

#### GENERAL DESCRIPTION

The VM2020 is an ultra-high AOP, high dynamic range, differential analog output piezoelectric MEMS microphone. This microphone consists of a piezoelectric sensor and circuitry to buffer and amplify the output.

It has an acoustic overload point of 152dB SPL for audio capture in loud environments. The VM2020 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

- Ultra-high AOP
- Differential Output
- Low part-to-part variation
- High dynamic range
- Stable performance in all conditions
- Dust and water resistant to IP57

#### APPLICATIONS

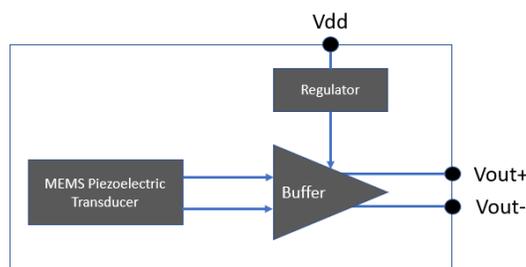
- Subwoofers
- Echo Cancellation
- Outdoor Applications

#### ORDERING INFORMATION

Product	Package Description	Quantity
VM2020AA	13" Tape and Reel	5,000

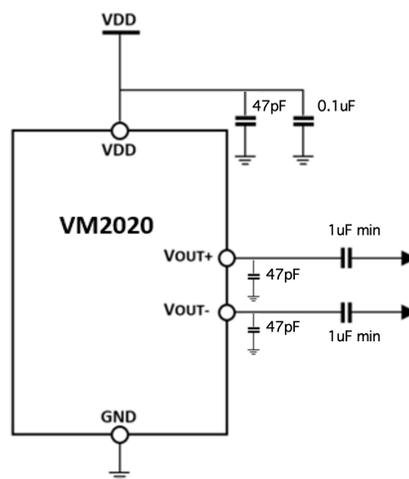


#### BLOCK DIAGRAM



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	-66	-63	-60	dBV
Signal-to-Noise Ratio	SNR	94 dB SPL at 1 kHz signal, 20Hz to 20kHz, A-weighted Noise		50		dB(A)
Total Harmonic Distortion	THD	94 dB SPL		0.1		%
Total Harmonic Distortion	THD	149 dB SPL		1		%
Acoustic Overload Point	AOP	10.0% THD		152		dB SPL
Roll Off Frequency		-3dB at 1KHz			80	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		248		μA
Power Supply Rejection Ratio	PSRR	VDD = 1.8, 1kHz, 200mV <sub>PP</sub> Sine wave		90		dB
Power Supply Rejection	PSR	VDD = 1.8, 217Hz, 100mV <sub>PP</sub> square wave, 20 Hz – 20kHz, A-weighted		-112		dB(A)
Output Impedance	Z <sub>OUT</sub>			1100		Ω
Output DC Offset		Both Vout+ and Vout-		0.8		V
Startup Time		Within ±0.5dB of actual sensitivity		200		μS

**ABSOLUTE MAXIMUM RATINGS**

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

**ENVIRONMENTAL ROBUSTNESS**

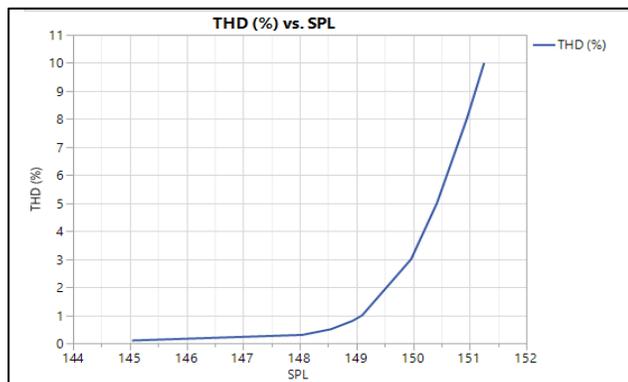
IP adherence is evaluated by 1kHz Sensitivity spec post stress

