SPG0660LR5H Rev 1
Datasheet

SPG0660LR5H

Low Noise, Very Narrow Digital Bottom Port SiSonic™ Microphone

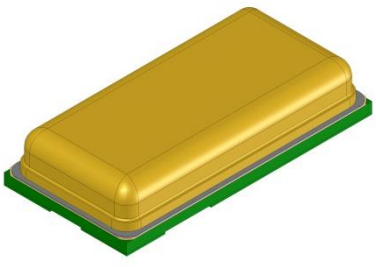
The SPG0660LR5H is a miniature, high-performance, low power, bottom port silicon digital microphone with a single bit PDM output. Using Knowles' proven high performance SiSonic™ MEMS technology, the SPG0660LR5H consists of an acoustic sensor, a low noise input buffer, and a sigma-delta modulator. These devices are suitable for applications such as cellphones, smart phones, laptop computers, sensors, digital still cameras, portable music recorders, and other portable electronic devices where excellent wideband audio performance and RF immunity are required.

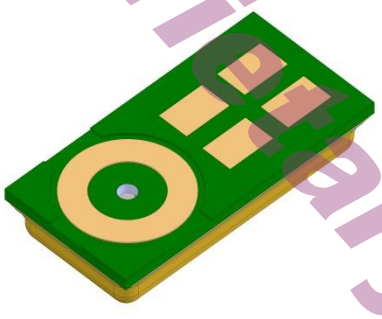
Product Features

- Low Noise
- Very Narrow Package
- High Drive Capability
- Low Current
- Flat Frequency Response
- RF Shielded
- Bottom Port
- PDM Output
- Supports Dual Multiplexed Channels
- Ultra-Stable Performance
- Standard SMD Reflow
- Omnidirectional

Typical Applications

- Portable electronics
- Cellphones
- Headsets
- Tablets
- Digital Still Cameras
- Portable Music Recorders





Absolute Maximum Ratings

Table 1: Absolute Maximum Ratings

Parameter	Absolute Maximum Rating	Units
Vdd, DATA to Ground	-0.3, +5.0	V
CLOCK to Ground	-0.3, +5.0	V
SELECT to Ground	-0.3, +5.0	V
Input Current	±5	mA
Short Circuit to/from DATA	Indefinite to Ground or Vdd	sec
Temperature	-40 to +100	ºC

Stresses exceeding these "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. 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.

Acoustic & Electrical Specifications

Table 2: General Microphone Specifications
Test Conditions: 23 ±2°C, 55±20% R.H., Vdd=1.8 V, Fclock = 3.072MHz, SELECT grounded, no load, unless otherwise indicate

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Voltage[1]	Vdd		1.6	-	3.6	V
Supply Current[1,2]	Idd		-	580	-	µA
Sleep Current[3]	Isleep	Fclock < 1 kHz	-	11	-	µA
Sensitivity[1]	S	94 dB SPL @ 1 kHz	-28	-26	-24	dBFS
Signal to Noise Ratio	SNR	94 dB SPL @ 1 kHz, A-weighted	-	63.5	-	dB(A)
Total Harmonic Distortion	THD	94 dB SPL @ 1 kHz, S = Typ	-	0.5		%
		110 dB SPL @ 1 kHz, S = Typ	-	2.0	-	
		120dB SPL @ 1kHz, S = Typ	-	10	-	
Power Supply Rejection	PSR	100 mVpp sinewave 600-20kHz	-	-80	-	dBFS
Low Frequency Corner	LFRO	-3 dB normalized to 1 kHz	-	80	-	Hz
DC Output		Fullscale = ±100	-	±0.3	-	% FS
Directivity			Omnidirectional			
Polarity		Increasing sound pressure	Increasing density of 1's			
Data Format			½ Cycle PDM			
Logic Input High	Vih		0.65xVdd	-	3.6	V
Logic Input Low	Vil		-0.3	-	0.35xVdd	V
Low→High Threshold	Vl-h		0.55xVdd		0.65xVdd	V
High→Low Threshold	Vh-l		0.35xVdd		0.45xVdd	V
Hysteresis Width	Vhyst		0.10xVdd	-	0.29xVdd	V
Logic Output High	Voh	I_{OUT} = 2 mA	0.7xVdd	-	Vdd	V
Logic Output Low	Vol	I_{OUT} = 2 mA	0	-	0.3xVdd	V
SELECT (high)			Vdd-0.2	-	3.6	V
SELECT (low)			-0.3	-	0.2	V
Short Circuit Current	Isc	Grounded DATA pin	2	-	10	mA
Output Load	Cload		-	-	160	pF
Fall-asleep Time[4,5]		Fclock < 1 kHz	-	-	10	ms

