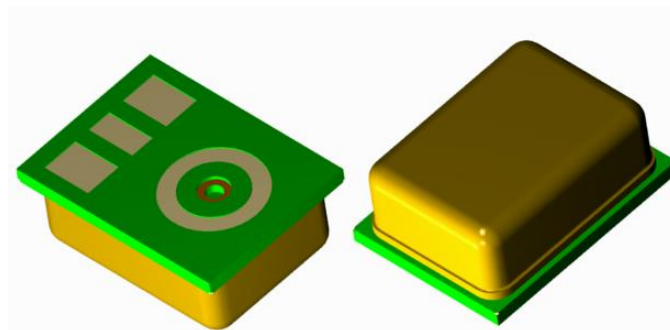


MEMS Microphone

The MM15 is a miniature, high- performance, low power, bottom port silicon microphone with extended dynamic range. Using Knowles’ proven high performance MEMS technology, the MM15 consists of an acoustic sensor, a low noise input buffer, and an output amplifier. These devices are suitable for applications where excellent wideband audio performance and RF immunity are required.

Product Features

- Small Package
- Flat Frequency Response
- Low Current
- Maximum RF Protection
- Bottom Port
- Ultra-Stable Performance
- Standard SMD Reflow
- Omnidirectional



Acoustic & Electrical Specifications

Table 1: General Microphone Specifications

Test Conditions: $22 \pm 2^{\circ}\text{C}$, $50 \pm 5\%$ R.H., $V_{DD} = 0.9\text{V}$ and no load unless otherwise indicated

Parameter		Minimum	Nominal	Maximum	Units	
Supply Voltage (V_{DD})		0.9	0.9	1.3	V	operating range
Sensitivity	100 Hz	-3.5	-1.5	+0.5	dB	dB re sensitivity @ 1kHz
	1 kHz	-59	-56	-53	dB	dB re 1V / 0.1 Pa
	10 kHz	-4.5	-1.5	+1.5	dB	dB re sensitivity @ 1kHz
	Peak	-	6	-	dB	dB re sensitivity @ 1kHz
Peak Frequency		-	18	-	kHz	-
Low Frequency Roll-Off		-	60	-	Hz	-3dB re sensitivity @ 1kHz
Supply Current (Drain)		-	38	49	μA	-
Output Load Voltage (V_L)		0.45	0.55	0.65	V	after settled (open load)
Input-Referred Noise, A-Weighted		-	26	29	dB SPL	20 Hz to 20kHz bandwidth
Signal to Noise Ratio, A-Weighted		-	67	-	dB A	20 Hz to 20kHz bandwidth
Input-Referred Noise, 1/3 rd Octave		-	15.5	-	dB SPL	@100 Hz
		-	11.3	-	dB SPL	@1 kHz
		-	18	-	dB SPL	@10 kHz
Output Impedance		3850	5100	6350	Ω	@ 1 kHz
Start Up Time		-	<0.5	-	seconds	sensitivity stable within +/- 0.2dB
Acoustic Overload Point		-	122	-	dB SPL	10% THD @ 1 kHz
Power Supply Rejection Ratio		-	-32	-24	dB	@ 1kHz
Input-Referred EMI	0.70-0.96 GHz 90 V/m	-	27	32	dB SPL	IEC 60118-13 Ed. 4.0
	1.4-2.0 GHz 50 V/m	-	26	31	dB SPL	
	2.0-2.7 GHz 35V/m	-	8.5	13.5	dB SPL	
Input Referred Vibration		-	54	60	dB SPL	blocked port, 1g acceleration, sensitivity @ 1kHz
Humidity Coefficient		-	0.0	-	dB	per %RH
Storage Temperature		-40	-	+100	$^{\circ}\text{C}$	-
Operating Temperature		-17	-	+63	$^{\circ}\text{C}$	-
Directivity		Omnidirectional				-
Polarity		Increasing output voltage				Increasing pressure at inlet
ESD Tolerance		MIL – STD – 750 Class 2 Rating EOS / ESD – S5.1 – 1993 Class 2 Rating				

Sensitivity, Output Impedance, A-Weighted Noise, and Supply Current are 100% tested.

