



Wake on Sound™
Piezoelectric MEMS Microphone
Evaluation Module

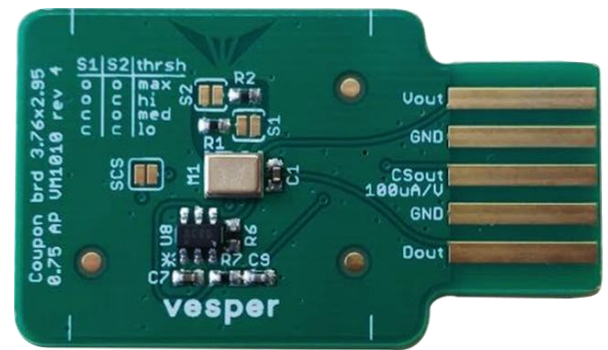
Data Sheet

PMM-3738-VM1010-EB-R

PUI Audio, with Vesper's exclusive technology, presents the world's first ZeroPower Listening™ piezoelectric MEMS microphone—the PMM-3738-VM1010-R—designed for ultra-low power, always-listening devices. The PMM-3738-VM1010-EB-R provides users a simple way to evaluate this microphone's performance.

Features:

- ZeroPower Listening™ technology
- Full audio output on wake-up
- Capable of voice detection with just 9 μ W operating power
- Extends Battery life up to 10x
- Dust and moisture resistant (IP test results pending)
- Easy-to-use evaluation board



The **PMM-3738-VM1010-R** is a single-ended analog MEMS microphone with *Wake on Sound*. The *Wake on Sound* mode allows for detection of voice activity while consuming only 5 μ A of supply current (9 μ W of power). In *Wake on Sound* mode, a sound in the vocal band above the level threshold (set by the designer) instantly alerts a processor of an acoustic event to “wake-up” the device.

Wake on Sound delivers voice activation to battery-powered voice-interface consumer devices—while drawing nearly zero power—such as smart speakers, smart TV remote controls, smart headphones, and IoT smart home products.



Specifications

All specifications are at 25°C, VSupply = 1.8 V unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
-----------	--------	------------	------	------	------	-------

Normal Mode Acoustic Specifications

Sensitivity		1 kHz, 94 dB SPL	-41	-38	-35	dBV
Signal-to-Noise Ratio	SNR	94 dB SPL at 1 kHz signal,		60		dB(A)
		20 Hz – 20 kHz, A-weighted Noise				
Signal-to Noise Ratio Voice Band	SNR	94 dB SPL at 1 kHz signal,		62		dB(A)
		20 Hz – 8 kHz, A-weighted				
Total Harmonic Distortion	THD	94 dB SPL		0.1		%
Acoustic Overload Point	AOP	10.0% THD		122		dB SPL
Roll Off Frequency		-3db at 1 kHz		100		Hz
Directivity			Omni			

Wake on Sound Acoustic Specifications

Acoustic Threshold	PaTH	Peak Acoustic Stimulus $R_g^1 = \text{Open}$		78		SPL
Acoustic Threshold	PaTH	Peak Acoustic Stimulus, $R_g^1 = 300 \text{ k}\Omega$		72		SPL

Preliminary

Normal Mode Electrical Specifications

Supply Voltage	VDD		1.6	1.8	3.6	V
Supply Current		$V_{DD} \leq 3.6$ V, Mode Normal		85	110	μ A
Power Supply Rejection Ratio	PSRR	VDD = 1.8, 1kHz, 200mV _{PP} Sine wave		-42		dB
Power Supply Rejection	PSR	VDD = 1.8, 217Hz, 100mV _{PP} square wave, 20 Hz – 20kHz, A-weighted		-74		dB(A)
Output Impedance	Z _{OUT}			700		Ω
Output DC Offset				0.8		V

Wake on Sound Mode Electrical Specifications

Supply Voltage	VDD		1.6	1.8	3.6	V
Supply Current		$V_{DD} \leq 3.6$ V, Mode WoS		5		μ A

