

# High SPL Differential Bottom Port SiSonic™ Microphone

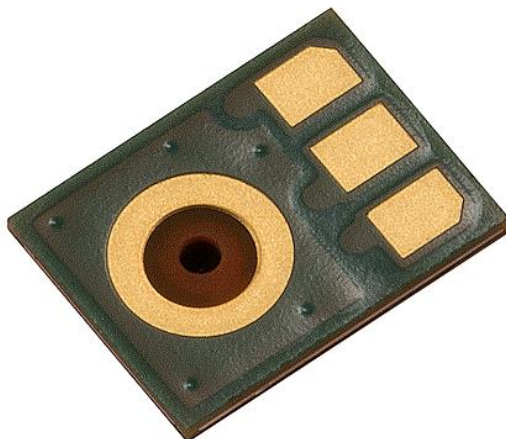
The SPA1687LR5H-1 is a miniature, high-performance, low power, bottom port silicon differential microphone. Using Knowles' proven high performance SiSonic™ MEMS technology, the SPA1687LR5H-1 consists of an acoustic sensor, a low noise input buffer, and a differential output amplifier. These devices are 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

- High SPL
- Low Noise
- Flat Frequency Response
- Differential Output
- Small Package
- Low Current
- MaxRF Protection
- Bottom Port
- Ultra-Stable Performance
- Standard SMD Reflow
- Omnidirectional

## Typical Applications

- Portable electronics
- Cellphones
- Laptop Computers
- Tablets
- Digital Still Cameras
- Portable Music Recorders



## Absolute Maximum Ratings

Table 1: Absolute Maximum Ratings

| Parameter                | Absolute Maximum Rating | Units |
|--------------------------|-------------------------|-------|
| Vdd to Ground            | -0.5, +5.0              | V     |
| Out-, Out+ to Ground     | -0.3, Vdd+0.3           | V     |
| Input Current to any pin | ±5                      | mA    |
| Temperature              | -40 to +100             | °C    |

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<sup>1</sup>

Table 2: General Microphone Specifications

Test Conditions: 23 ±2°C, 55±20% R.H., V<sub>DD</sub>=2.7V, no load, unless otherwise indicate

| Parameter                 | Symbol | Conditions                    | Min                       | Typ | Max | Units |
|---------------------------|--------|-------------------------------|---------------------------|-----|-----|-------|
| Directivity               |        |                               | Omnidirectional           |     |     |       |
| Polarity                  |        | Increasing sound pressure     | Increasing Output Voltage |     |     |       |
| Startup Time <sup>2</sup> |        | S within 0.5dB on final value | -                         | -   | 30  | ms    |
| Mode Switch Time          |        | 94 dB SPL @ 1 kHz, A-weighted | -                         | -   | 30  | ms    |

Table 3: Microphone Specifications

Test Conditions: 23 ±2°C, 55±20% R.H., V<sub>DD</sub>=2.7V, no load, unless otherwise indicate

| Parameter                    | Symbol | Conditions   | Min  | Typ  | Max  | Units  |
|------------------------------|--------|--|------|------|------|--------|
| Supply Voltage               | Vdd    |  | 2.3  | 2.7  | 3.6  | V      |
| Supply Current               | Idd    |  | -    | 300  | 325  | µA     |
| Sensitivity                  | S      | 94 dB SPL @ 1 kHz  | -39  | -38  | -37  | dBV/Pa |
| Signal to Noise Ratio        | SNR    | 94 dB SPL @ 1 kHz, A-weighted  | 64   | 65   | -    | dB(A)  |
| Total Harmonic Distortion    | THD    | 94 dB SPL @ 1 kHz, S = Typ, Rload > 10k                                | -    | 0.1  | 0.5  | %      |
| Acoustic Overload Point      | AOP    | 10% THD @ 1 kHz,<br>S = Typ, Rload > 10k                               | 132  |      | -    | dB SPL |
| Power Supply Rejection Ratio | PSRR   | 100 mVpp, sinewave @ 1K Hz   | 80   | 85   | -    | dB     |
| Power Supply Rejection       | PSR    | 100mVpp 7/8 duty cycle rectangular wave<br>@217Hz, A-weight, 20K Hz BW |      | -101 | -100 |        |
| DC Output                    |        |  | 0.59 | 0.69 | 0.78 | V      |
| Output Impedance             | Zout   | @ 1 kHz  | -    | -    | 600  |        |
| DC offset                    |        | OUT+ to OUT-   |      | ±5   | ±50  | mV     |

<sup>1</sup> Sensitivity and Supply Current are 100% tested.

