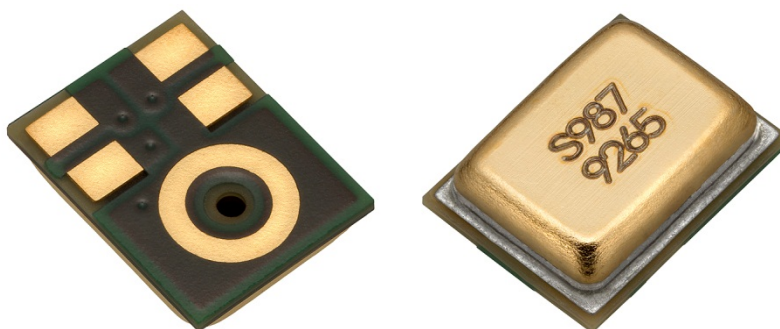


## Precision High SNR Zero-Height SiSonic™ Microphone



The SPH1611LR5H-1 is a miniature, high-performance, low power, bottom port silicon microphone. Using Knowles' proven high performance SiSonic™ MEMS technology, the SPH1611LR5H-1 consists of an acoustic sensor, a low noise input buffer, and an 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.

### Features:

- Matched Sensitivity
- High SNR
- Small package
- Flat Frequency Response
- MaxRF protection
- Zero-Height Mic™
- Ultra-Stable Performance
- Standard SMD Reflow
- Omnidirectional

## 1. ABSOLUTE MAXIMUM RATINGS

| Parameter                 | Absolute Maximum Rating     | Units |
|---------------------------|-----------------------------|-------|
| V <sub>DD</sub> to Ground | -0.5, +5.0                  | V     |
| OUT to Ground             | -0.3, V <sub>DD</sub> + 0.3 | V     |
| Input Current to Any Pin  | ±5                          | mA    |
| Temperature Range         | -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.

## 2. ACOUSTIC & ELECTRICAL SPECIFICATIONS

TEST CONDITIONS: 23 ±2°C, 55±20% R.H., V<sub>DD</sub> (min) < V<sub>DD</sub> < V<sub>DD</sub> (max), no load, unless otherwise indicated