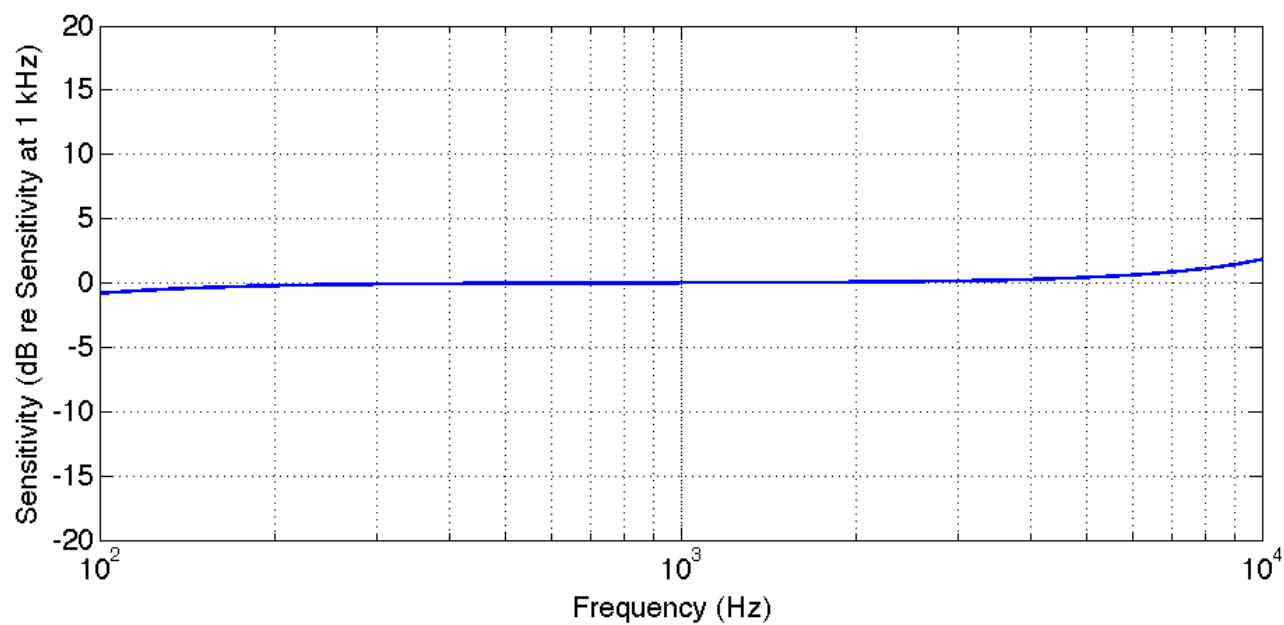
Digital Electrical Interface Specifications

Logic Input High			0.65*VDD		3.6	V
Logic Input Low			-0.3		0.35*VDD	V
Logic Output High		I _{Load} = 2mA	0.7*VDD	VDD		V
Logic Output Low		I _{Load} = 2mA		0	0.3*VDD	V
Driving Capability					100	pF

Absolute Maximum Ratings

Parameter	Maximum	Units
Supply Voltage	3.6	V
Sound Pressure Level	160	dB re 20 μ Pa
Temperature Range	-40 to +85	$^{\circ}$ C

Frequency Response (Normal Mode)



Environmental Robustness

IP adherence is evaluated by 1 kHz Sensitivity spec post stress

Ingress Protection Type	Description
Dust Resistance	IP5X

Microphone Modes

mode pin	Mic mode	I _{dd} , typ. (μA)	V _{out} pin	d _{out} pin
high	Wake-on-Sound	5	GND	<i>low, then latches high after first wake-up event</i>
low or floating	Normal-Power	85	<i>audio output</i>	Tied to GND through low impedance

Microphone Operation

The **PMM-3738-VM1010-R** is a user-controlled, multi-mode microphone. Through the single bit digital input pin *mode*, the user provides a signal that will put the microphone into *Wake on Sound* or *Normal* modes of operation. When in the *Wake on Sound* mode, should a sound be detected, the microphone will output a digital high through the *dout* pin. The user can then switch the microphone to *Normal* mode by providing a digital low to the *mode* pin. The user would at some later point, provide a digital high to the *mode* pin to return the microphone to *Wake on Sound* mode. Figure 2 shows the states of various pins that are either user provided (*mode*, *V_{dd}*) or PMM-3738-VM1010-R provided (*dout*, *V_{out}*) at three points of operation.

