	**Ring Feed (Input).** Normally connected to Ring relay for negative battery feed voltage and ringing voltage input.
12	VCC	**Positive Power Supply Voltage (+5 V).**
13	RC	**Relay Control (Input)**. Active high.
14	RD	**Relay Drive.** Open collector sinks current when RC is at logic high.
15	RV	**Ring Feed Voltage.** Normally connected to pin 11 (RF) through a normally closed relay and to external diode protection.

Pin Description

Pin#	Name	Description
16	VRLY	**Relay voltage Supply (+5 V).**
17	CD	**Clamping Diode**. Normally connected to AGND.
18	VBAT	**Negative Battery Feed Supply Voltage (-48 V).** Battery supply for the Subscriber Line. Typically -48VDC is applied to this pin.
19	CAP	**Ring Trip Filter Capacitor.** Normally connected via an external capacitor to ground to prevent false ring trip. Must be open circuit to allow dial pulse detection.
20	SHK	**Switch Hook Detect (Output).** A logic level 1 will indicate that the Subscriber Line is in the 'Off-Hook' state.

Note 1: C4 in Figure 3 can be added permanently to this pin for certain dial pulse applications.

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 MH88612BV-K family employs complex feedback circuits to supply a constant current feed or, if necessary, constant voltage feed to the line. With a nominal -48 V battery the device will supply a constant current of typically 25 mA to a line up to 1100 Ω. For longer lines there is insufficient battery voltage so the device automatically switches to constant voltage mode where Tip and Ring will stay at their minimum and maximum voltage levels and the supplied current will be reduced accordingly. The maximum line resistance supported is 2000 Ω including the telephone set.

Switch Hook Detection

The SHK pin will go to logic 1 to indicate that a telephone connected to the line has gone off-hook (on-line). Off-hook will not be indicated if the loop resistance (including the telephone set) is too high for the device to support.

The SHK output will toggle to indicate dial pulses on the line. If the capacitor on CAP (Pin 19) has not been switched out of circuit the dial pulses will be distorted.

Ringing And Ring Trip Detection

In Figure 3 a ringing signal (e.g.,90 Vrms and -48Vdc) is applied to the line by disconnecting pin 15 (RV) from pin 11(RF), and connecting the ringing voltage at pin 11 (RF) by use of the relay K1.

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 1.0 μF capacitor connected from pin 19 (CAP) to ground will provide adequate attenuation when ringing is applied. Once an off-hook condition has been detected a logic low should be applied to pin 13 (RC) which will deactivate the relay (K1) to disconnect the ringing voltage from pin 11 and reconnect to pin 15. At that time the SLIC will revert to constant current feed operation.

For applications requiring Dial Pulse Detection the Capacitor connection to ground C1 should be controlled such that the capacitor is disconnected during Pulse Dialling.

If the signalling method is unknown, a capacitor of approximately 56 nf should be permanently fitted between CAP (pin 19) and ground. This should be in addition to the capacitor mentioned in the above paragraph.

During off-hook conditions (on-line), the capacitor (C1) should not have a low impedance path to ground. This can be achieved using a transistor (Q1) and resistor (R2) as shown in Figure 3, with R2 providing a high impedance path for C1. When ringing is applied (RC = 5V) the transistor will short circuit R2 which will give C1 a low impedance path to ground and provide the required filtering.

Other methods can be used to switch out C1, such as a relay or a codec system drive output (with a similar configuration as above).