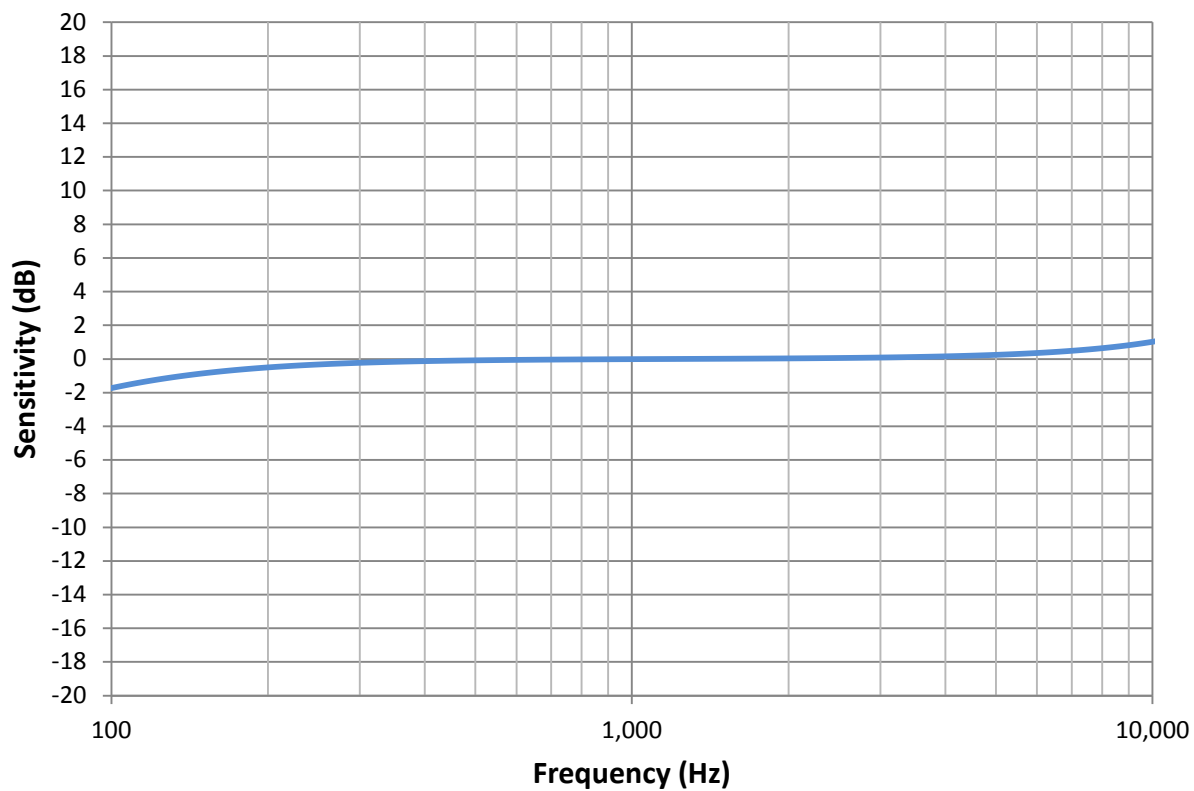
| Parameter                     | Symbol           | Conditions  | Min                       | Typ  | Max | Units  |
|-------------------------------|------------------|---|---------------------------|------|-----|--------|
| Supply Voltage <sup>1</sup>   | V <sub>DD</sub>  |   | 1.5                       | -    | 3.6 | V      |
| Supply Current <sup>1,2</sup> | I <sub>DD</sub>  |   | -                         | 145  | 185 | μA     |
| Sensitivity <sup>1</sup>      | S                | 94 dB SPL @ 1 kHz   | -39                       | -38  | -37 | dBV/Pa |
| Signal to Noise Ratio         | SNR              | 94 dB SPL @ 1 kHz, A-weighted   | -                         | 65   | -   | dB(A)  |
| Total Harmonic Distortion     | THD              | 94 dB SPL @ 1 kHz,<br>S = Typ, R <sub>load</sub> > 2 kΩ                       | -                         | 0.2  | 0.3 | %      |
| Acoustic Overload Point       | AOP              | 10% THD @ 1 kHz,<br>S = Typ, V <sub>DD</sub> = 3.6V, R <sub>load</sub> > 2 kΩ | 122                       | 124  | -   | dB SPL |
| Power Supply Rejection Ratio  | PSRR             | 200mVpp sinewave<br>@ 1 kHz, V <sub>DD</sub> = 1.8V                           | -                         | 60   | -   | dB     |
| Power Supply Rejection        | PSR              | 100 mVpp square wave<br>@ 217 Hz, V <sub>DD</sub> = 1.8V, A-weighted          | -                         | -92  | -   | dBV(A) |
| DC Output                     |                  | V <sub>DD</sub> = 1.5V  | -                         | 1.10 | -   | V      |
| Output Impedance              | Z <sub>OUT</sub> | @ 1 kHz   | -                         | -    | 400 | Ω      |
| Directivity                   |                  |   | Omnidirectional           |      |     |        |
| Polarity                      |                  | Increasing sound pressure   | Increasing output voltage |      |     |        |

<sup>1</sup> 100% tested.

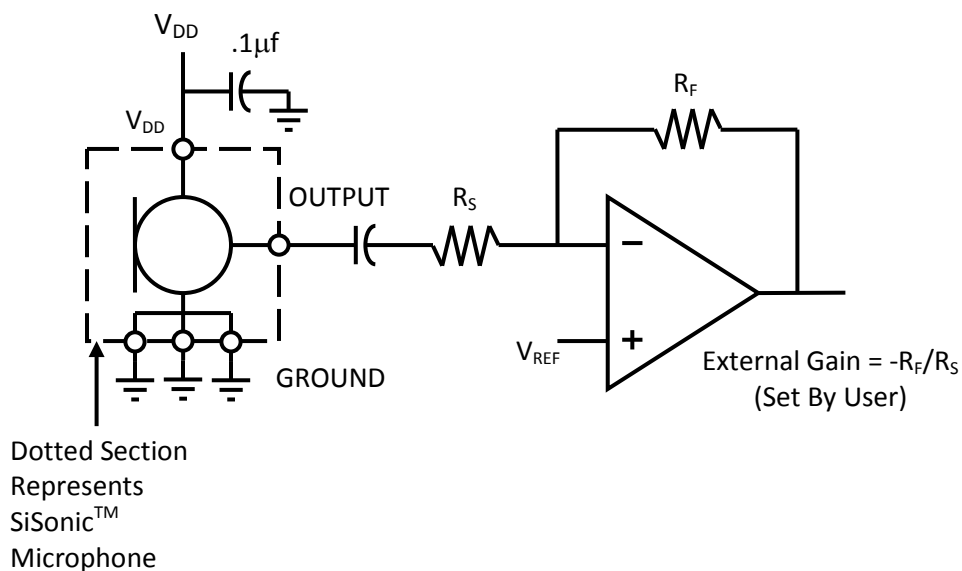
<sup>2</sup> Maximum specifications are measured at maximum V<sub>DD</sub>. Typical specifications are measured at V<sub>DD</sub> = 1.8V.