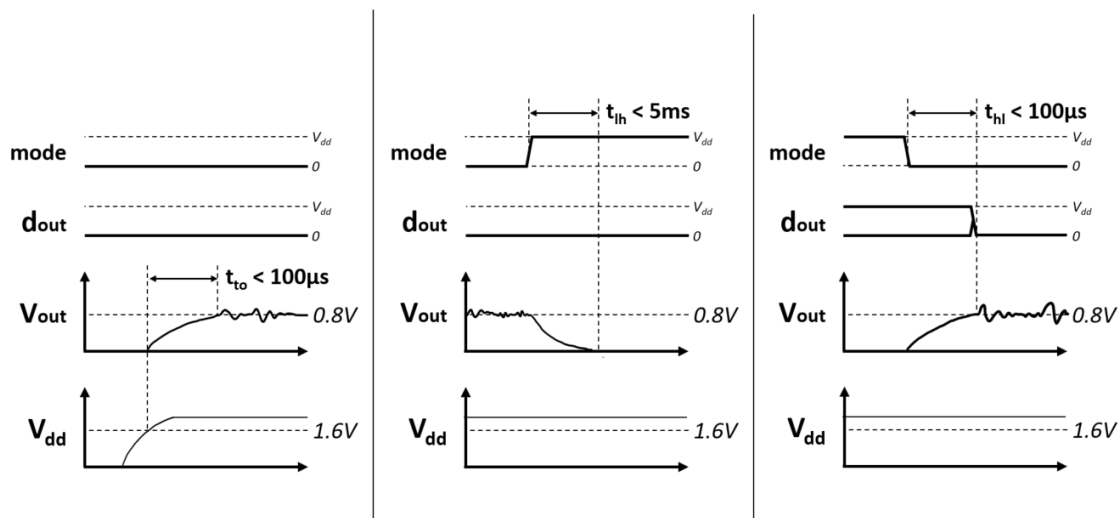


Figure 2: Timing diagrams showing turn-on time (left), transition time into *Wake-on-Sound* mode (center) & *Normal* mode (right)

It is recommend to power up the microphone in *Normal* mode (*mode* pin low), and then enter into *WoS* mode as needed.