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

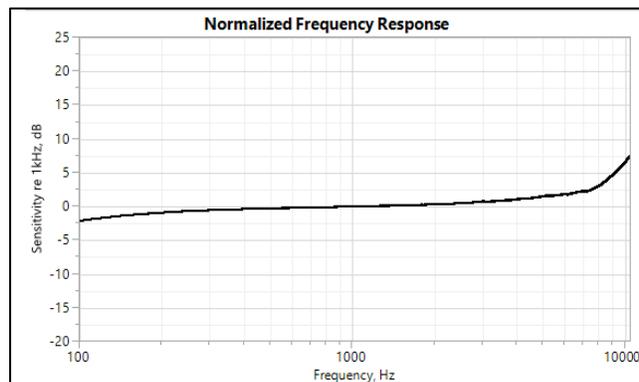
**RELIABILITY SPECIFICATIONS**

Stress Test	Description
Temperature Cycling Test	-40 $^{\circ}$ C to +125 $^{\circ}$ C, 850 cycles
High Temperature Operating Life	+125 $^{\circ}$ C, 1000 hours, biased
High Temperature Storage	+125 $^{\circ}$ C, 1000 hours, unbiased
Temperature Humidity Bias	+85 $^{\circ}$ C, 85% RH, 1000 hours, biased
Reflow	3 reflow cycles with peak temperature of +260 $^{\circ}$ C
ESD-HBM	1 discharge, all pins, $\pm$ 2kV
ESD-CDM	3 discharges, all pins, $\pm$ 750V

#### TYPICAL PERFORMANCE CHARACTERISTICS

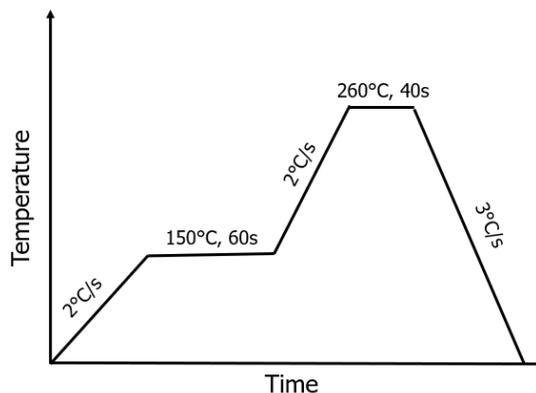


THD+N vs Amplitude at 1kHz



Normalized Frequency Response

#### SOLDER REFLOW PROFILE



Solder Reflow Profile

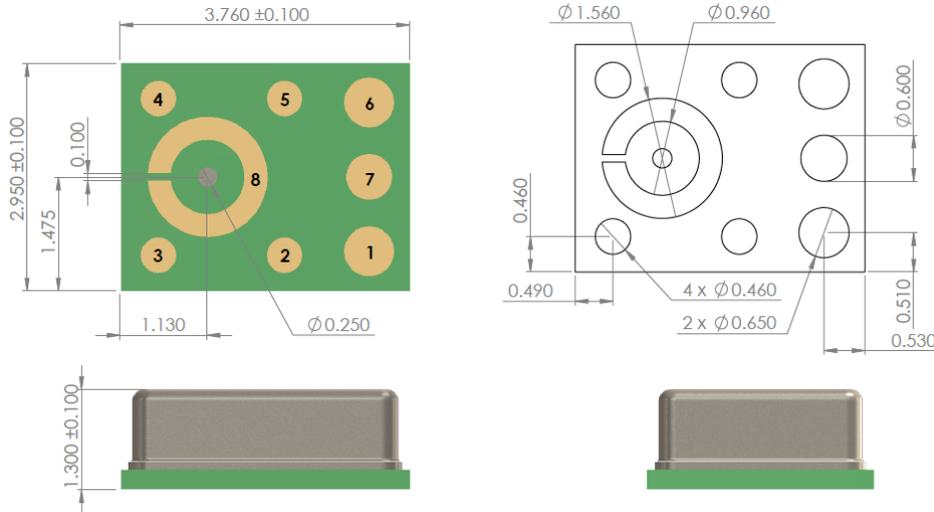
#### HANDLING INSTRUCTIONS

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.