Functional operation at these or any other conditions beyond those indicated under “Acoustic & Electrical Specifications” is not implied. Exposure beyond those indicated under “Acoustic & Electrical Specifications” for extended periods may affect device reliability.

Frequency Response

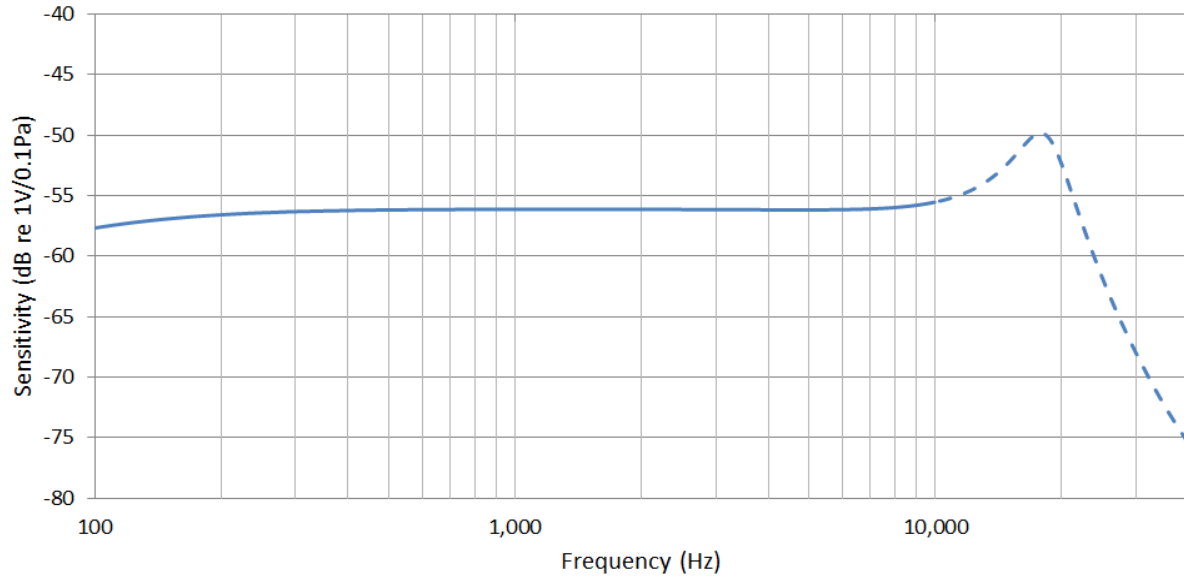


Figure 1: Typical frequency response measured in a pressure cavity under nominal conditions (Table 1). Response above 10 kHz is typical in free field and not measured in the pressure cavity.