System Architecture

A. Control loop for *Wake-on-Sound*:

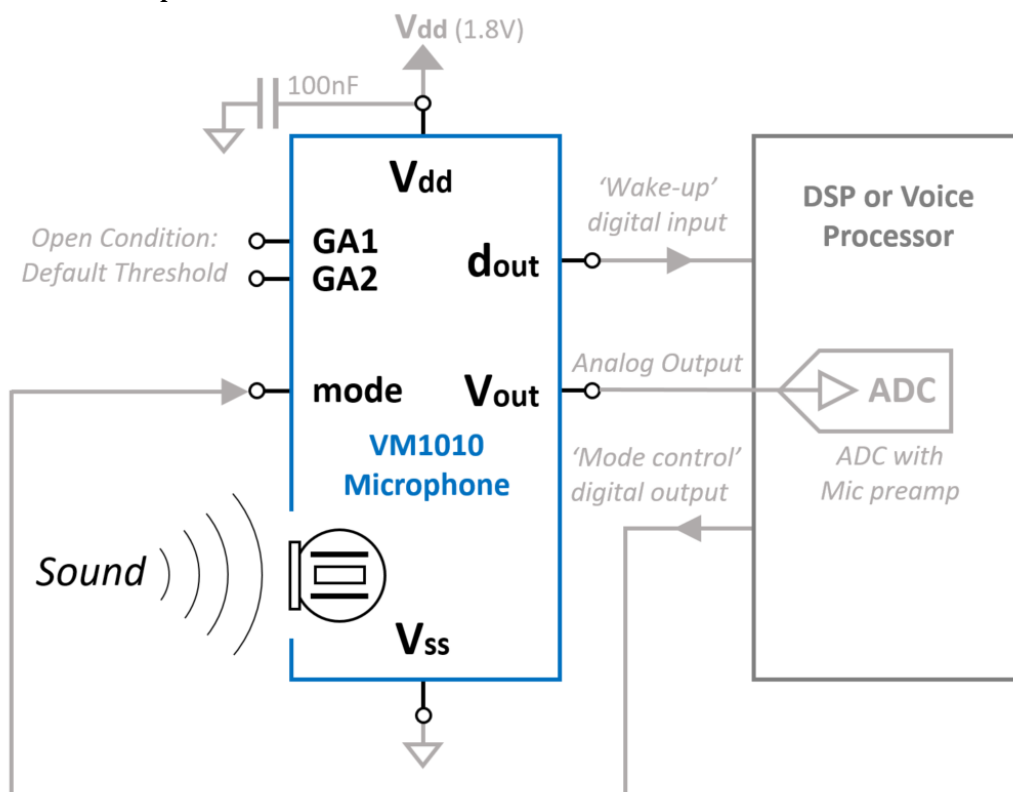
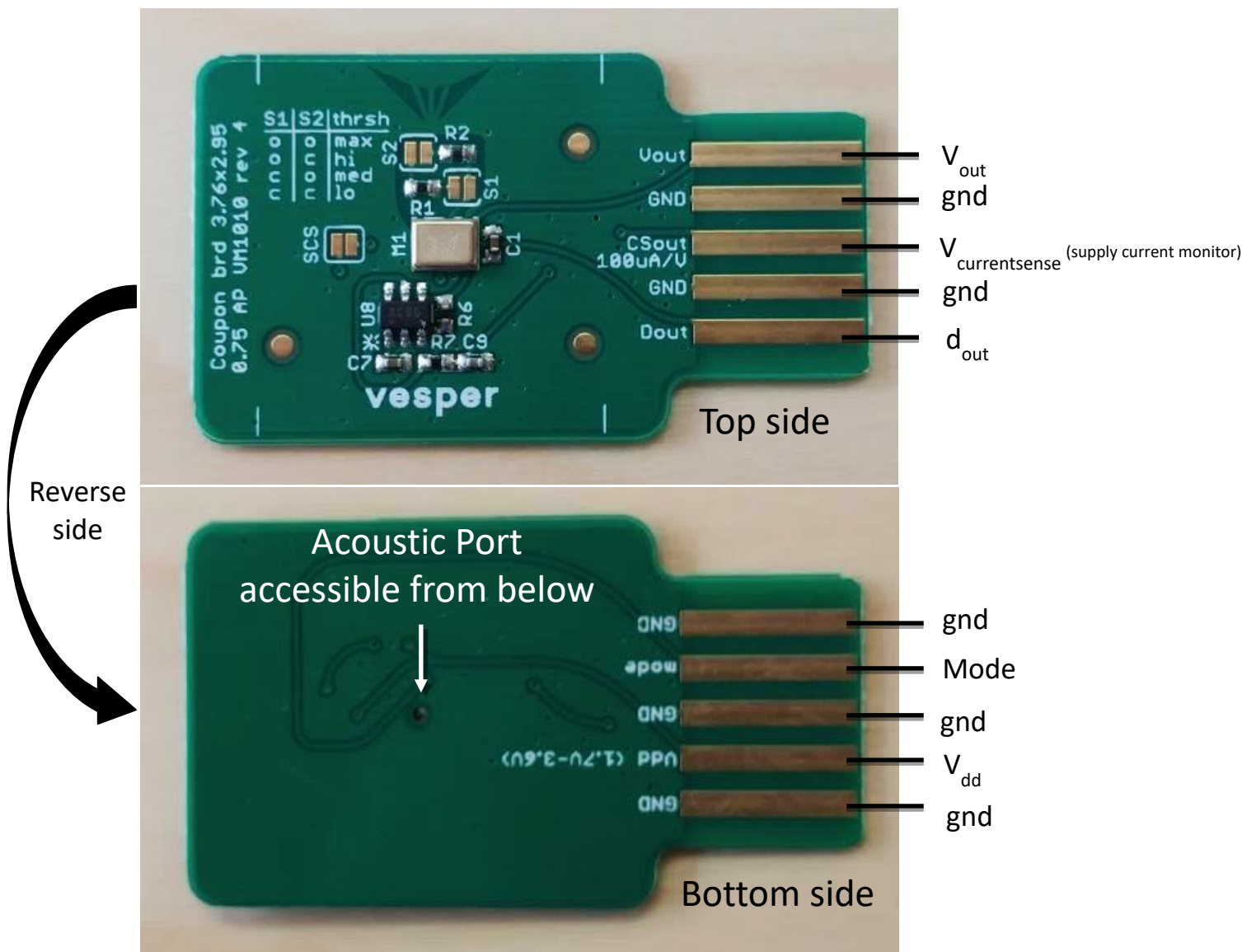


