**Low-Noise Bottom Port
Piezoelectric MEMS Microphone
with Wake on Sound Feature**

Data Sheet	PMM-3738-VM1010-R

PUI Audio, with Vesper's exclusive technology, presents the **PMM-3738-VM1010-R**: The world's first ZeroPower Listening™ piezoelectric MEMS microphone designed for ultra-low power always listening solution; delivering voice activation to battery-powered devices.

Features:
- ZeroPower Listening™ technology
- Full audio output on wake-up
- Capable of voice detection with just 9 µW operating power
- Extends Battery life up to 10x
- Dust and moisture resistant (IP test results pending)
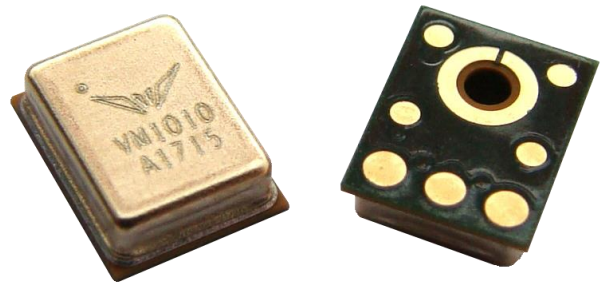
The **PMM-3738-VM1010-R** is a single-ended analog MEMS microphone with *Wake on Sound*. The *Wake on Sound* mode allows for detection of voice activity while consuming only 5 µA of supply current (9 µW of power). In *Wake on Sound* mode, a sound in the vocal band above the level threshold instantly alerts a processor of an acoustic event. The processor (DSP or Voice Processor) then switches the **PMM-3738-VM1010-R** into *Normal* mode, with full audio output within 100 microseconds! Fast enough for the microphone to capture the triggering sound and pass it along for processing. This is the system architecture for *ZeroPower Listening™*.

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Sensitivity		1 kHz, 94 dB SPL	-41	-38	-35	dBV
Signal-to-Noise Ratio	SNR	94 dB SPL at 1 kHz signal, 20 Hz – 20 kHz, A-weighted Noise		60		dB(A)
Signal-to Noise Ratio Voice Band	SNR	94 dB SPL at 1 kHz signal, 20 Hz – 8 kHz, A-weighted		62		dB(A)
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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Acoustic Threshold	PaTH	Peak Acoustic Stimulus Rg^1 = Open		78		SPL
Acoustic Threshold	PaTH	Peak Acoustic Stimulus, Rg^1 = 300 kOhm		72		SPL

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	μA
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		μA

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 µPa
Temperature Range	-40 to +85	°C

Frequency Response (Normal Mode)
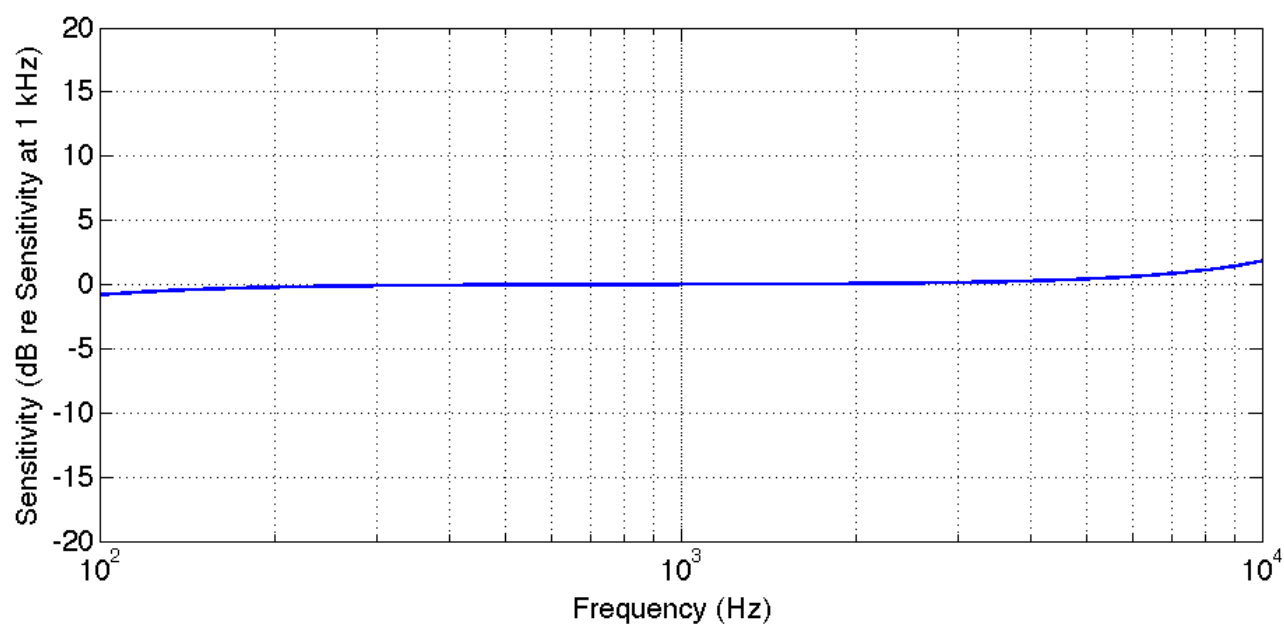
Environmental Robustness