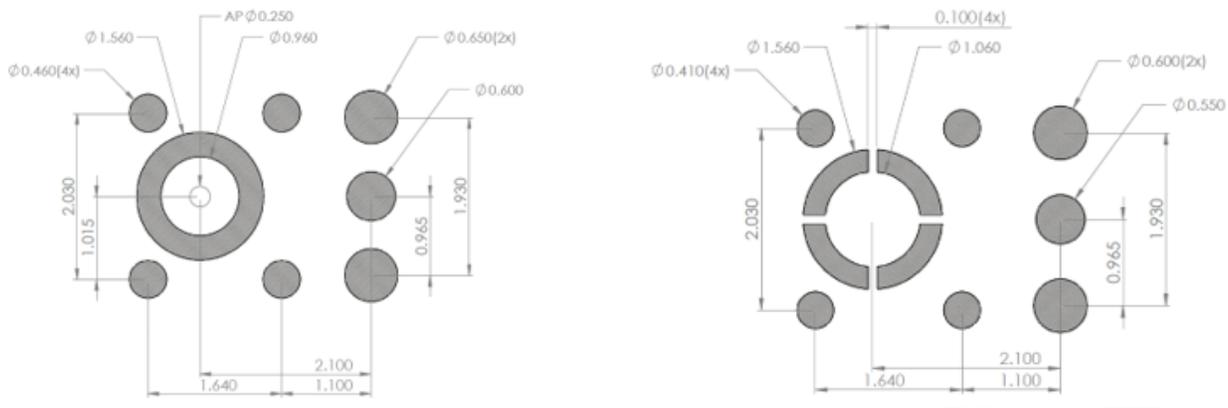
Please refer to this [Application Note](#) for Microphone Assembly Guidelines.

**DIMENSIONS AND PIN LAYOUT**



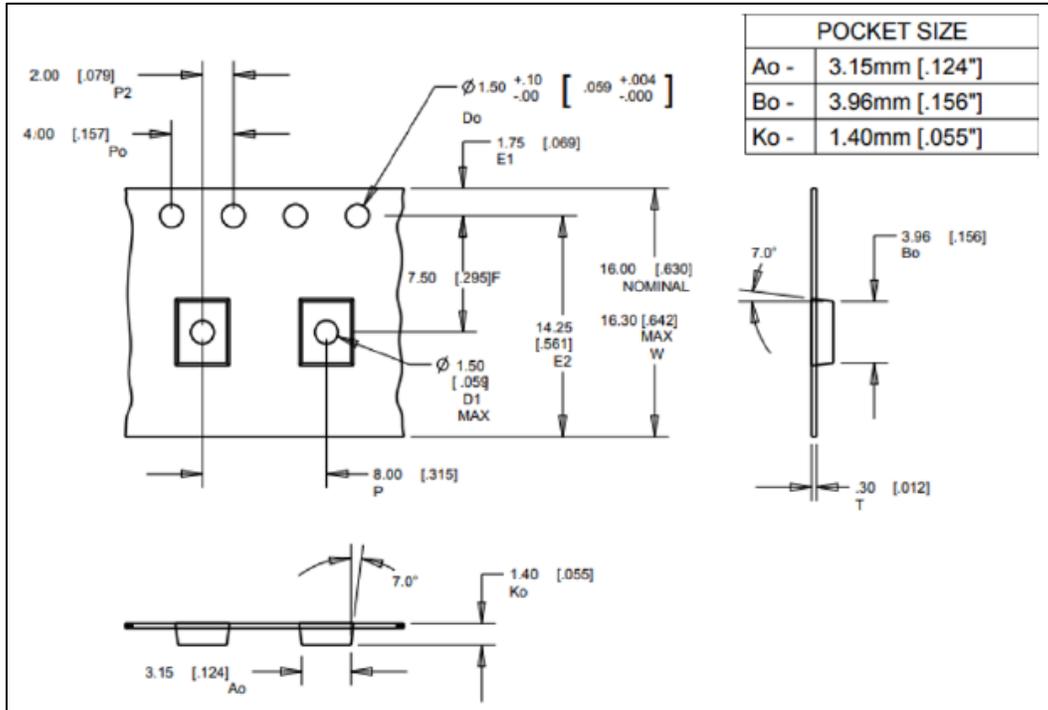
Pin Number	Pin Name	Description
1	VOUT-	Negative Output Voltage
2	GND	Ground
3	GND	Ground
4	GND	Ground
5	GND	Ground
6	VDD	Power Supply
7	VOUT+	Positive Output Voltage
8	GND	Ground