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Wake-up Time[4,6]		Fclock ≥ 1MHz	-	-	20	ms
Startup Time[4]		Powered Down → Active Mode	-	-	50	ms
Restart Time[4]		Active → Powered Down → Active Mode	-	-	70	ms
Clock Frequency	Fclock		1.0	-	3.25	MHz
Clock Duty Cycle			40	-	60	%
Clock Rise/Fall Time[8]	Tedge		-	-	20	ns
Output Load[8]	Cload	STATUS or DATA	-	-	160	pF
Delay Time to Data Line Driven	Tdd		18	-	-	ns
Delay Time to Valid Data	Tdv	Max Cload	-	-	115	ns
Delay Time to High Z[7]	Tdz		0	-	16	ns

[1] 100% tested.

[2] Idd varies with Cload according to: ΔIdd = 0.5*Vdd*ΔCload*Fclock.

[3]Maximum specifications are measured at Vdd(max). Typical specifications are measured at standard test conditions.

[4] Valid microphones states are: Powered Down Mode (mic off), Sleep Mode (low current, DATA = high-Z, fast startup), and Active Mode (normal operation)

[5] Time from Fclock < 1 kHz to Isleep specification is met when transitioning from Active Mode to Sleep Mode.

[6] Time from Fclock ≥ 1 MHz to all applicable specifications are met when transitioning from Sleep Mode to Active Mode.

[7] Thold is dependent on Cload.