3rd Octave Equivalent Noise

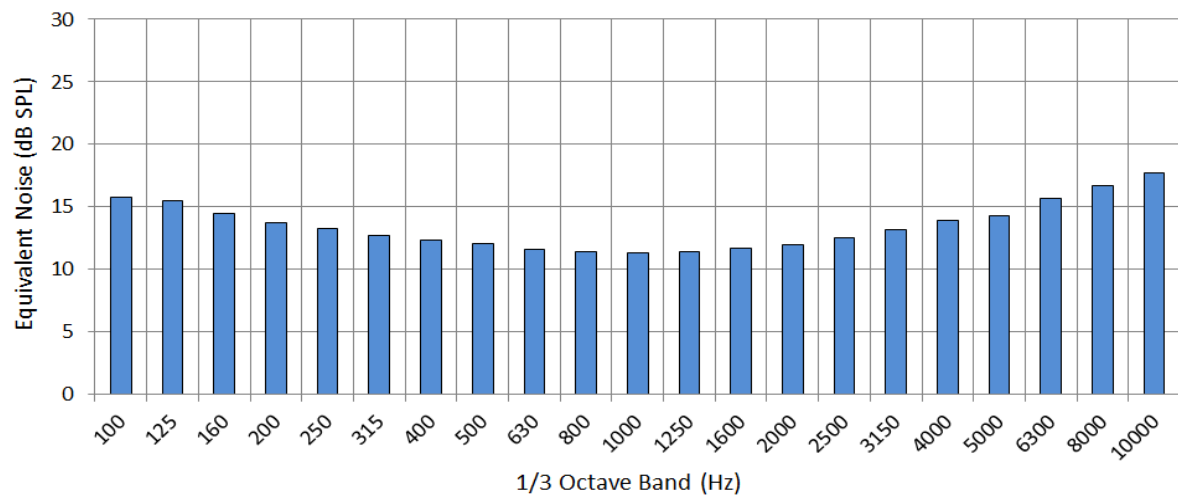


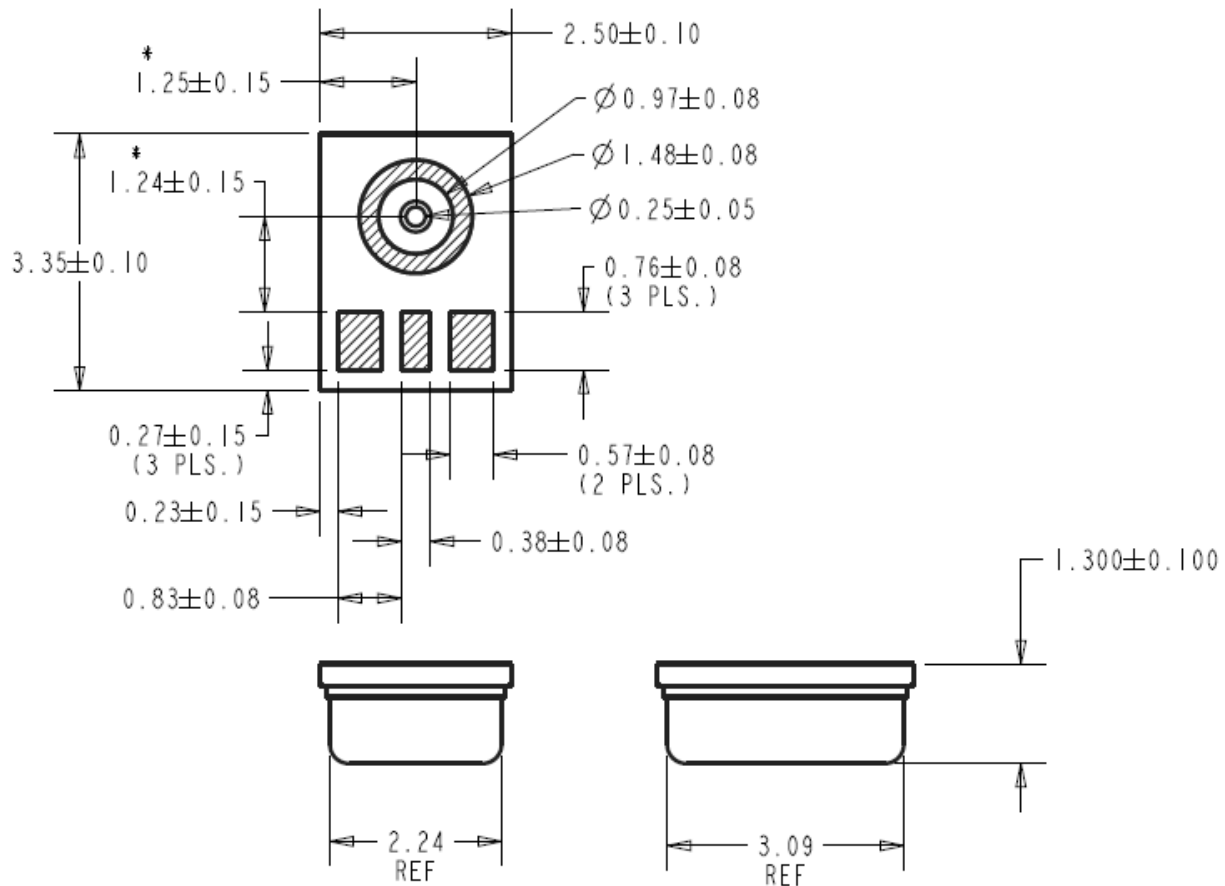
Figure 2: Typical Equivalent Noise under nominal conditions (Table 1)