<sup>2</sup> OUT+ and OUT- must be AC coupled

## Application Notes

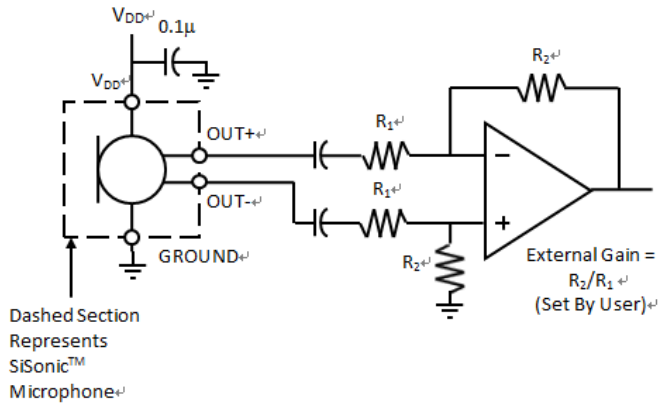


Figure 1: Typical Application Circuit

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

When  $OUT-$  is grounded, it is not driven after a subsequent power-up

$OUT+$  and  $OUT-$  must use an AC coupled capacitor

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

# Performance Curves

Test Conditions: 23 ±2°C, 55±20% R.H. V<sub>DD</sub> =2.7, no load, unless otherwise