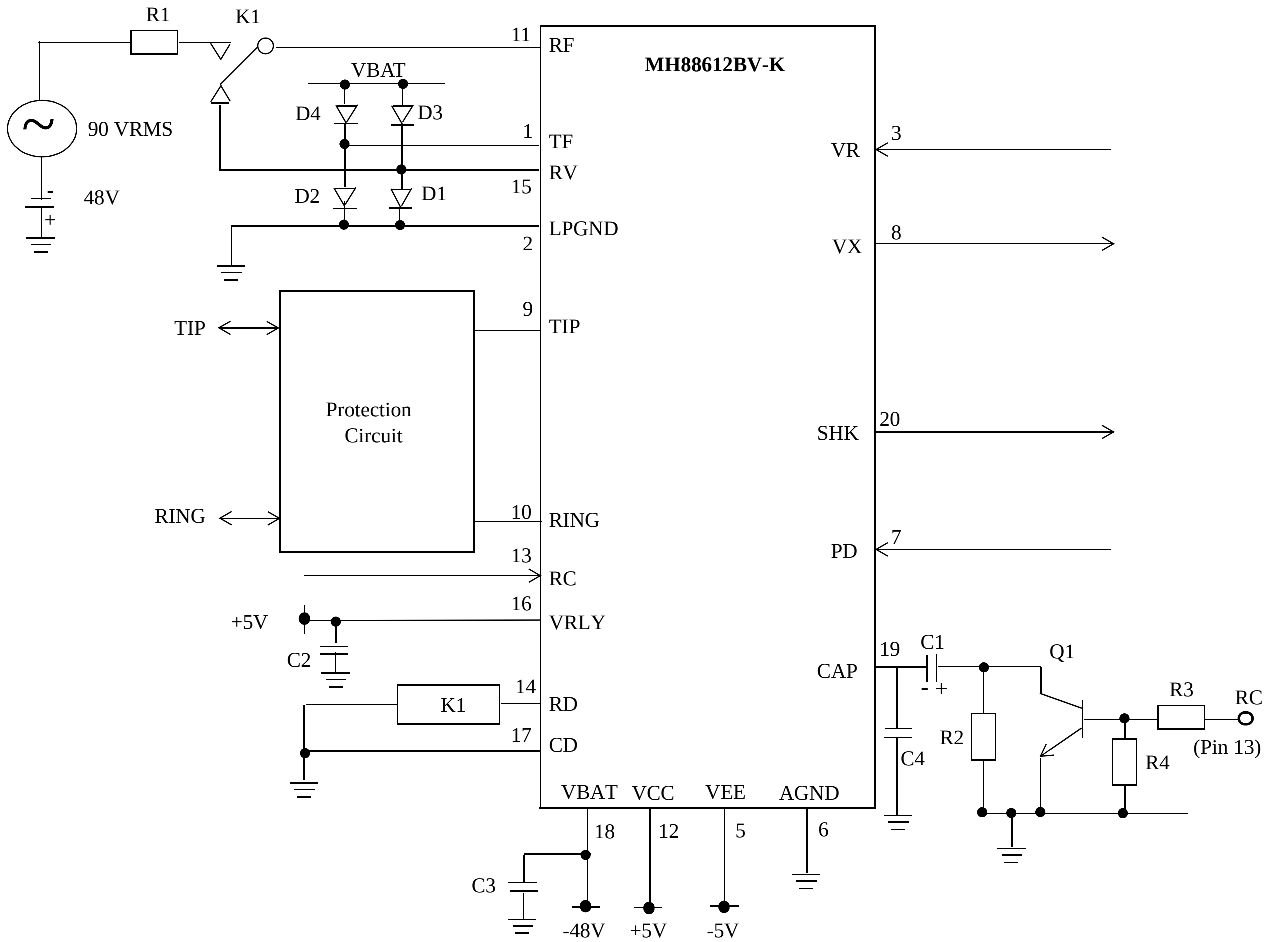
For applications using DTMF signalling, C1 can be permanently connected to ground.

Current Limit

The Tip or Ring of the telephone line may accidentally be 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.

Power Denial

The power denial function is a feature of the MH88612 which allows for powering down of the subscriber loop. A logic high voltage applied to the power denial input effectively removes the battery voltage from the loop driver circuitry. The resulting I_{LOOP} is negligible and power consumption is minimized. The power denial function is useful for disabling a loop which may have a ground fault.



Component List

= earth = ground

R1	200Ω ± 10%, 1/4W
R2	470kΩ ± 5%, 1/4W
R3, R4	10kΩ ± 5%, 1/4W
C1	1.0µF, ± 10%, 25V electrolytic capacitor
C2, C3	0.1µF, ± 20%, 50V ceramic de-coupling capacitors
D1,D2, D3, D4	Diode rectifier 200V, 1A, IN4003
Q1	General purpose switching transistor
K1	Relay E/M, 5V or 6V, 1 Form C
C4	10nF - 56nF 20% 16V capacitor

Protection Circuit - Depending on the application the Protection circuit may need to provide over-voltage and/or over-current protection. In certain circumstances no protection will be required.

Figure 3 - Typical Application Circuit

Absolute Maximum Ratings*

	Parameter	Symbol	Min.	Max.	Units
1	DC Supply Voltage LPGND = AGND	V_{CC} V_{EE} V_{BAT} V_{RLY}	-0.3 -9 -60 -0.3	9 0.3 0.3 40	V V V V
2	Storage Temperature	T_S	-40	100	°C
3	Package Power Dissipation	PD		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	Test Conditions
1	Operating Supply Voltage	V_{CC} V_{EE} V_{BAT} V_{RLY}	4.75 -5.25 -54	5.0 -5.0 -48 5	5.25 -4.75 -42	V V V V	
2	Relay Driver Current	I_{RLY}			100	mA	
3		T_o	0		70	°C	

