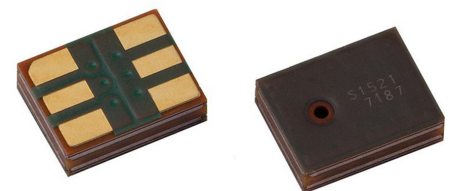
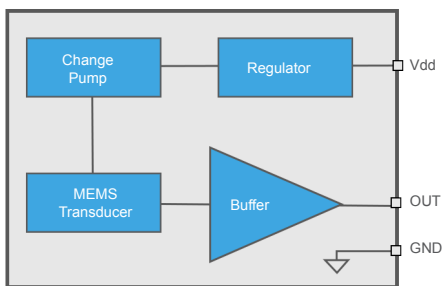


WIDE BANDWIDTH, LOW NOISE, PRECISION TOP PORT SISONIC™ MICROPHONE



The SPH1642HT5H-1 is a miniature, high-performance, low power, matched sensitivity top port silicon microphone. Using Knowles' proven high performance SiSonic™ MEMS technology, the SPH1642HT5H-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.



PRODUCT FEATURES

- Matched Sensitivity
- LGA Package
- Flat Frequency Response
- Low Current
- MaxRF Protection
- Top 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	-0.3, +5.0	V
Out to Ground	-0.3, Vdd+0.3	V
Input Current to any pin	±5	mA
Storage Temperature	-40 to +100	°C
Operating Temperature	-30 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 SPECIFICATIONS¹

Table 2: General Microphone Specifications

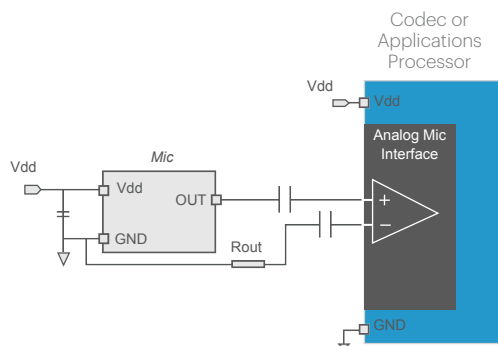
Test Conditions: 23 ±2°C, 55±20% R.H., Vdd=1.8V, no load, unless otherwise indicated

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Voltage	Vdd		1.5	-	3.6	V
Supply Current	Idd	Vdd = 3.6V	-	132	185	μA
		Vdd = 1.8V	-	117	130	
Sensitivity	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, S = Typ, Rload > 2kΩ	-	0.25	-	%
		1% THD @ 1 kHz Vdd = 1.8v, S = Typ, Rload > 2kΩ	-	107	-	dB SPL
Acoustic Overload Point	AOP	10% THD @ 1 kHz, Vdd = 1.8v, S = Typ, Rload > 2kΩ	-	124	-	dB SPL
Low Frequency Rolloff	LFRO	-3dB relative to 1kHz	-	55	-	Hz
Power Supply Rejection Ratio	PSRR	200 mVpp sinewave @ 1kHz, Vdd = 1.8 v	-	77	-	dB
Power Supply Rejection	PSR+N	200 mVpp 7/8 duty cycle rectangular wave @ 217 Hz, Vdd = 1.8V, A-weighted	-	-102	-	dBV(A)
DC Output		Vdd = 1.8V	-	1.30	-	V
Output Impedance		@ 1 kHz	-		500	Ω
Sensitivity Drop		Vdd(min) ≤ Vdd ≤ Vdd(max)	-	-	±0.25	dB
Directivity			Omnidirectional			
Polarity		Increasing sound pressure	Increasing output voltage			

¹ Sensitivity and Supply Current are 100% tested.

APPLICATION NOTES

Figure 1: Typical Application Circuit



NOTES:

All Ground pins must be connected to ground.

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.