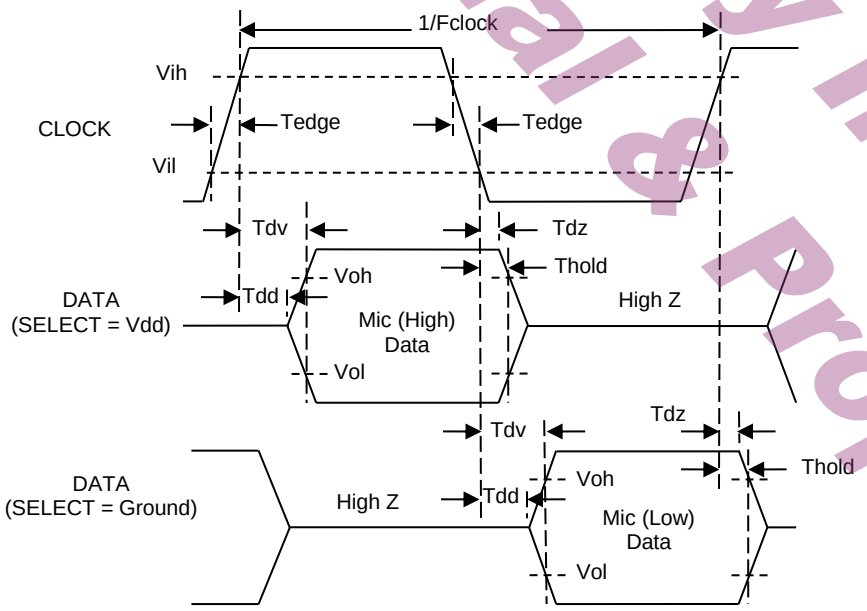


Figure 1: Timing Diagram

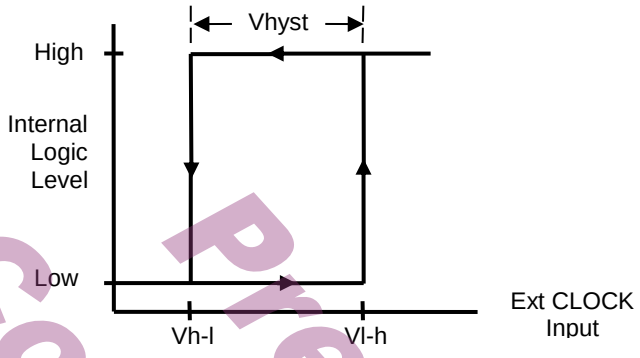


Figure 2: Hysteresis Diagram

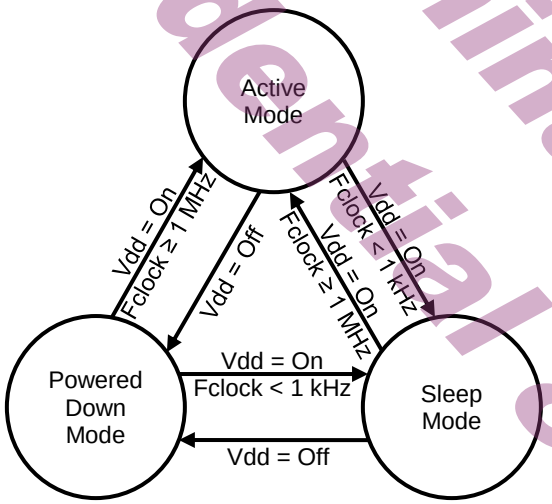


Figure 3: State Diagram

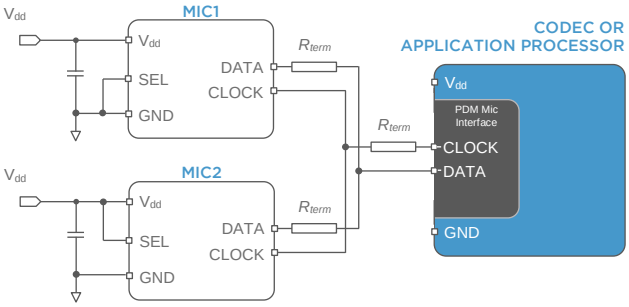


Figure 4: Typical Application Circuit

Notes: Capacitors near the microphone should not contain Class 2 dielectrics due to their piezoelectric effects.

Detailed information on acoustic, mechanical, and system integration can be found in the latest *SiSonic™ Design Guide* application note.

Microphone	SELECT	Asserts DATA on	Latch DATA on
Mic (High)	Vdd	CLK rising edge	CLK falling edge
Mic (Low)	Ground	CLK falling edge	CLK rising edge

