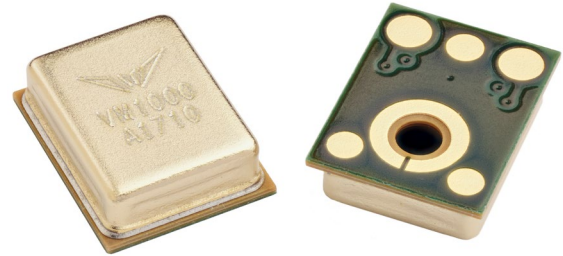


### GENERAL DESCRIPTION

Vesper presents the world's first piezoelectric MEMS microphone. The VM1000 provides superior performance and quality in all environments. The VM1000 is a low noise, high dynamic range, single-ended analog output piezoelectric MEMS microphone. This microphone consists of a piezoelectric sensor and circuitry to buffer and amplify the output.

The VM1000 has a small 3.76 mm X 2.95 mm X 1.3 mm package. This microphone is reflow solder compatible with no sensitivity degradation.



### FEATURES

- Unique piezoelectric MEMS transducer
- Ultra-Fast Startup Time, 200 $\mu$ Sec
- Very-low noise floor
- Low part-to-part variation
- High dynamic range
- Stable performance in all conditions
- Dust and water resistant to IP57

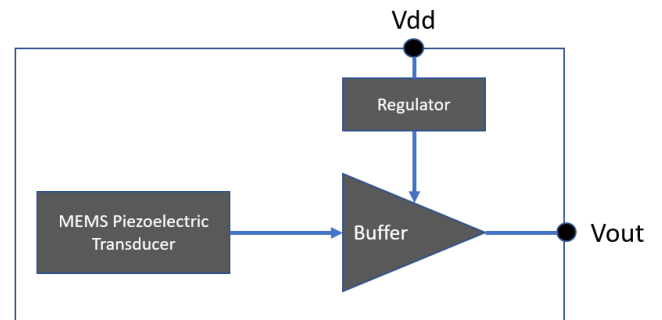
### APPLICATIONS

- Voice User Interface
- Beamforming Arrays
- Smart Home Devices
- Outdoor Applications
- Wearables

### ORDERING INFORMATION

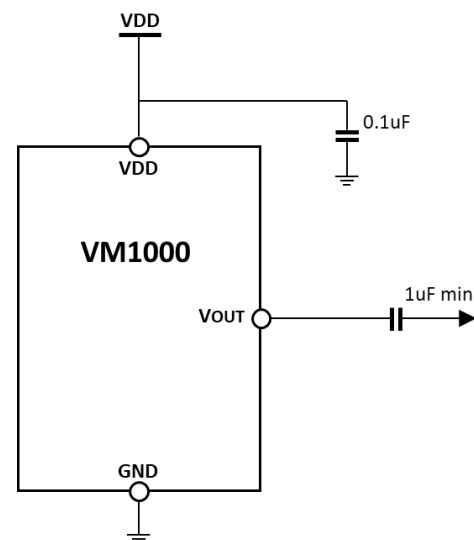
Product	Package Description	Quantity
VM1000AC	13" Tape and Reel	5,000

### BLOCK DIAGRAM



Functional Block Diagram

### TYPICAL APPLICATION CIRCUIT



Typical Application Circuit

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## SPECIFICATIONS

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
<b>Acoustic Specifications</b>						
Sensitivity		1 kHz, 94 dB SPL	-39	-38	-37	dBV
Signal-to-Noise Ratio	SNR	94 dB SPL at 1 kHz signal, 20Hz to 20kHz, A-weighted Noise		62		dB(A)
Signal-to-Noise Ratio Voice Band	SNR	94 dB SPL at 1 kHz signal, 20Hz to 8kHz, A-weighted Noise		64		dB(A)
Total Harmonic Distortion	THD	94 dB SPL		0.1		%
Acoustic Overload Point	AOP	10.0% THD		127		dB SPL
Sensitivity Recovery Time After High SPL Event <sup>1</sup>		135 dB SPL for 50msec followed by 94 dB SPL		10		mS
Roll Off Frequency		-3dB at 1KHz		100		Hz
Directivity			Omni			
Polarity		Increase in sound pressure	Increase in output voltage			
<b>Electrical Specifications</b>						
Supply Voltage			1.6	1.8	3.6	V
Supply Current		V <sub>Supply</sub> ≤ 3.6 V (TBR)		165		μA
Power Supply Rejection Ratio	PSRR	VDD = 1.8, 1kHz, 200mV <sub>PP</sub> Sine wave		55		dB
Power Supply Rejection	PSR	VDD = 1.8, 217Hz, 100mV <sub>PP</sub> square wave, 20 Hz – 20kHz, A-weighted		-85		dB(A)
Output Impedance	Z <sub>OUT</sub>			400		Ω
Output DC Offset				0.8		V
Startup Time				200		μS