### 3. FREQUENCY RESPONSE CURVE

**Typical Free Field Response  
Normalized to 1 kHz**



## 4. INTERFACE CIRCUIT

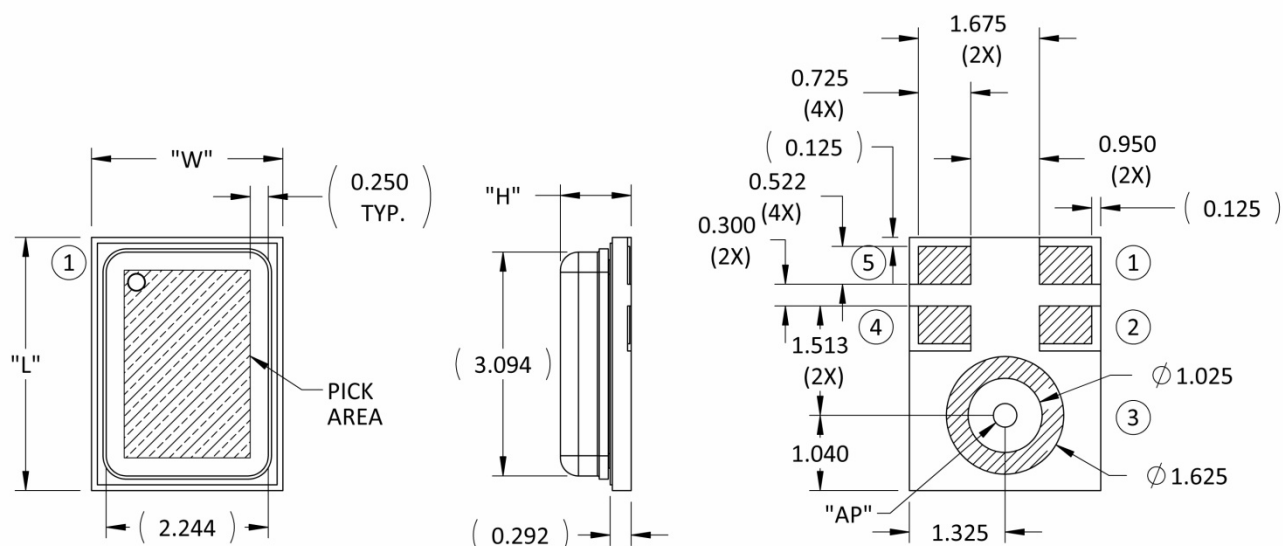


Notes: All Ground pins must be connected to ground.

Capacitors near the microphone should not contain Class 2 dielectrics.

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

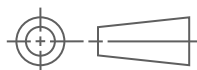
## 5. MECHANICAL SPECIFICATIONS



| Item               | Dimension | Tolerance |
|--------------------|-----------|-----------|
| Length (L)         | 3.50      | ±0.10     |
| Width (W)          | 2.65      | ±0.10     |
| Height (H)         | 0.98      | ±0.10     |
| Acoustic Port (AP) | Ø0.325    | ±0.05     |

| Pin # | Pin Name        | Type   | Description   |
|-------|-----------------|--------|---------------|
| 1     | OUTPUT          | Signal | Output Signal |
| 2     | GROUND          | Power  | Ground        |
| 3     | GROUND          | Power  | Ground        |
| 4     | GROUND          | Power  | Ground        |
| 5     | V <sub>DD</sub> | Power  | Power Supply  |

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

Technical drawing of a 4-hole circular plate. The drawing includes a side view at the top and a top view at the bottom.