Table 3: SELECT Functionality

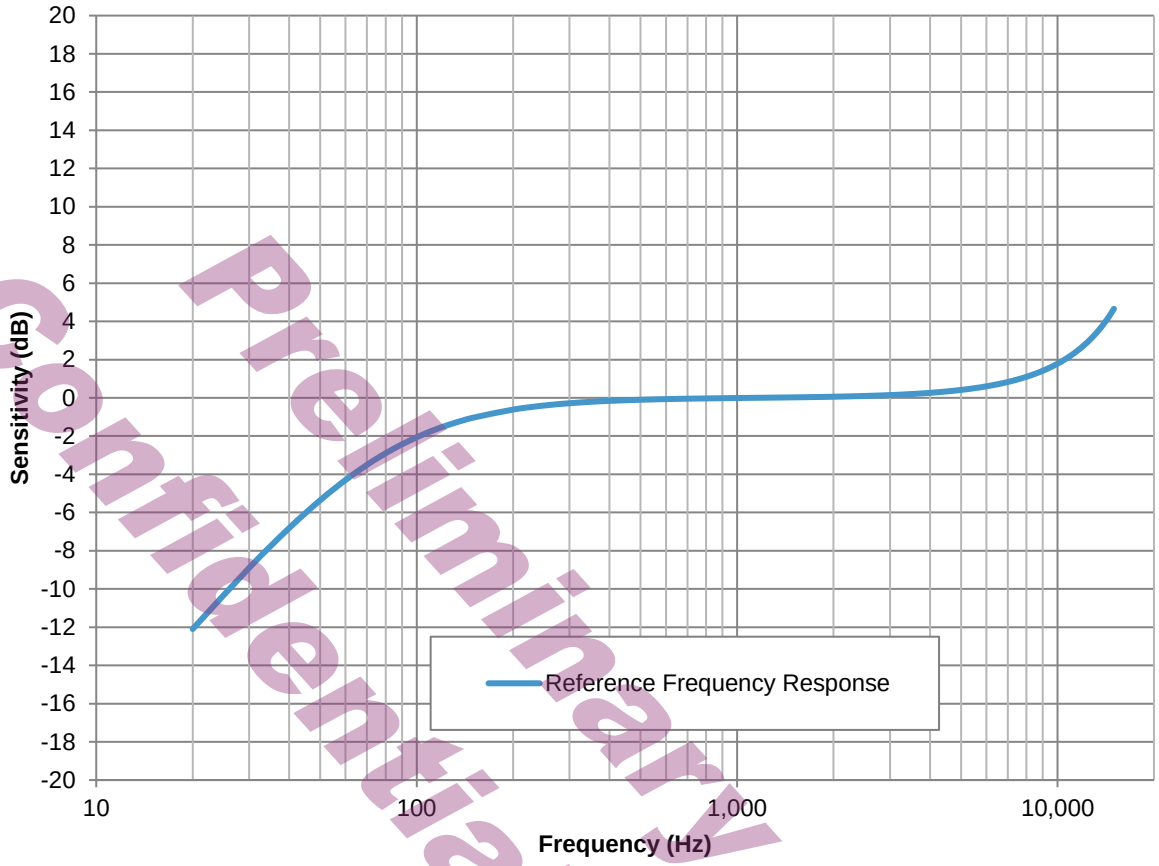
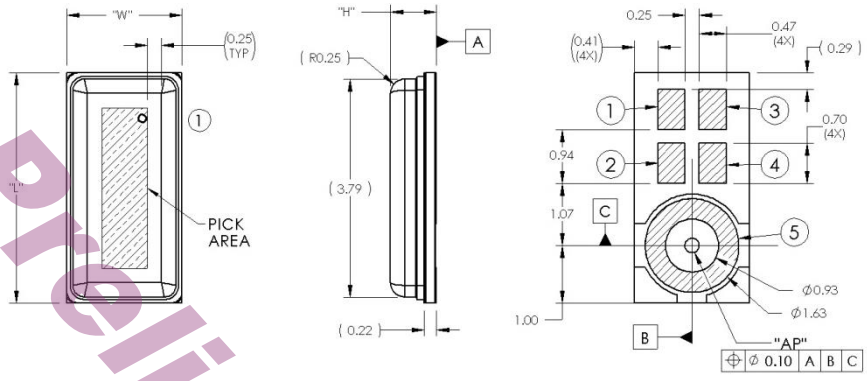


Figure 5: Typical Free Field Response Normalized to 1 kHz

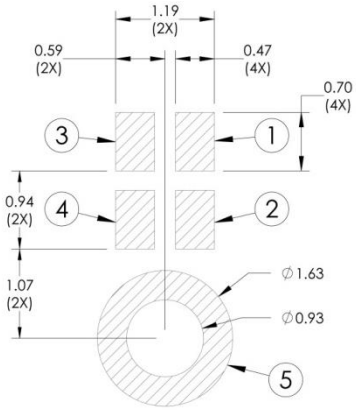
Mechanical Specifications



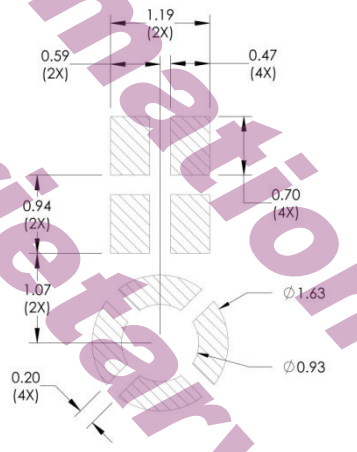
tem	Dimension	Tolerance
Length (L)	4.00	±0.10
Width (W)	2.00	±0.10
Height (H)	0.80	±0.10
Acoustic Port (AP)	Ø0.25	±0.05