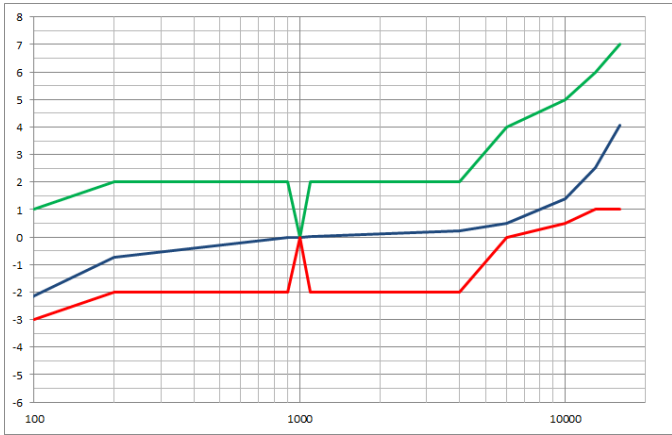


Figure 2: Typical Free Field Response Normalized to 1 kHz

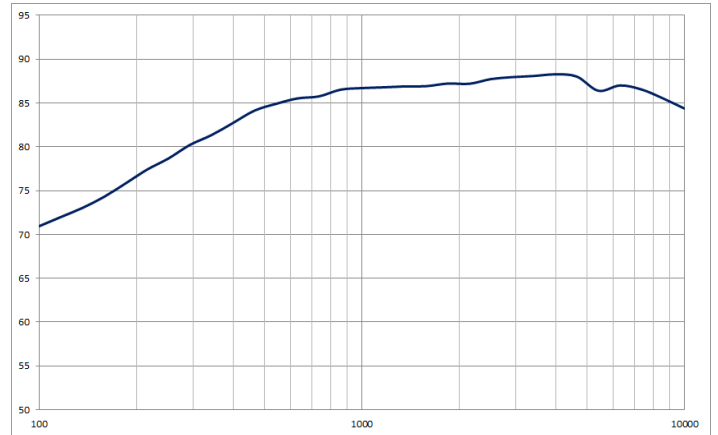


Figure 5: Typical PSRR

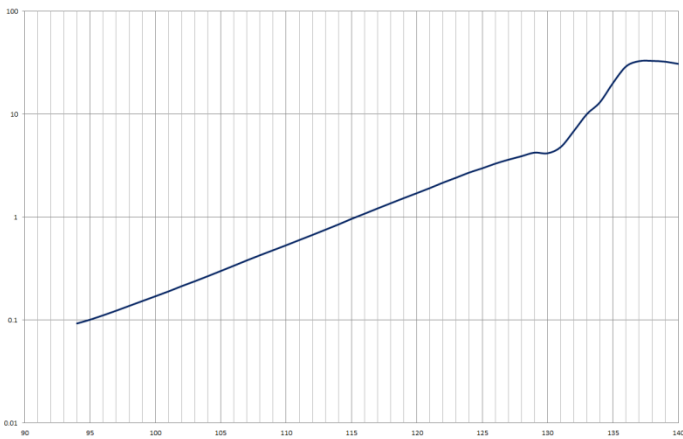


Figure 3: Typical THD vs SPL

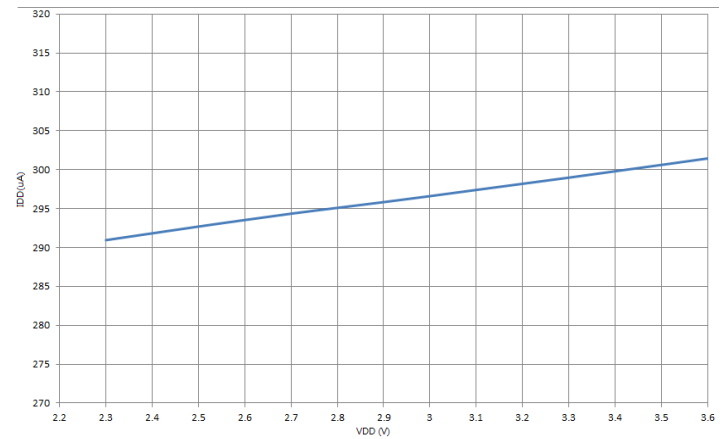


Figure 6: Typical Idd vs Vdd

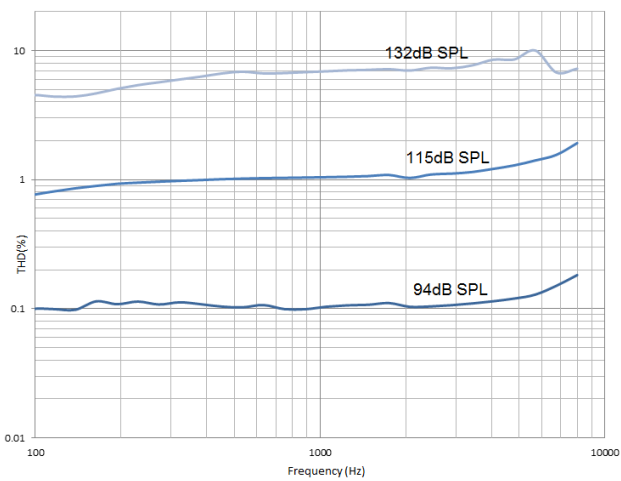


Figure 4: THD vs Frequency Response

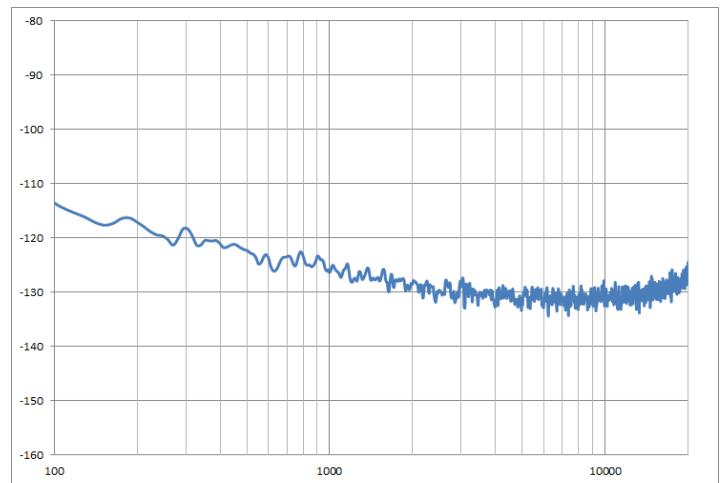
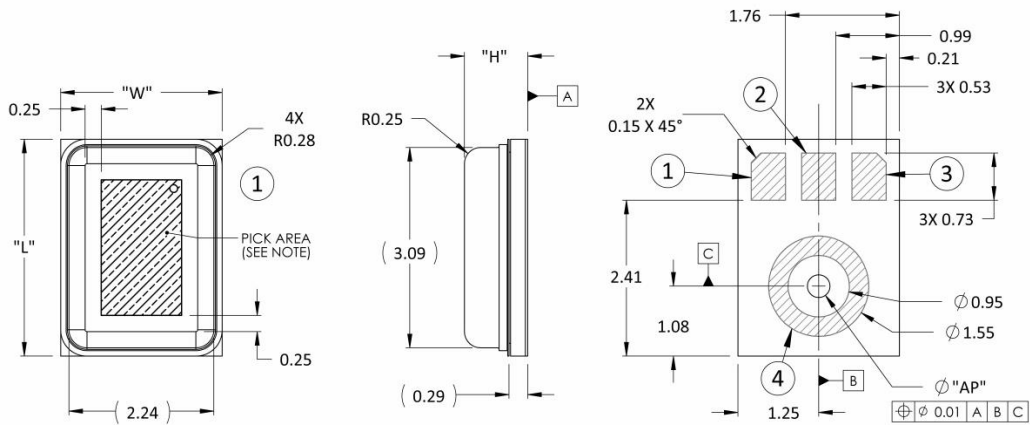