PERFORMANCE CURVES

Test Conditions: Vdd=1.8V, no load, unless otherwise indicated

Figure 2: Typical Free Field Response Normalized to 1 kHz

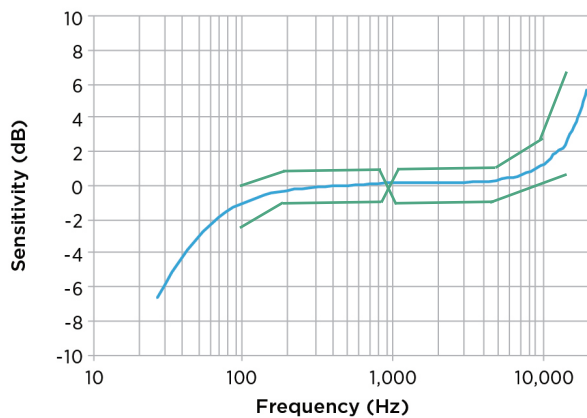


Figure 3: Typical PSRR vs Frequency

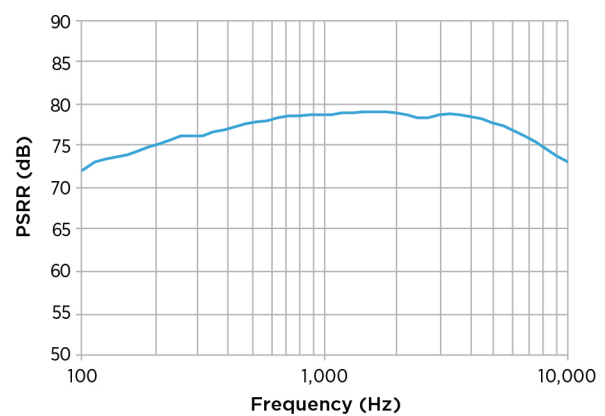


Figure 4: Typical THD vs SPL

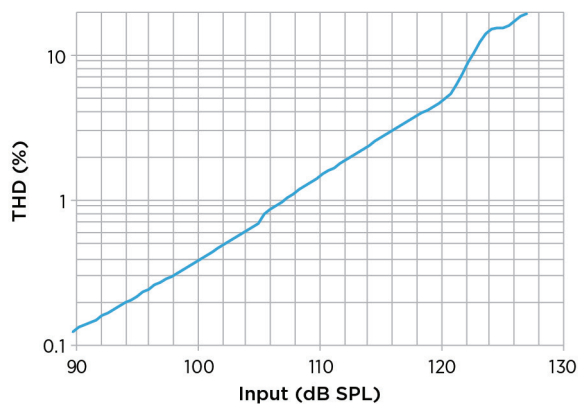


Figure 5: Typical Idd vs Vdd

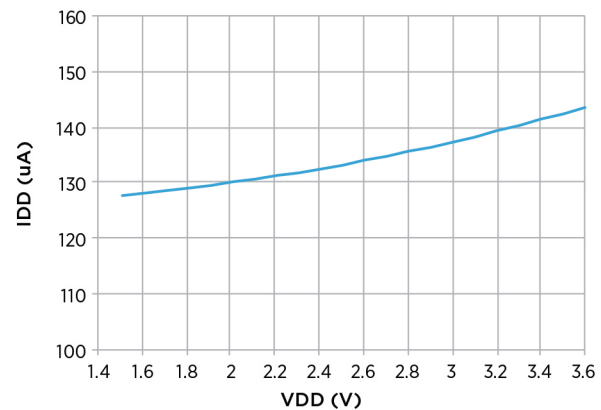


Figure 6: THD vs Frequency

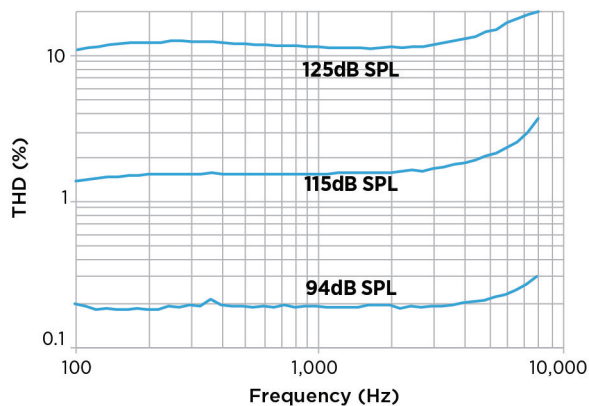
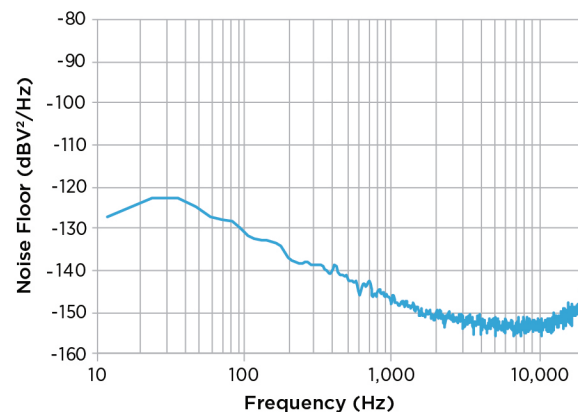


Figure 7: Noise Floor Power Spectral Density



Technical drawings of a 3x3 grid of cells.

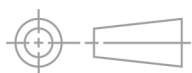
Left Drawing (Single Cell):

- Width: 0.980
- Height: 1.325
- Circle diameter: $\phi 0.610$
- Label: "AP" with an arrow pointing to the circle.