Figure 3: Block diagram of example system built around the PMM-3738-VM1010- R microphone

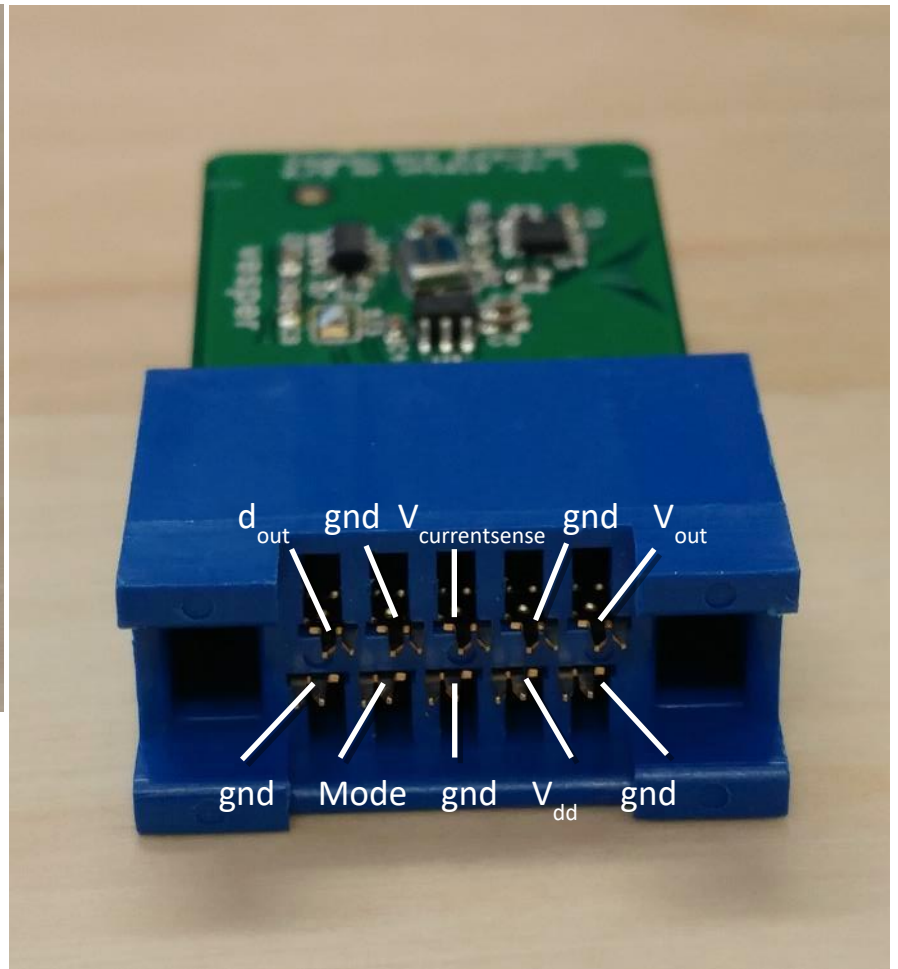
In the figure above, the PMM-3738-VM1010-R microphone wakes up the system when triggered by sound. The DSP or Voice Processor can be kept in a low-power state when there is no sound to process.

Evaluation Board Pinout



Wiring to Edge-Connector

The recommended edge-connector is CW Industries CWR-170-10-0000.