Table 2: Microphone Matching Specifications

Test Conditions: $22 \pm 2^\circ\text{C}$, $50 \pm 5\%$ R.H., $V_{DD} = 0.9\text{V}$ and no load unless otherwise indicated

Parameter		Unit	Range	Window / Reel	Remarks
Window Size	100	Number	--	--	The number of sequentially positioned microphones which meet the matching criteria. Absolute range of deviation among microphones within a window or entire reel.
Phase	200Hz	degrees	1.5	Window	
Sensitivity	1kHz	dB	1.0	Window	

Mechanical Specifications



Notes: Metal can may be flush with, but not extend past, edge of microphone base on four sides.

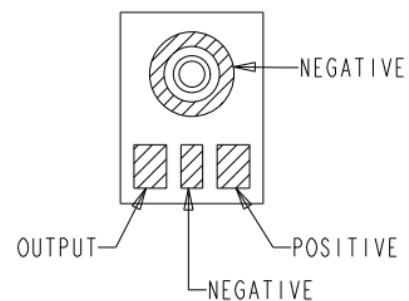
"*" Denotes dimension applies to the center of ground ring.

Pick Area only extends to 0.25 mm of any edge or hole unless otherwise specified.

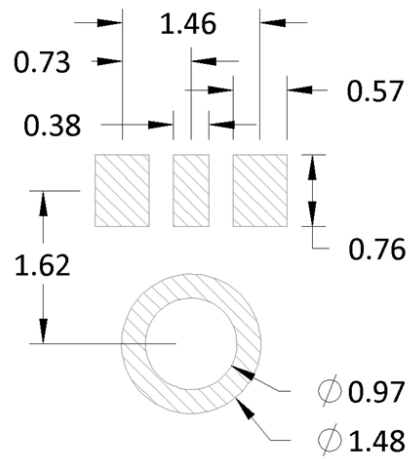
Dimensions in millimeters

Weight: 0.023grams

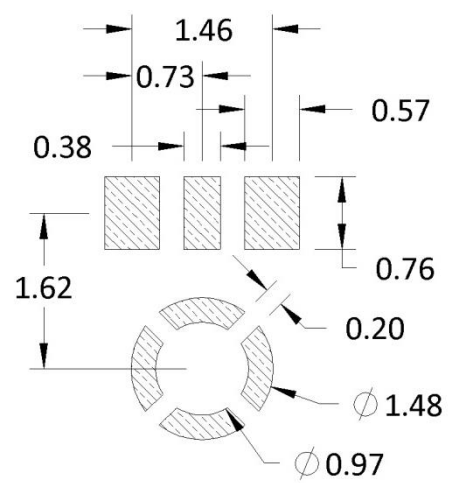
TERMINAL DEFINITION



Example Land Pattern

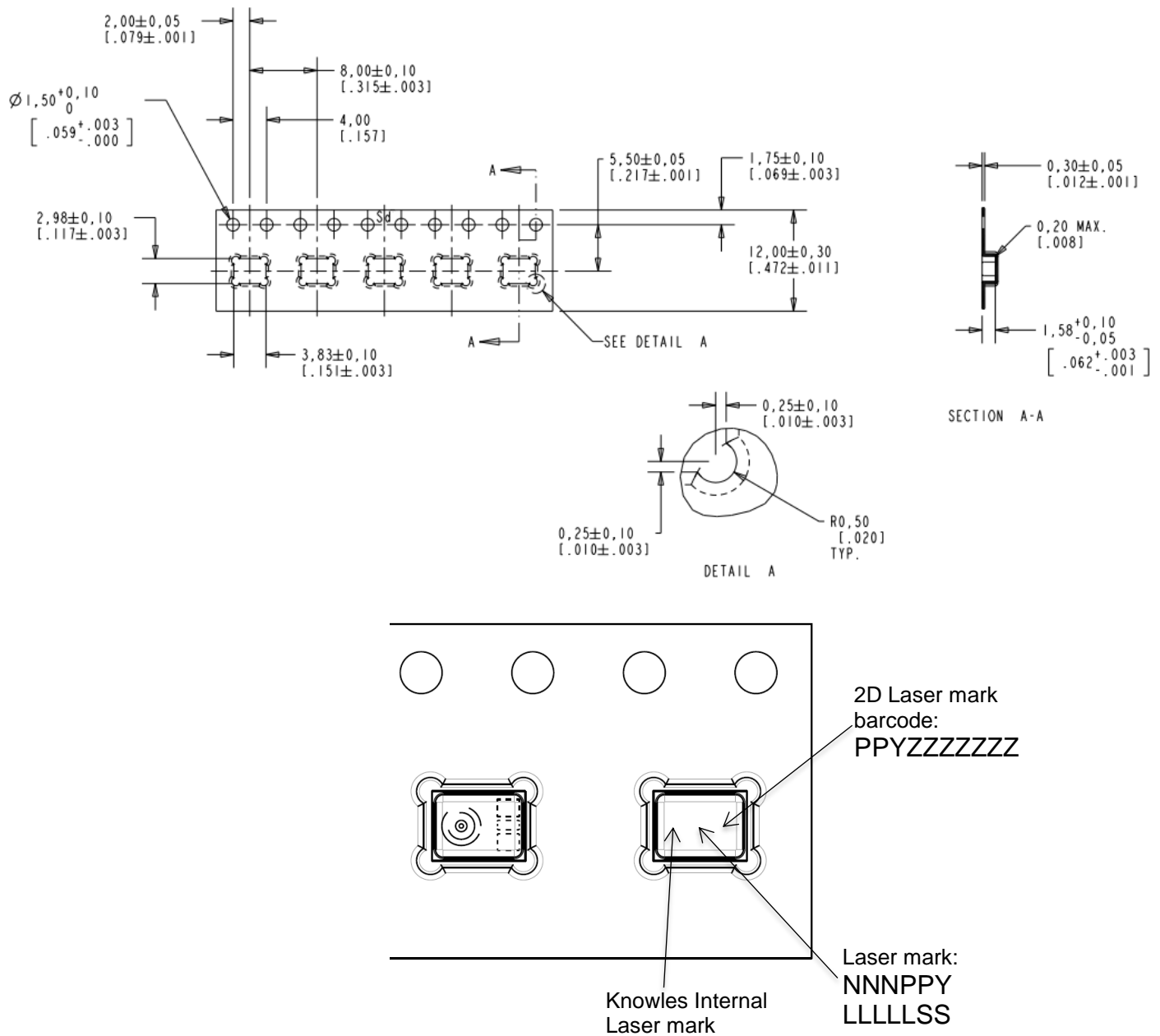


Example Solder Stencil Pattern



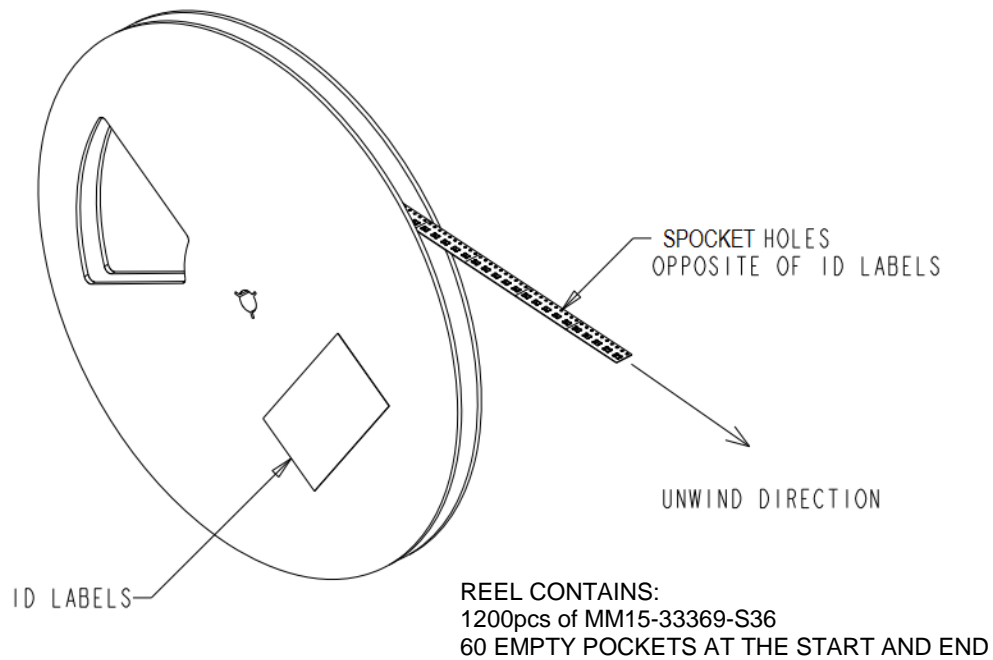
Notes: Dimensions are in millimeters unless otherwise specified.
Further optimizations based on application should be performed.