Pin #	Pin Name	Type	Description
1	DATA	Digital O	PDM Output
2	Vdd	Power	Power Supply
3	CLOCK	Digital I	Clock Input
4	SELECT	Non-Digital Input	Lo/Hi (L/R) Select. This pin is internally pulled low
5	GROUND	Power	Ground

Example Land Pattern

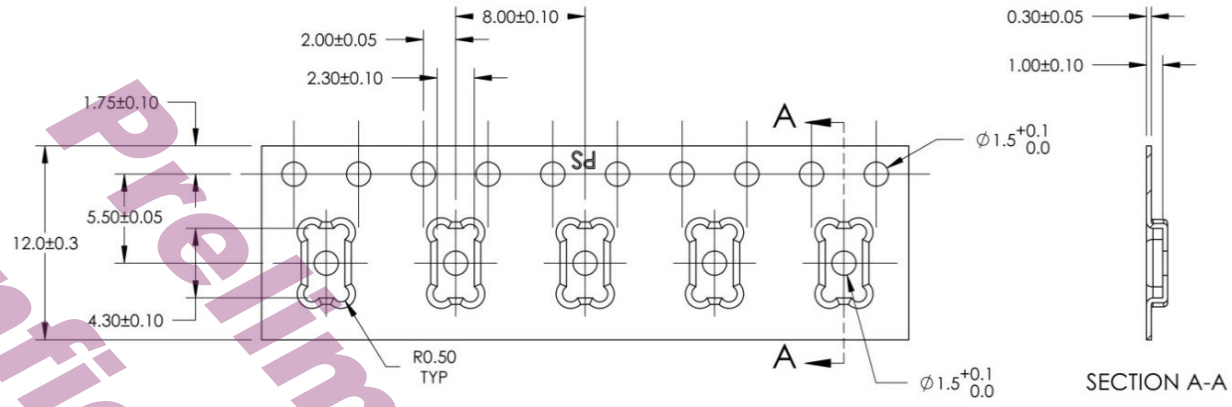


Example Solder Stencil Pattern

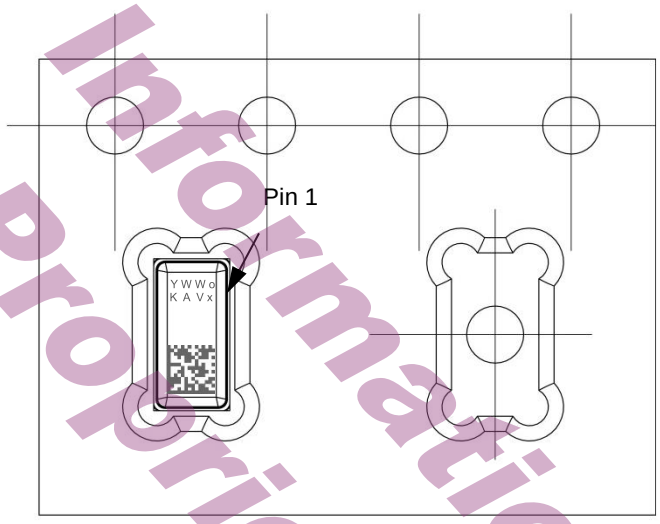


Notes:
Pick Area only extends to 0.25 mm of any edge or hole unless otherwise specified.
Dimensions are in millimeters unless otherwise specified.
Tolerance is ±0.15mm unless otherwise specified
Detailed information on AP size considerations can be found in the latest *SiSonic™ Design Guide* application note.
Further optimizations based on application should be performed.