<sup>1</sup> Microphone is subjected to 135 dB SPL input at 1kHz for 50msec and then 94 dB SPL at 1kHz for measuring sensitivity recovery time. Recovery time is defined as the time taken for sensitivity to be within +1dB or -0.5dB of actual sensitivity.

**ABSOLUTE MAXIMUM RATINGS**

Parameter	Rating	Units
Supply Voltage	-0.3 to +3.6	V
Sound Pressure Level	160	dB re 20 µPa
Operating Temperature Range	-40 to +85	°C
Storage Temperature Range	-55 to +150	°C
Mechanical Shock	10,000g per IEC 60028-2-27:2008	
Vibration	Per MIL-STD 883E, 2007.2	

**ENVIRONMENTAL ROBUSTNESS**

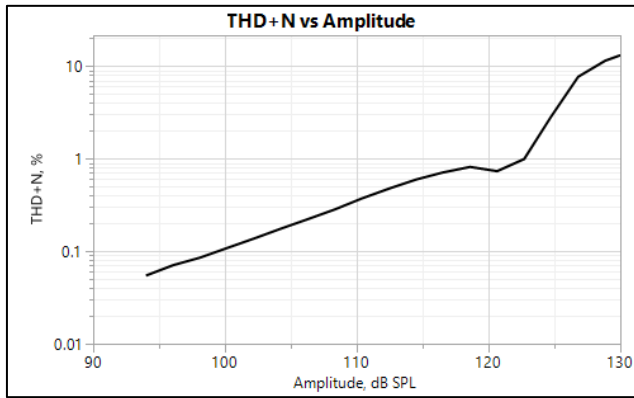
IP adherence is evaluated by 1kHz Sensitivity spec post stress

Ingress Protection Type	Description
Dust Resistance	IP5X;
Water Immersion	IPX7; 2 hrs drying time, dry environment

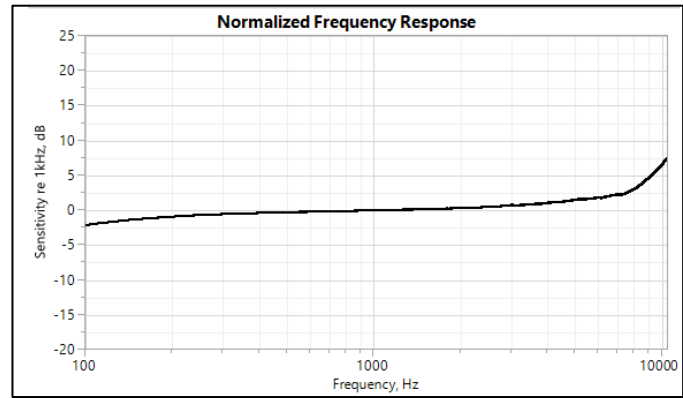
**RELIABILITY SPECIFICATIONS**

Stress Test	Description
Temperature Cycling Test	-40°C to +125°C, 850 cycles
High Temperature Operating Life	+125°C, 1000 hours, biased
High Temperature Storage	+125°C, 1000 hours, unbiased
Temperature Humidity Bias	+85°C, 85% RH, 500 hours, biased
Reflow	3 reflow cycles with peak temperature of +260°C
ESD-HBM	1 discharge, all pins, ± 2kV
ESD-CDM	3 discharges, all pins, ± 750V
ESD-MM	3 discharges, all pins, ± 200V