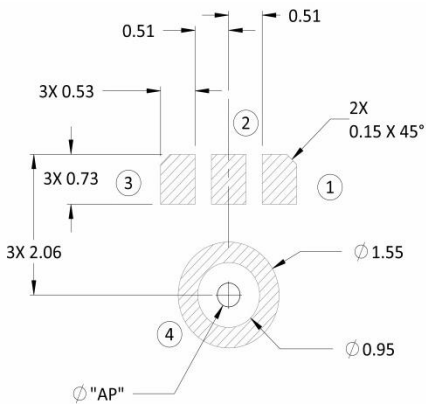
Figure 6: Noise Level

# Mechanical Specifications

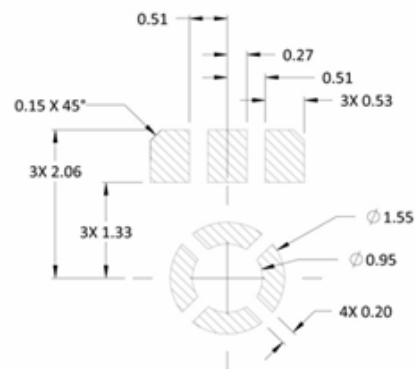


| Pin # | Pin Name | Type   | Description                |
|-------|----------|--------|----------------------------|
| 1     | Vdd      | Power  | Power Supply               |
| 2     | OUT-     | Signal | Inverted Output Signal     |
| 3     | OUT+     | Signal | Non-Inverted Output Signal |
| 4     | GROUND   | Power  | Ground                     |

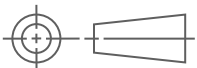
## Example Land Pattern



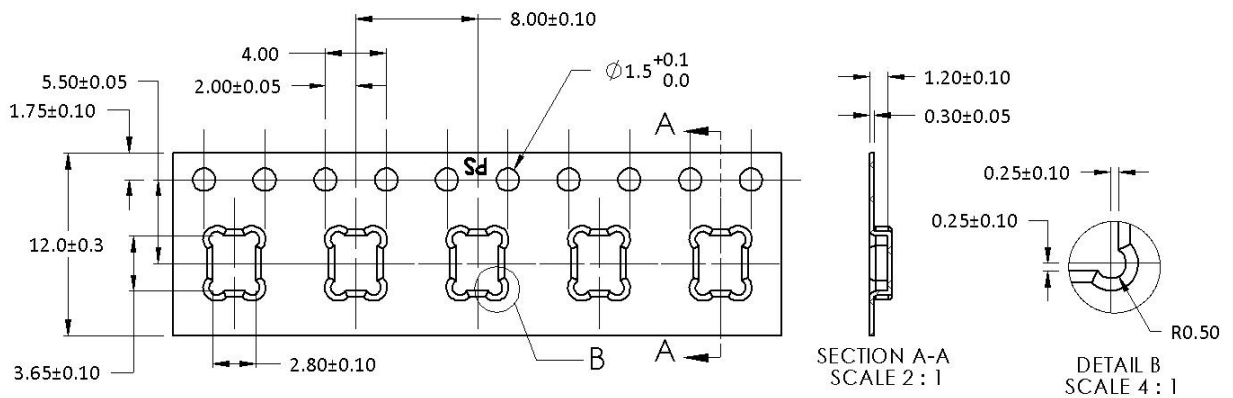
## Example Solder Stencil Pattern



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



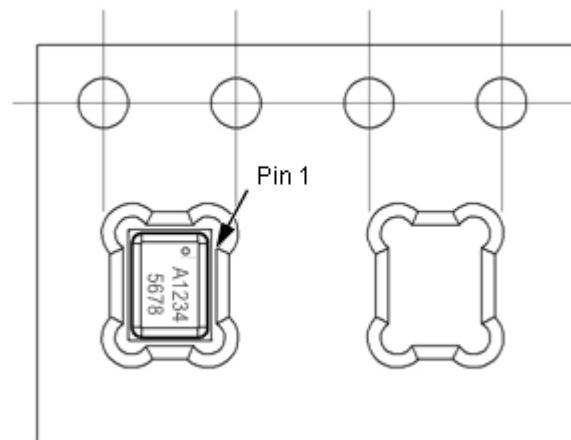
| Model Number  | Suffix | Reel Diameter | Quantity Per Reel |
|---------------|--------|---------------|-------------------|
| SPA1687LR5H-1 | -8     | 13"           | 5,900             |
| SPA1687LR5H-1 | -T     | 13"           | 300               |