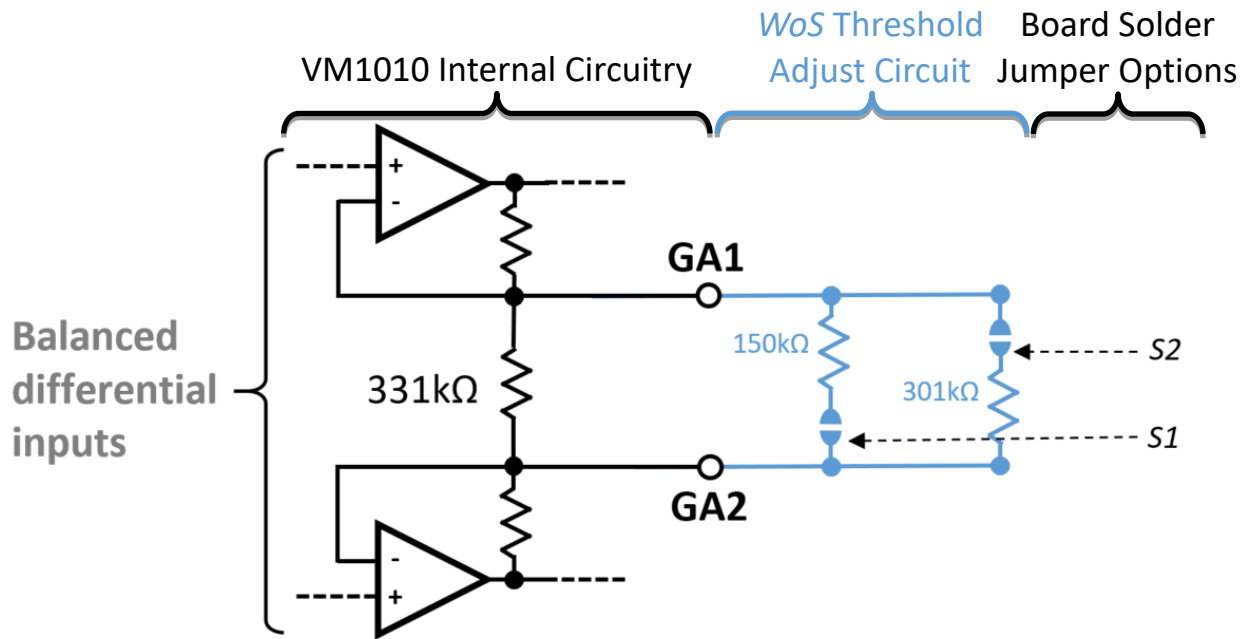


The **V_{dd}** supply range is 1.7V to 3.6V

Wake on Sound threshold adjustment

- The evaluation board has a resistor circuit to configure the Wake-on-Sound threshold to pre-set levels
- The solder jumper options S1 and S2 set the Wake-on-Sound threshold:

S1 State	S2 state	GA1-GA2 impedance	WoS threshold
Open	Open	331 kΩ	78 dBSPL
Open	Closed	158 kΩ	72 dBSPL
Closed	Open	103 kΩ	68 dBSPL
Closed	Closed	77 kΩ	66 dBSPL