**Side View Dimensions:**

- Overall width: 1.675 (2X)
- Overall height: 0.725 (4X)
- Distance from top edge to center of hole 1: 0.475
- Distance from top edge to center of hole 5: 0.522 (4X)
- Distance from bottom edge to center of hole 1: 0.822 (2X)
- Distance from bottom edge to center of hole 5: 1.513

**Top View Dimensions:**

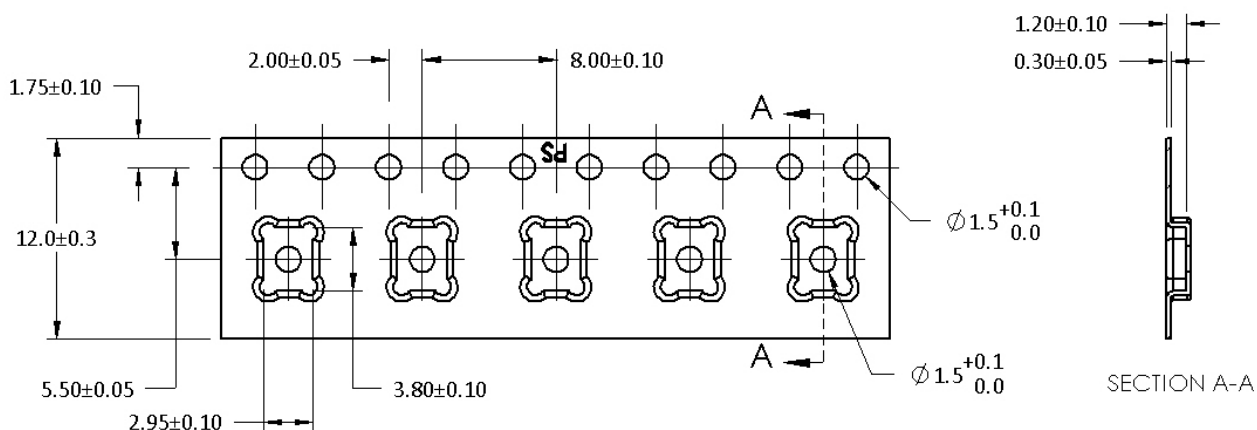
- Outer diameter:  $\varnothing 1.625$
- Inner diameter:  $\varnothing 1.025$
- Feature "AP" - SEE NOTE

**Callouts:**

- 1, 2, 3, 4, 5: Circled numbers identifying specific features or holes.

Further optimizations based on application should be performed.

## 8. PACKAGING & MARKING DETAIL



| Model Number  | Suffix | Reel Diameter | Quantity Per Reel |
|---------------|--------|---------------|-------------------|
| SPH1611LR5H-1 | -8     | 13"           | 5,900             |

Alpha Character A:

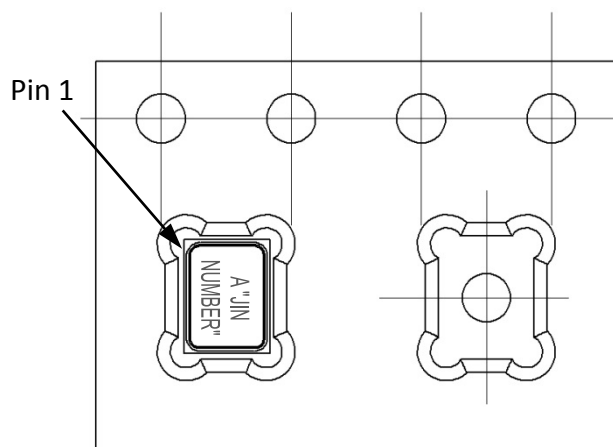
"S": Knowles SiSonic™ Production

"E": Knowles Engineering Samples

"P": Knowles Prototype Samples

"JIN NUMBER":

Unique Job Identification Number  
for product traceability



Notes: Dimensions are in millimeters unless otherwise specified.