Packaging & Marking Detail



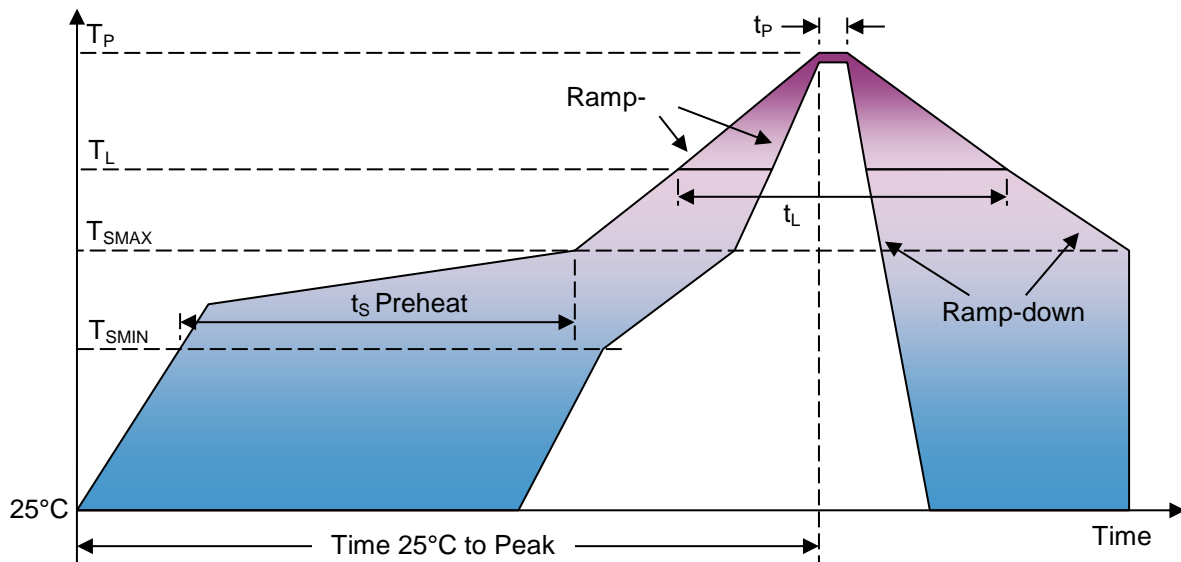
Symbol	Definition	# Characters
N	Part Number (last three digits)	3 (369)
P	Production Week	2
Y	Production Year	1
L	Last 5 characters of Oracle Lot Number	5
S	Sub-lot Number	2
Z	Serial Number	7

PACKAGING:



Notes: Dimensions are in millimeters unless otherwise specified.
Vacuum pickup only in the pick area indicated in Mechanical Specifications.
Tape & reel per EIA-481.
Labels applied directly to reel and external package.
Shelf life: Twelve (12) months when devices are to be stored in factory supplied, unopened ESD moisture sensitive bag under maximum environmental conditions of 30°C.