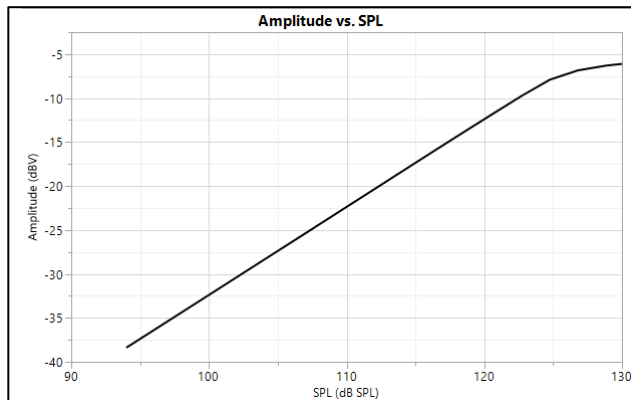
**TYPICAL PERFORMANCE CHARACTERISTICS**



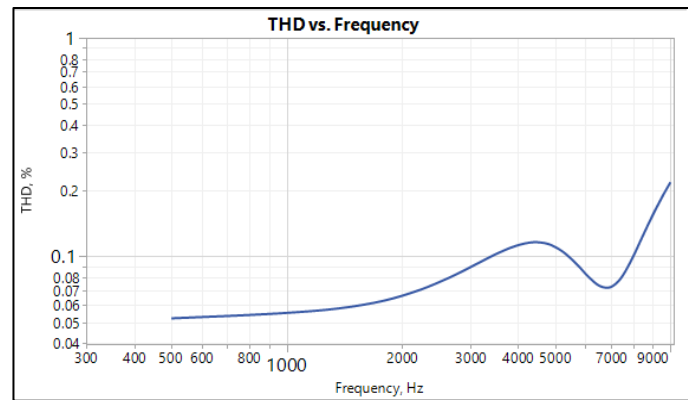
*THD+N vs Amplitude*



*Normalized Frequency Response*

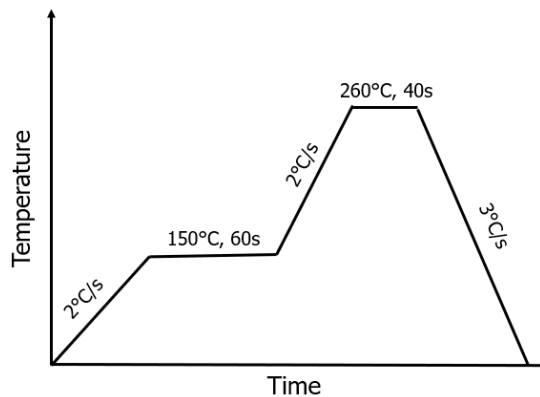


*Linearity at 1kHz*



*THD vs Frequency, 94dB SPL*

**SOLDER REFLOW PROFILE**



*Solder Reflow Profile*

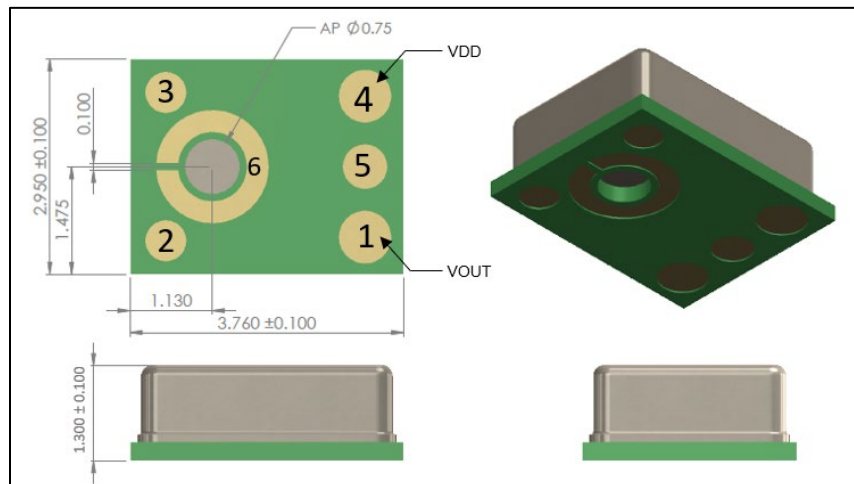
**HANDLING INSTRUCTIONS**

The Piezo MEMS microphone is very robust to harsh environments such as dust and moisture. However, to avoid mechanical damage to the mic we recommend using appropriate handling procedures when manually handling the parts or when using pick and place equipment. The following guidelines will 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.