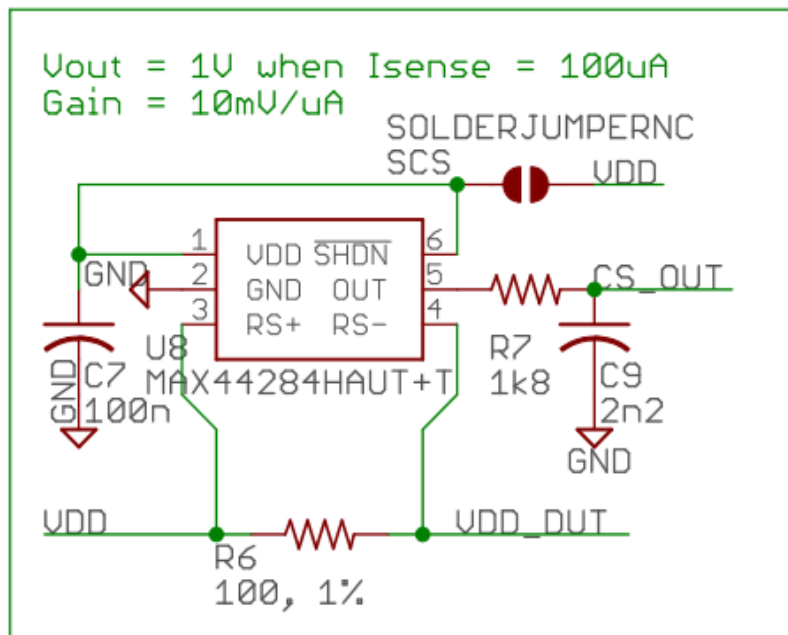


Supply Current Monitor

The PMM-3738-VM1010-EB-R evaluation board has a real-time supply-current monitor that shows the microphone supply-current as a voltage on $V_{\text{supplycurrent}}$.

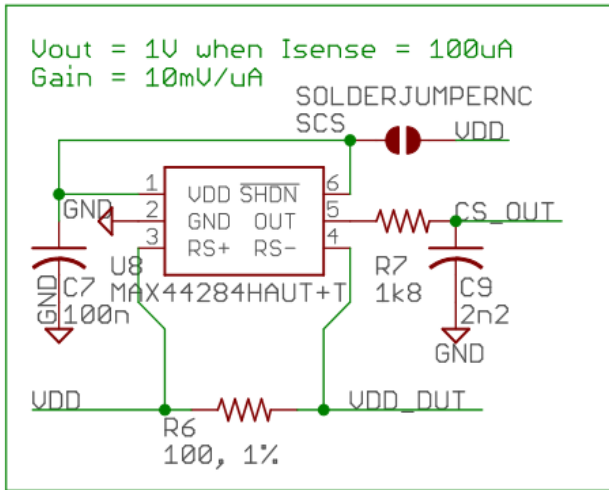
This circuit is implemented with the Maxim MAX44284H amplifier IC and the supply-current monitor has a gain of $10\text{mV}/\mu\text{A}$.