Recommended Reflow Profile



Profile Feature	Pb-Free
Ramp-up rate (25°C to T_{SMIN})	3°C/second (see note)
Average Ramp-up rate (T_{SMAX} to T_P)	3°C/second max.
Preheat <ul style="list-style-type: none"> • Temperature Min (T_{SMIN}) • Temperature Max (T_{SMAX}) • Time (T_{SMIN} to T_{SMAX}) (t_s) 	150°C 200°C 60-180 seconds
Time maintained above: <ul style="list-style-type: none"> • Temperature (T_L) • Time (t_L) 	217°C 60-150 seconds
Peak Temperature (T_P)	260°C
Time within 5°C of actual Peak Temperature (t_p)	20-40 seconds
Ramp-down rate (T_P to T_{SMAX})	6°C/second max
Time 25°C to Peak Temperature	8 minutes max

Notes: Based on IPC/JDEC J-STD-020 Revision C.
All temperatures refer to topside of the package, measured on the package body surface
Ramp-up rate (25°C to T_{SMIN}) can be optimized based on application.

Additional Notes

- (A) MSL (moisture sensitivity level) Class 1.
- (B) Maximum of 3 reflow cycles is recommended.
- (C) In order to minimize device damage:
 - Do not board wash or clean after the reflow process.
 - Do not brush board with or without solvents after the reflow process.
 - Do not directly expose to ultrasonic processing, welding, or cleaning.
 - Do not insert any object in port hole of device at any time.
 - Do not apply over 30 psi of air pressure into the port hole.
 - Do not pull a vacuum over port hole of the microphone.
 - Do not apply a vacuum when repacking into sealed bags at a rate faster than 0.5 atm/sec.

Materials Statement

Meets the requirements of the European RoHS directive 2011/65/EC as amended.

Meets the requirements of the industry standard IEC 61249-2-21:2003 for halogenated substances and Knowles Green Materials Standards Policy section on Halogen-Free.

Product is Beryllium Free according to limits specified on the Knowles Hazardous Material List (HSL for Products).

Ozone depleting substances are not used in the product or the processes used to make the product, including compounds listed in Annex A, B, and C of the "Montreal Protocol on Substances That Deplete the Ozone Layer."

This product meets RoHS and REACH requirements as of date of publication. To receive latest certificate of compliance, send email to environmental@knowles.com

Reliability Specifications

Test	Description
Reflow	5 reflow cycles with peak temperature of +260°C
High Temperature Storage	+105°C environment for 1,000 hours (IEC 68-2-2 Test Ba)
Low Temperature Storage	-40°C environment for 1,000 hours (IEC 68-2-1 Test Aa)
High Temperature Bias	+105°C environment while under bias for 1,000 hours (IEC 68-2-2 Test Ba)
Low Temperature Bias	-40°C environment while under bias for 1,000 hours (IEC 68-2-1 Test Aa)
Temperature/Humidity Bias	+85°C/85% R.H. environment while under bias for 1,000 hours (JESD22-A101A-B)
Thermal Shock	100 cycles of air-air thermal shock from -40°C to +125°C with 15 minute soaks (IEC 68-2-4)
Vibration	16 minutes in each X, Y, Z axis from 20 to 2,000 Hz with peak acceleration of 20 G (MIL 883E, Method 2007.2,A)
Mechanical Shock	3 pulses of 10,000 G in each of the X, Y, and Z directions (IEC 68-2-27 Test Ea)
ESD-HBM	3 discharges of ±2kV direct contact to I/O pins (MIL 883E, Method 3015.7)
ESD-LID/GND	3 discharges of ±8kV direct contact to lid while unit is grounded (IEC 61000-4-2)
ESD-MM	3 discharges of ±200V direct contact to IO pins (ESD STM5.2)

Notes: After reliability tests are performed, the sensitivity of the microphones shall not deviate more than 3dB from their initial value.
After 3 reflow cycles, the sensitivity of the microphones shall not deviate more than 1 dB from its initial value.

Specification Revisions

Revision	Specification Changes	Date
A	Initial Release	1-17-19

Date of Publication: 17 January 2019

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