- Label: "PICK AREA (SEE NOTE)" with an arrow pointing to the shaded rectangular area.
- Overall width: "L"
- Overall height: "W"

Right Drawing (3x3 Grid):

- Grid dimensions: 3X 1.176 (width) and 3X 1.032 (height).
- Cell dimensions: 0.200 X 45° (top-left corner), 4X 0.323 (top edge), 2X 0.500 (middle edge), 4X 0.622 (bottom edge), 4X 0.130 (bottom edge).
- Cell labels: 1, 2, 3 (right column); 4, 5, 6 (middle column); 1, 2, 3 (left column).

Pin #	Pin Name	Type	Description
1	GROUND	Power	Ground
2	GROUND	Power	Ground
3	GROUND	Power	Ground
4	OUTPUT	Signal	Output Signal
5	TEST PIN (Knowles Internal Use)	N/A	Connect to Ground
6	Vdd	Power	Power Supply



Further optimizations based on application should be performed.

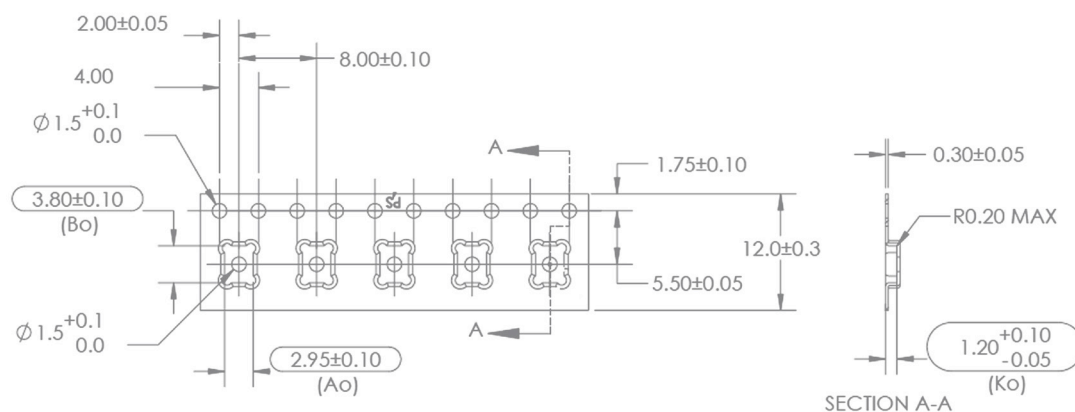
Technical drawing of a stepped profile with dimensions and callouts:

- Overall width: 6X 1.032
- Overall height: 4X 0.323
- Overall depth: 3X 1.176
- Callout 1: 0.200 X 45° (pointing to the top edge of the first step)
- Callout 2: 2X 0.500 (pointing to the second step)
- Callout 3: 4X 0.622 (pointing to the third step)
- Callout 4: 4X 0.323 (pointing to the fourth step)
- Callout 5: 2X 0.500 (pointing to the fifth step)
- Callout 6: 0.200 X 45° (pointing to the bottom edge of the sixth step)

Technical drawing of a 3D-printed part showing dimensions and tolerances. The drawing includes a side view on the left and a top view on the right. The side view shows a rectangular part with a width of 6X 1.032. The top view shows a rectangular part with a width of 0.200 X 45° and a height of 4X 0.323. The top view also shows a central rectangular feature with a width of 2X 0.500 and a height of 4X 0.622. The overall width of the top view is 3X 1.176. The drawing includes a note indicating that the dimensions are in inches and that the tolerances are in thousandths of an inch.



PACKAGING & MARKING DETAIL



Model Number	Suffix	Reel Diameter	Quantity Per Reel
SPH1642HT5H-1	-8	13"	5,900

"o": orientation mark

Alpha Character A:

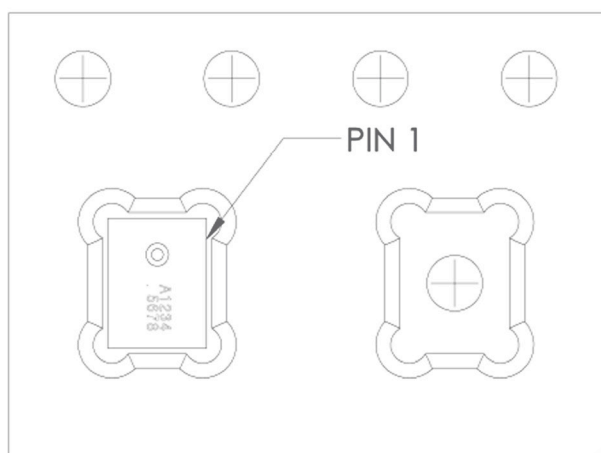
"S": Knowles SiSonic™ Production

"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.

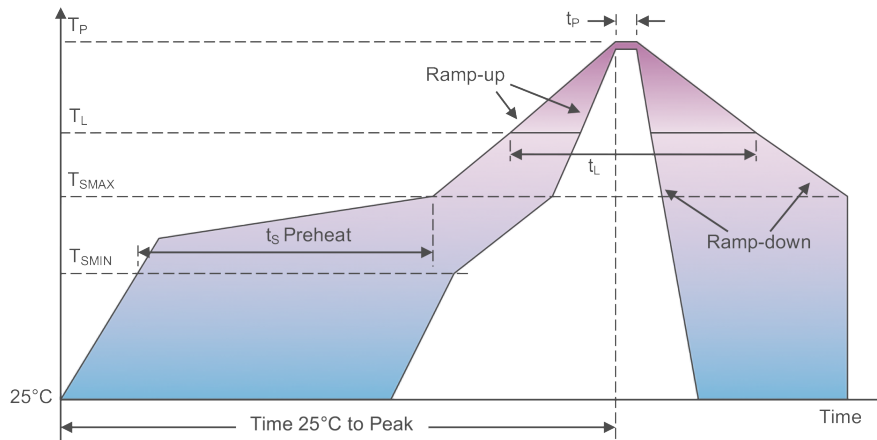
Vacuum pickup only in the pick area indicated in Mechanical Specifications.

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.

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"> • 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.

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
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	12 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-HBM (LID/GND)	3 discharges of ±8kV direct contact to lid while unit is grounded (MIL 883E, Method 3015.7)
ESD-MM	3 discharges of ±200V direct contact to IO pins (ESD STM5.2)

NOTES:

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

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 ECR#15-181	5/21/15
B	Changed THD to 0.25% ECR#15-129	7/21/2015
C	Changed microphone photograph ECR#16-1240	10/27/2016
D	Update Pin description ECR #17-1656	5/15/17
E	Update Temperature range ECR#17-2010	11/13/17
F	Add Frequency Response Masks (ECR 20-3632)	3/13/20

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