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

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

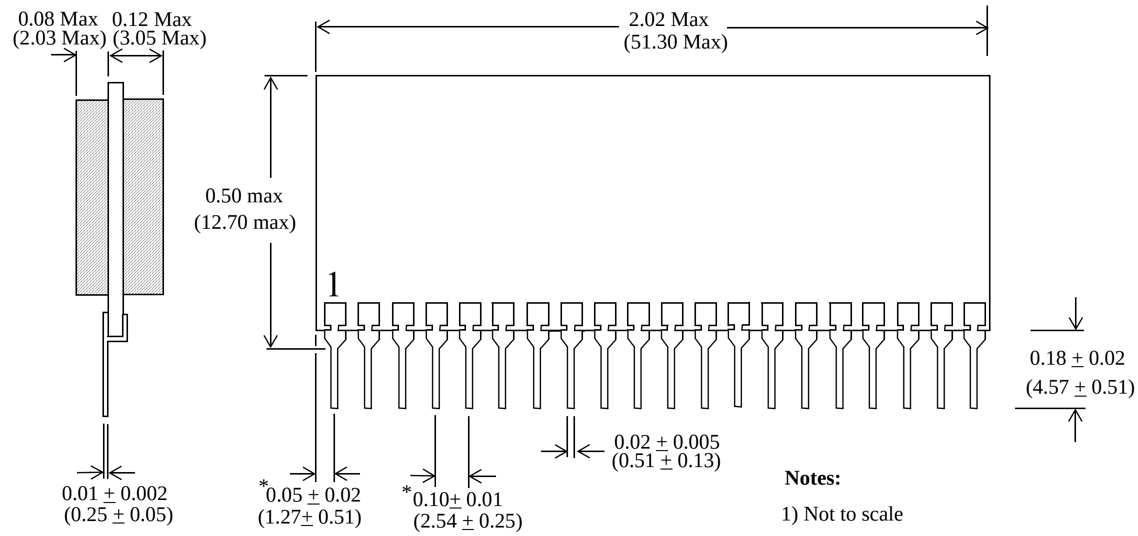
	Characteristics	Sym.	Min.	Typ.‡	Max.	Units	Test Conditions
1	Supply Current V_{CC} V_{EE} V_{BAT}	I_{CC} I_{EE} I_{BAT}		7.5 -5.1 3	 800	mA mA µA mA	 PD = Logic High PD = Logic Low, Idle
2	Power Consumption	P_C		160 1600		mW mW	Standby V_{BAT} = -48V Active (Off Hook)
3	Constant Current Line Feed	I_{Loop}	23 15	25 16.5	27 19	mA mA	R_{Loop} <1100Ω R_{Loop} ≤2000Ω V_{BAT} = -48V
4	Operating Loop Resistance	R_{Loop}			2000	Ω	V_{BAT} = -48V @ I_{Loop} = 16mA, R_{Loop}includes telephone set
5	Ring Ground Over-Current protection				45	mA	V_{BAT} = 48V
6	Off-Hook Detect Output Low Voltage (On-hook) Output High Voltage (Off-hook)	 V_{OL} V_{OH}	 2.7		 0.4	 V V	Active high logic I_{OL} = 8mA I_{OL} = -100mA
7	RC, PD Control Input Input Low Volt (no activation) Input High Volt (activation)	 V_{IL} V_{IH}	 2.0		 0.7	 V V	Active high logic LSTTL compatible
8	RC, PD control Input Input Low Current (no activation) Input high current (activation)	 I_{IL} I_{IH}			 50 0.5	 µA mA	
9	PD Control Input Input Low Current Input High Current	 I_{IL} I_{IH}			 0.5 0.3	 mA mA	

† 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 Frequency	V_{RING} F_{RING}	 17		90 25	V_{rms} Hz	Superimposed on V_{BAT} = -48V
2	Ringer Equivalence Number	REN			2		
3	Ring Trip Detect time			200	300	ms	
4	Input AC Impedance 2-wire	Zin		600 900		Ω Ω	MH88612BV-K MH88612BV-4K
5	Input Impedance at VR			100		kΩ	
6	Output Impedance at VX			10		Ω	
7	Gain 2-wire to VX Gain relative to Gain @ 1kHz		-1.3 -0.3	-1.0	-0.7 +0.3	dB	Input + 3dBm, 1kHz across Tip and Ring 300-3400 Hz
8	Gain VR to 2-wire Gain relative to Gain @ 1kHz		-1.3 -0.3	-1.0	-0.7 +0.3	dB dB	Input 0.5Vrms 1kHz at VR Z_{Load} = 600Ω 300 - 3400 Hz
9	2-wire Return Loss over 300-3400Hz		20	30		dB	Input 0.5Vrms, 1kHz across Tip and Ring Z_{Load}= 600Ω
10	Transhybrid Loss	THL	20	30		dB	300-3400 Hz Z_{Load}= 600Ω
11	Longitudinal to Metallic Balance		40 46	55 55		dB dB	300-600Hz 600-3400Hz
12	Total Harmonic Distortion at VX at Tip and Ring	THD		 0.1 0.1	 1.0 1.0	 % %	 Input + 3dBm, 1kHz across Tip and Ring Input 1.0Vrms 1kHz at VR
13	Common Mode Rejection Ratio 2-wire to VX	CMRR	 40	 50		dB	Input 0.5Vrms, 1kHz
14	Idle channel Noise	Nc			+14	dBrnC	@ 2 Wire and VX C- Message weighted
15	Power supply rejection ratio V_{CC} V_{EE} V_{BAT}	PSRR	 26 26 26			 dB dB dB	 100 mV_{PP} ripple, 1kHz on $V_{CC}/V_{EE}/V_{BAT}$, measure at VX and across Tip and Ring

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



Notes:

1) Not to scale

2) Dimensions in inches.
(Dimensions in millimetres)

3) Pin tolerances are non-accumulative.

4) Recommended soldering conditions:
wave soldering max. temp: 260°C for
10 secs.

* Dimensions to centre of pin.

Figure 4 - Mechanical Data

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