Packaging & Marking Detail



Model Number	Suffix	Reel Diameter	Quantity Per Reel
SPG0660LR5H-B	-8	13”	5,900

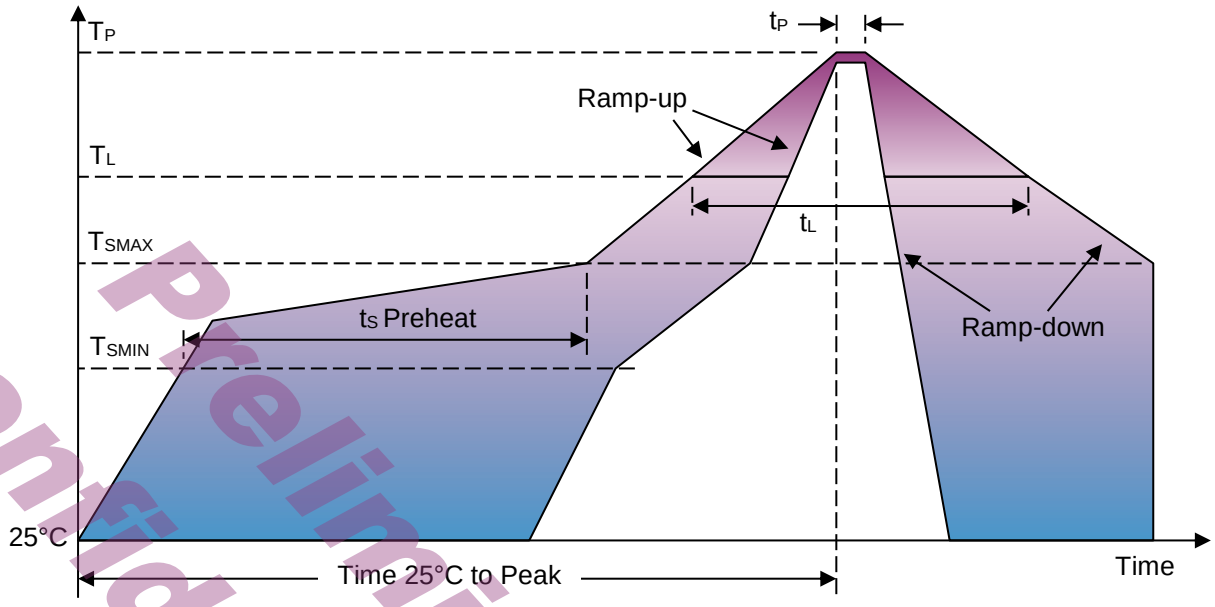


YWW: Year/Week date code
Letter: “o”, orientation mark
Letter: “K”
Alpha Character A:
“M”: Manufactured in Malaysia
Version Number Vx:
Ex: Engineering version number x
Px: Prototype version number x
Mx: Mass production version number x

2D Barcode serial number:
The 2D Barcode is for Knowles internal tracking

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, 70% R.H.

Recommended Reflow Profile



Profile Feature	Pb-Free
Average Ramp-up rate (T_{SMAX} to T_P)	3°C/second max.
Preheat • 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: • 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

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.

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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.

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."

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

Reliability Specifications

Test	Description
Thermal Shock	100 cycles of air-air thermal shock from -40°C to +125°C with 30 minute soaks (IEC 68-2-4)
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 68-2-2 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 68-2-2 Test Aa)
Temperature/Humidity Bias	+85°C/85% R.H. environment while under bias for 1,000 hours (IEC 68-2-78 Test Cab)
Vibration	12 minutes in each axis from 20 to 2,000 Hz in X,Y, and Z directions with peak acceleration of 20g (MIL 883E, Method 2007.2,A)
Electrostatic Discharge	3 discharges at +/-8kV direct contact to lid when unit is grounded (IEC 61000-4-2) and 3 discharges at +/-2kV direct contact to I/O pins (MIL 883E, Method 3015.7) and 3 discharges at +/- 200V pin-to-pin (ESDA STM 5.2, ESD-MM)
Reflow	5 reflow cycles with peak temperature of +260°C
Tumble test	200 tumbles in 100g block from a height of 1m onto a steel base
Mechanical Shock	3 pulses of 10,000g in each of the ±X, ±Y, ±Z directions while under bias (IEC 68-2-27 Test Ea)

Notes: Microphones must meet all acoustic and electrical specifications before and after reliability testing.

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Specification Revisions

Revision	Specification Changes	Date
1	Initial Draft	6/04/19

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