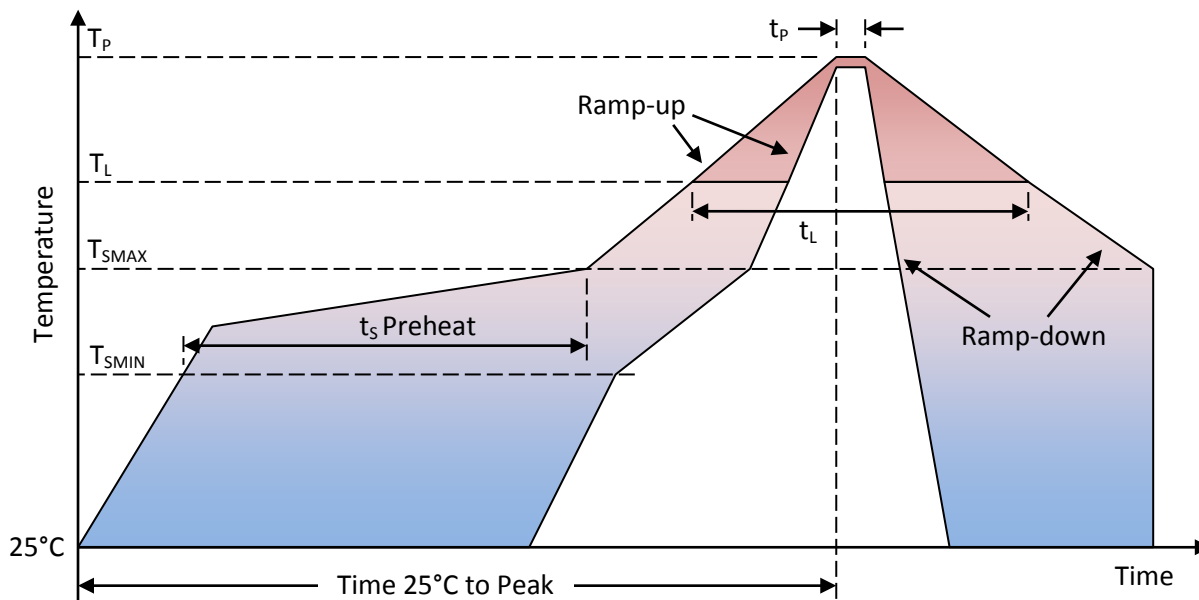
Vacuum pickup only in the pick area indicated in Mechanical Specifications.

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.

## 9. 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.



## 10. 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.

## 11. 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.”

## 12. RELIABILITY SPECIFICATIONS

| Test                        | Description   |
|-----------------------------|---|
| Thermal Shock               | 100 cycles air-to-air thermal shock from -40°C to +125°C with 15 minute soaks. (IEC 68-2-4)   |
| High Temperature Storage    | 1,000 hours at +105°C environment (IEC 68-2-2 Test Ba)  |
| Low Temperature Storage     | 1,000 hours at -40°C environment (IEC 68-2-2 Test Aa)   |
| High Temperature Bias       | 1,000 hours at +105°C under bias (IEC 68-2-2 Test Ba)   |
| Low Temperature Bias        | 1,000 hours at -40°C under bias (IEC 68-2-2 Test Aa)  |
| Temperature / Humidity Bias | 1,000 hours at +85°C/85% R.H. under bias. (JESD22-A101A-B)  |
| Vibration                   | 4 cycles of 20 to 2,000 Hz sinusoidal sweep with 20 G peak acceleration lasting 12 minutes in X, Y, and Z directions. (Mil-Std-883E, Method 2007.2 A) |
| ESD-HBM                     | 3 discharges of ±2 kV direct contact to I/O pins. (MIL 883E, Method 3015.7)   |
| 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 ±200 V direct contact to I/O pins. (ESD STM5.2)   |
| Reflow                      | 5 reflow cycles with peak temperature of +260°C   |
| Mechanical Shock            | 3 pulses of 10,000 G in the X, Y, and Z direction (IEC 68-2-27, Test Ea)  |

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

After 3 reflow cycles, the sensitivity of the microphone shall not deviate more than 1dB from its initial value.

### 13. SPECIFICATION REVISIONS

| Revision | Specification Changes        | Date   |
|----------|------------------------------|--------|
| A        | Initial Release (DCN 15-163) | 3/6/15 |
|          |                              |        |
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