**PCB DESIGN AND LAND PATTERN LAYOUT**

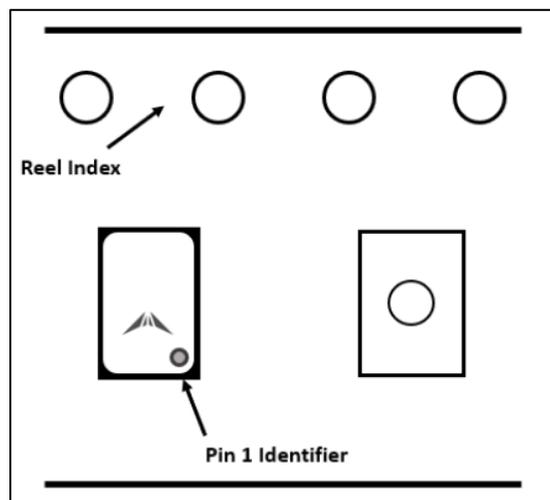


*PCB and Solder Stencil Pattern – All dimensions are in mm*

**TAPE AND REEL SPECIFICATIONS**

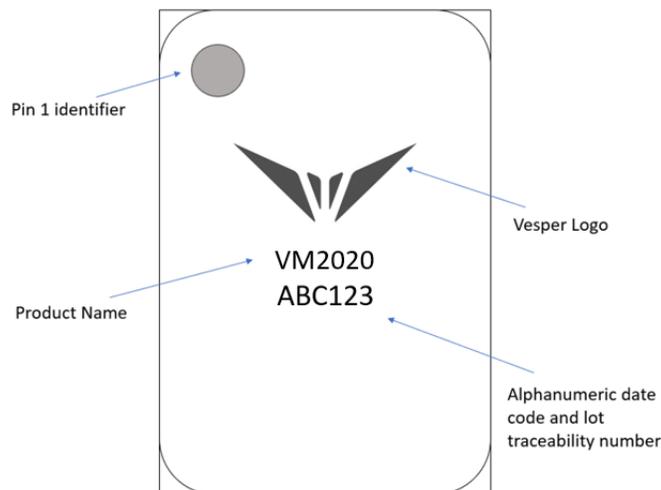


*Tape and Reel specification - All dimensions in millimeters (inches)*



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

## LID MARKING



*Lid Marking Description*

## SUPPORTING DOCUMENTS

VM2020\_Coupon\_PCB\_UserGuide - Vesper VM2020 Coupon PCB board user guide

VM2020\_3D\_Model – Vesper VM2020 3D CAD Layout

AN3 – Vesper Piezoelectric MEMS Microphone Assembly Guidelines

AN7, [Application Note AN7](#) – Improving Barge-in Performance on Smart Speakers with Ultra High Dynamic Range Microphone

## 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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## LEGAL INFORMATION

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**REVISION HISTORY**

Revision	Date	Description
0.0.0	02/22/2019	Initial Revision
0.0.1	03/11/2019	Added Reel Orientation Updated Reliability Spec
0.0.2	03/21/2019	Updated Product Name from VM2020 to VM2020AA for documentation
0.0.3	07/14/2019	Updated Vdd limits and output impedance
0.0.4	12/2/2019	Updated dimensions from 2 decimal points to 3 Added reference to Application Note AN7
0.0.5	07/28/2020	Added pin numbers to the 2d drawing
0.0.6	01/11/2021	Updated Typical Application Circuit