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	*low, then latches high after first wake-up event*
low or floating	Normal-Power	85	*audio output*	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*, *Vdd*) or PMM-3738-VM1010-R provided (*dout*, *Vout*) at three points of operation.
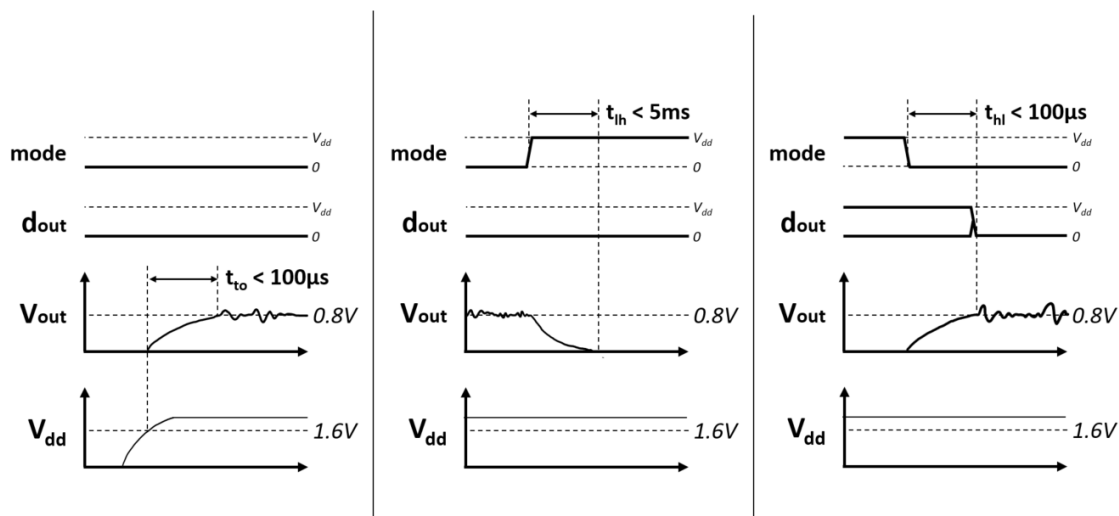

Figure 2: Timing diagrams showing turn-on time (left), transition time into *Wake-on-Sound* mode (center) & *Normal* mode (right)

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

System Architecture

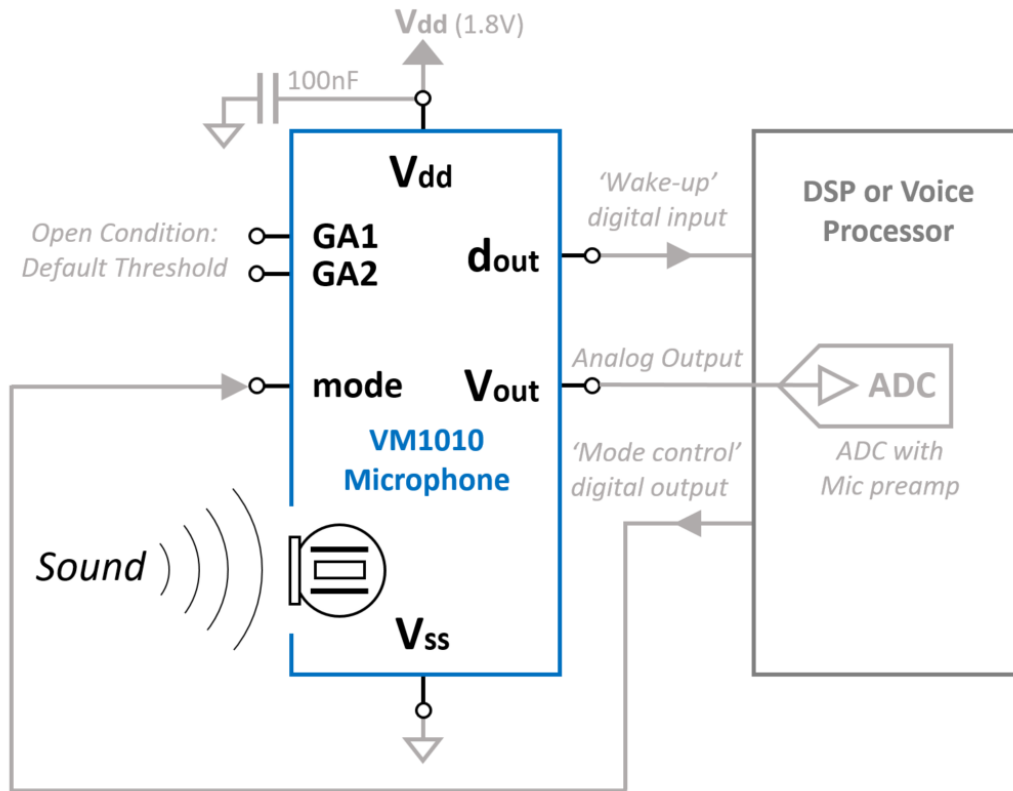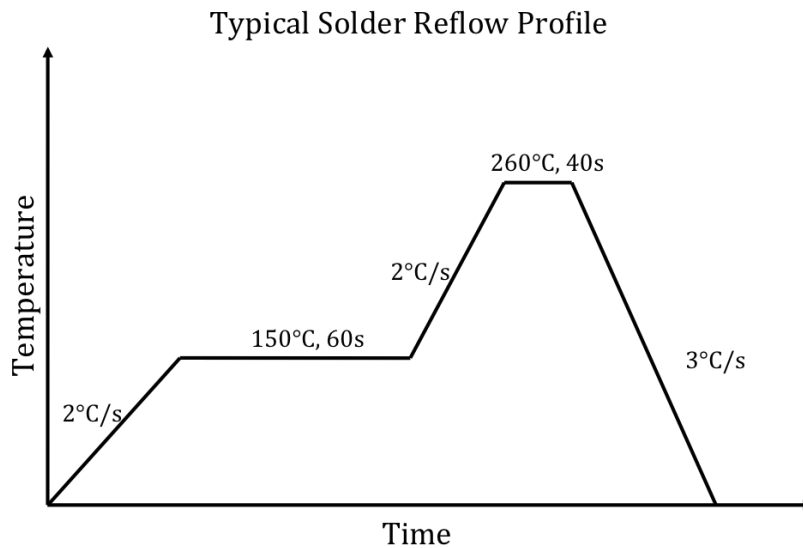   A. Control loop for *Wake-on-Sound*:

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.

Solder Reflow Profile

Typical Solder Reflow Profile

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.
- Do not board wash or clean after the reflow process or expose the acoustic port to harsh chemicals.

Dimensions and Pin Layout
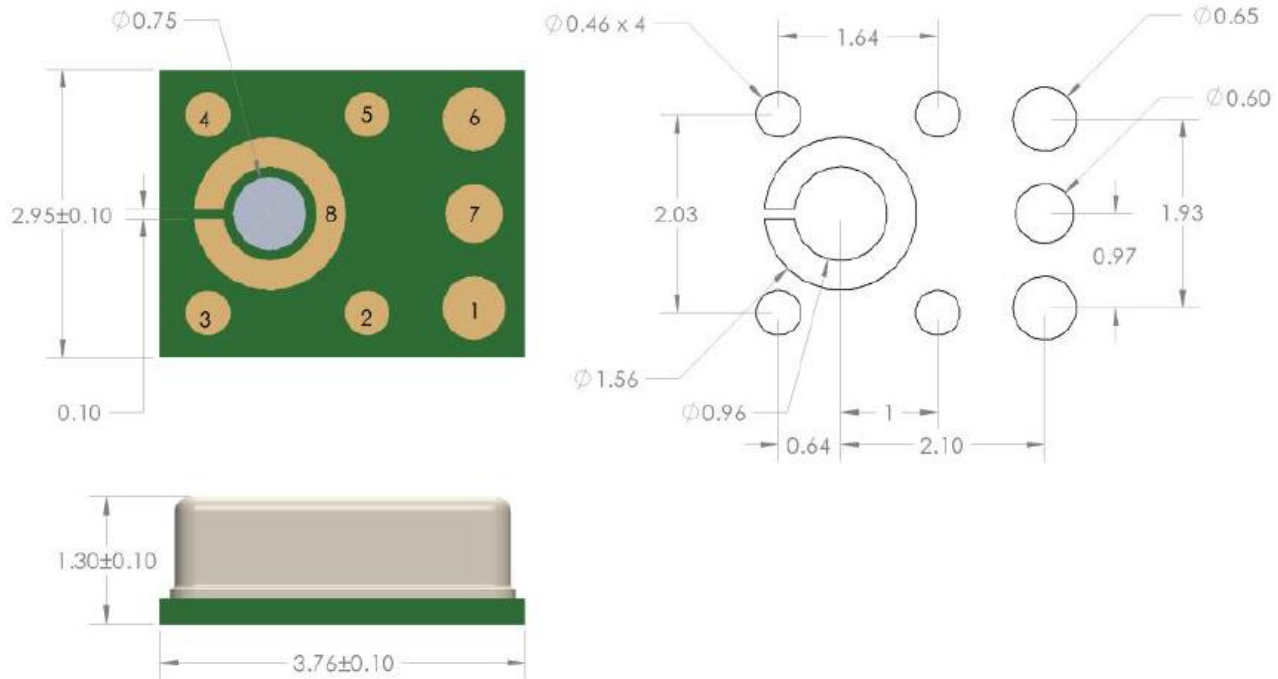
Pin Number	Pin Name	Description
1	V_{out}	Analog Output Voltage
2	GA2	Wake-on-Sound Acoustic Threshold Adjust pin 2
3	GA1	Wake-on-Sound Acoustic Threshold Adjust pin 1
4	GND	Ground
5	mode	Mode control *(hi=Wake-on-Sound, lo=Normal-Power)*
6	V_{dd}	Power Supply *(1.6V to 3.6V)*
7	d_{out}	Digital output 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	6/1/2017
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.

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