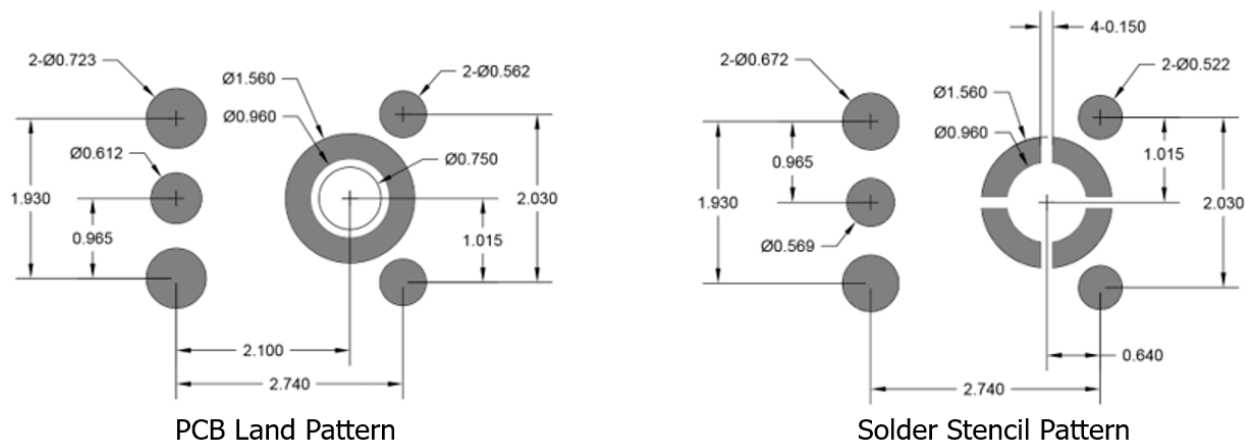
Please refer to this [Application Note](#) for Microphone Assembly Guidelines.

**DIMENSIONS AND PIN LAYOUT**



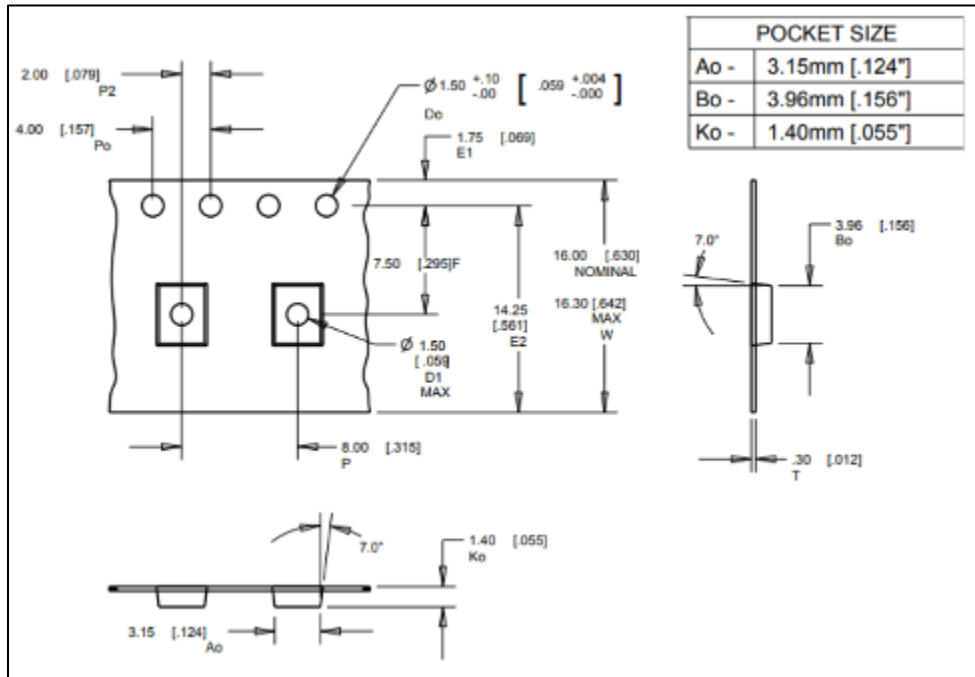
Pin Number	Pin Name	Description
1	V <sub>OUT</sub>	Analog Output Voltage
2	GND	Ground
3	GND	Ground
4	V <sub>DD</sub>	Power Supply
5	GND	Ground
6	GND	Ground