Current Sense

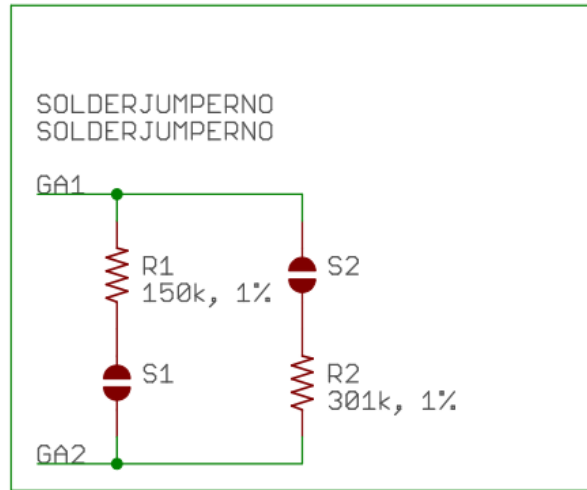


PMM-3738-VM1010-EB-R Full Schematic View

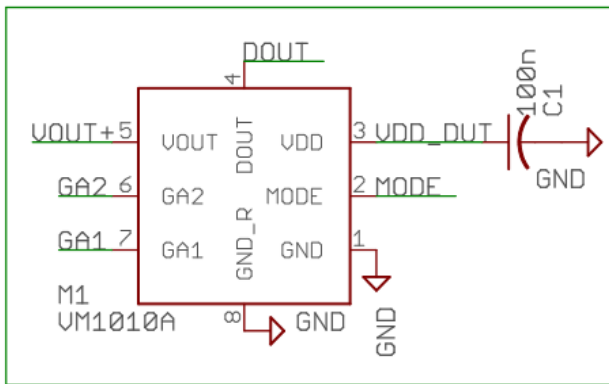
Current Sense



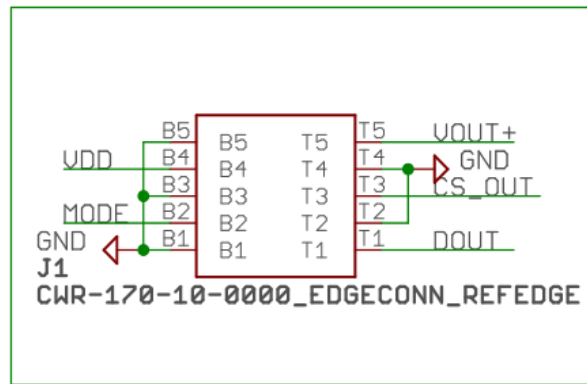
Gain adjust circuit



Mic



Edge connector

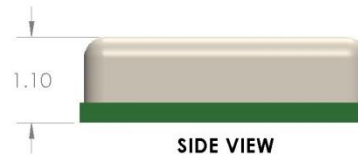
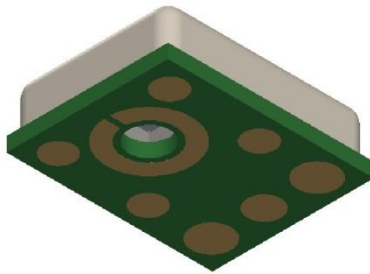
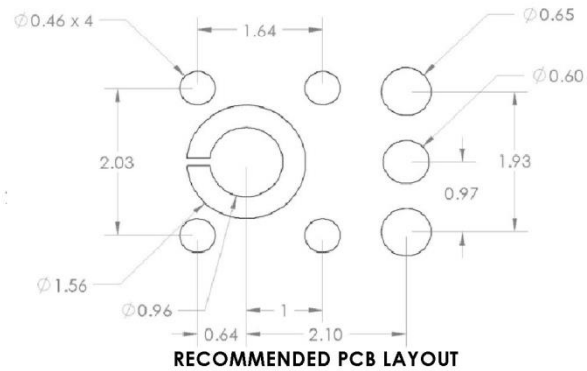
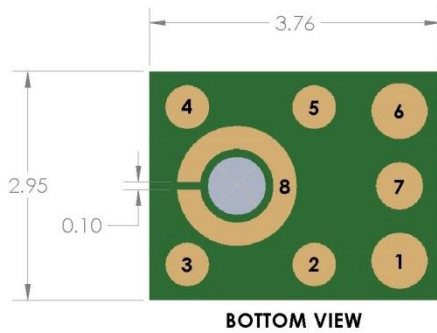


Handling Instructions

PUI Audio's piezoelectric MEMS microphones are very robust to harsh environments such as dust and moisture. However, to avoid mechanical damage to the microphone, we recommend using appropriate handling procedures when manually handling the parts or when using pick and place equipment. The following guidelines will help to avoid damage:

- Do not apply a vacuum to the bottom side of the microphone. A vacuum pen may be used with care on the top side only.
- Do not apply very high air pressure over the port hole.
- Do not insert any large particles or objects in the port hole. The microphone is robust to small particles per IP5x specification.

PMM-3738-VM1010-R Dimensions and Pin Layout



Pin Number	Pin Name	Description
1	V_{out}	Analog Output Voltage
2	GA2	Wake-on-Sound Acoustic Threshold Adjust pin 2
3	GA1	Wake-on-Sound Acoustic Threshold Adjust pin 1
4	GND	Ground
5	mode	Mode control (<i>hi=Wake-on-Sound, lo=Normal-Power</i>)
6	V_{dd}	Power Supply (1.6V to 3.6V)
7	d_{out}	Digital output for Wake-on-Sound trigger
8	GND	Ground

Engineering Samples

Engineering samples are date coded 1737 or lower. Engineering samples may vary from the technical specifications contained in this data sheet, are not intended for use in end-products, and are intended for evaluation and testing, only. The performance of an engineering sample may not reflect the performance of a final product.

Specifications Revisions

Revision	Description	Date
Preliminary	Released from Engineering	6/12/2017
A	Revised Pin Numbers on Drawing	6/26/2017
B	Revised Dimensions on Pins 1, 2, 3, 4, 5, and 6	8/14/2017

Note:

1. All dimensions are in millimeters.
2. Specifications subject to change or withdrawal without notice.
3. This part is RoHS 2011/65/EU Compliant.