Alpha Character A:

- "S" Knowles Sisonic Production
- "E" Knowles Engineering Samples
- "P" Knowles Prototype samples

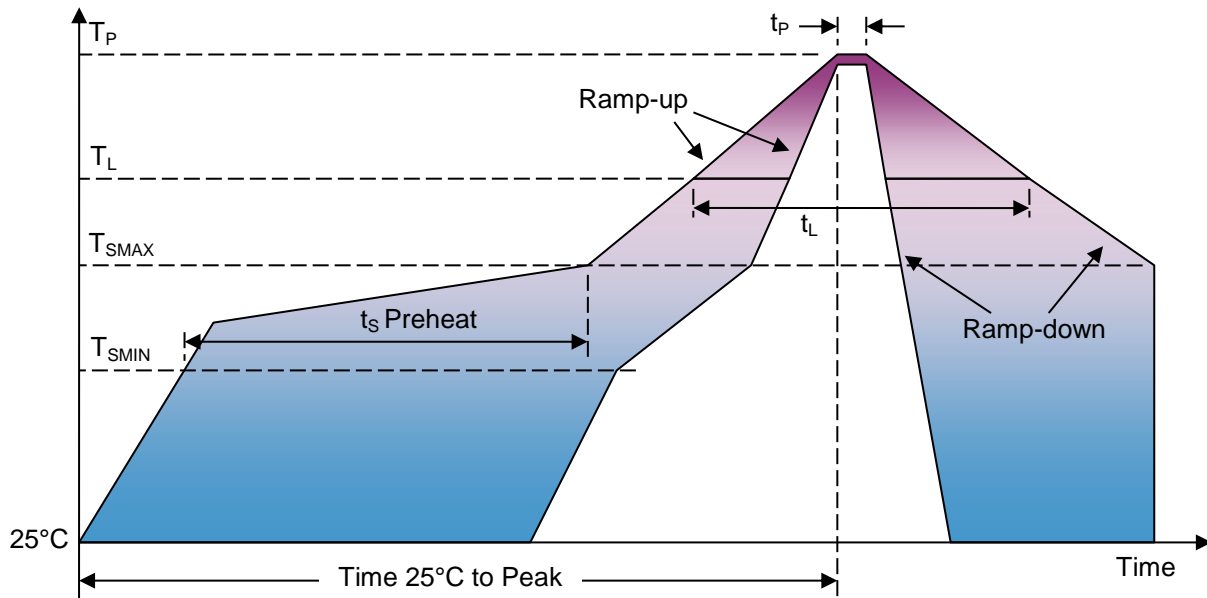
"12345678":

Unique Job Identification Number for Product traceability



- 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 <ul style="list-style-type: none"> <li>Temperature Min (<math>T_{SMIN}</math>)</li> <li>Temperature Max (<math>T_{SMAX}</math>)</li> <li>Time (<math>T_{SMIN}</math> to <math>T_{SMAX}</math>) (<math>t_s</math>)</li> </ul> | 150°C<br>200°C<br>60-180 seconds |
| Time maintained above: <ul style="list-style-type: none"> <li>Temperature (<math>T_L</math>)</li> <li>Time (<math>t_L</math>)</li> </ul>   | 217°C<br>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

- MSL (moisture sensitivity level) Class 1.
- Maximum of 3 reflow cycles is recommended.
- 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.

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."

## Reliability Specifications

| Test                      | Description  |
|---------------------------|--|
| Thermal Shock             | 100 cycles of air-air thermal shock from -40°C to +125°C with 15 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 (JESD22-A101A-B)   |
| 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) |
| ESD-HBM                   | 3 discharges of ±2 kV direct contact to I/O pins. (ESD STM5.2)   |
| ESD-LID/GND               | 3 discharges of ±8 kV direct contact to lid while unit is grounded. (IEC 61000-4-2)  |
| ESD-MM                    | 3 discharges of ±200V direct contact to I/O pins. (MIL 883E, Method 3015.7)  |
| 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: 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.





Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

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- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
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- Комплексную поставку.
- Работу по проектам и поставку образцов.
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- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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