**PCB DESIGN AND LAND PATTERN LAYOUT**

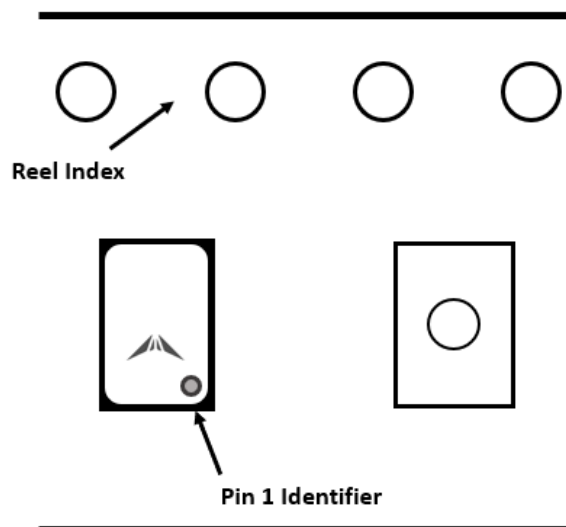


*PCB and Solder Stencil Pattern – All Dimensions are in mm*

**TAPE AND REEL SPECIFICATIONS**



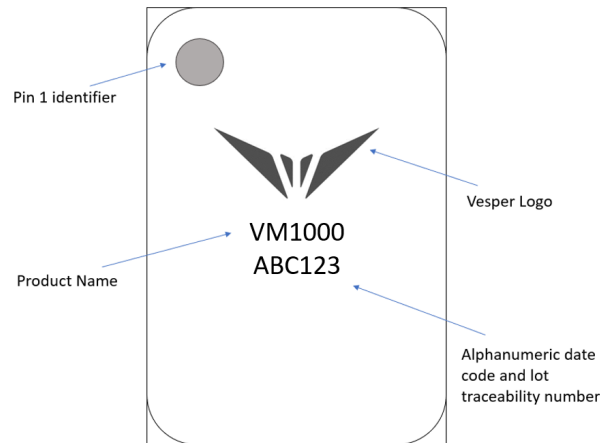
*Tape and Reel specification - All dimensions in millimeters (inches)*



*Part Orientation in Reel (Note: dimensions not to scale)*



## LID MARKING



*Lid Marking Description*

## SUPPORTING DOCUMENTS

VM1000\_Coupon\_PCB\_UserGuide - Vesper VM1000 Coupon PCB board user guide

VM1000\_3D\_Model – Vesper VM1000 3D CAD Layout

AN3 – Vesper Piezoelectric MEMS Microphone Assembly Guidelines

## COMPLIANCE INFORMATION

Electrostatic discharge (ESD) sensitive device:

Although this product features industry standard protection circuitry, damage may occur if subjected to excessive ESD. Proper ESD precautions should be taken to avoid damage to the device.



## CONTACT DETAILS

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Boston, MA 02110  
Email: [info@vespermems.com](mailto:info@vespermems.com)

## LEGAL INFORMATION

For any questions or comments on the datasheet email: [erratum@vespermems.com](mailto:erratum@vespermems.com)

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**REVISION HISTORY**

Revision	Date	Description
0.0.0	05/22/2019	Initial Revision
0.0.1	07/17/2019	Added link to Microphone Assembly Guidelines
0.0.2	07/30/2019	Updated Tape and Reel Information, Fixed Typo
0.1.0	09/11/2019	Added THD vs Frequency and Linearity Plot Updated Sensitivity Spread from $\pm 3\text{dB}$ to $\pm 1\text{dB}$ Updated Product Order Name to VM1000AC Updated package height from 1.1mm to 1.3mm