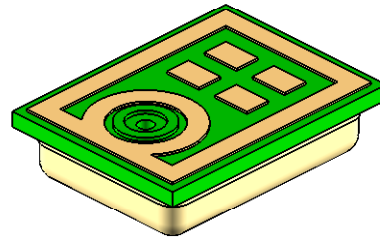
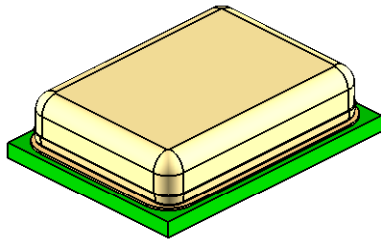


"4 x 3 x 1" Digital Zero-Height SiSonic™
Microphone Specification



Knowles Acoustics
1151 Maplewood Drive
Itasca, IL 60143

1. DESCRIPTION AND APPLICATION

- 1.1 DESCRIPTION Digital Surface Mount Silicon Microphone
- 1.2 APPLICATION Consumer electronics

2. PART MARKING

Identification Number Convention

S 1 2 3

4 5 6 7

S: Identification Marking

"S" - Knowles SiSonic Production

"E" - Knowles Engineering Samples

Digits 1-7: Job Identification Number

3. MATERIALS STATEMENT

3.1 Meets the requirements of the European RoHS directive, 2002/95/EC as amended.

3.2 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.

3.3 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."

4. TEMPERATURE RANGE

4.1 Operating Temperature Range: -40°C to +100°C

4.2 Storage Temperature Range: -40°C to +100°C

5. ABSOLUTE MAXIMUM RATINGS

| Parameter | Absolute Maximum Rating | Unit |
|--|---|------|
| CLOCK to Ground | -0.3, +5.0 | V |
| SELECT, V _{DD} , DATA to Ground | -0.3, +5.0 | V |
| Input Current | ±5 | mA |
| DATA Output Short Circuit | Indefinite to Ground or V _{DD} | |

Stresses at these Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only. The device may not function when operated at these or any other conditions beyond those indicated under "Acoustic & Electrical Specifications". Exposure beyond those indicated under "Acoustic & Electrical Specifications" for extended periods may affect device reliability.

6. ACOUSTIC & ELECTRICAL SPECIFICATIONS

TEST CONDITIONS: 23 ±2°C, 60-70% R.H., V_{DD} = 1.8v, f_{clock}=2.4MHz, no load, unless otherwise specified

| Parameter | Symbol | Condition | Limits | | | Unit |
|--------------------------------------|--|--|---------------------------|------|----------------------|-------|
| | | | Min. | Nom. | Max. | |
| Supply Voltage ¹ | V _{DD} | | 1.6 | --- | 3.6 | V |
| Current Consumption ^{1,5,6} | I _{DD} | | --- | 500 | 700 | µA |
| Sleep Current ⁶ | I _{SLEEP} | f _{clock} < 1kHz | --- | 4 | 7 | µA |
| Directivity | | | Omni-directional | | | |
| Sensitivity ¹ | S | 94 dB SPL @ 1kHz | -29 | -26 | -23 | dBFS |
| Signal to Noise Ratio | SNR | 94 dB SPL @ 1kHz, A-weighted | --- | 60.5 | --- | dB(A) |
| Total Harmonic Distortion | THD | 94 dB SPL @ 1kHz | --- | --- | 1 | % |
| | | 115 dB SPL @ 1kHz | --- | --- | 10 | % |
| Polarity | | Increasing sound pressure | Increasing density of 1's | | | |
| Fall-asleep Time ^{2,3} | | f _{clock} < 1kHz | --- | --- | 10 | ms |
| Wake-up Time ^{2,4} | | f _{clock} ≥ 1MHz | --- | --- | 20 | ms |
| Short Circuit Output Current | I _{SC} | Grounded output pin | 2 | --- | 10 | mA |
| Output Load | C _{LOAD} | | --- | --- | 160 | pF |
| Data Format | | | 1/2 Cycle PDM | | | |
| Clock Frequency | f _{clock} | | 1.0 | --- | 3.25 | MHz |
| Clock Duty Cycle | | | 40 | --- | 60 | % |
| Clock Rise/Fall Time | t _{edge} | | --- | --- | 13 | nsec |
| Logic Input Low | V _{IL} | | -0.3 | --- | 0.35xV _{DD} | V |
| Logic Input High | V _{IH} | | 0.65xV _{DD} | --- | 3.6 | V |
| Logic Output Low | V _{OL} | I _{OUT} = 2ma | 0 | --- | 0.3xV _{DD} | V |
| Logic Output High | V _{OH} | I _{OUT} = 2ma | 0.7xV _{DD} | --- | V _{DD} | V |
| Data Time | t _{setup} + t _{edge} | 160 pF Load | 47 | --- | --- | nsec |
| Delay time for valid data | t _{valid} | min t _{valid} valid for no load max t _{valid} valid for max Cload | 18 | --- | 115 | nsec |
| Delay time for High Z | t _{hold} | | 0 | --- | 16 | nsec |

¹ 100% tested

² Valid microphone states are: Powered Down mode (mic off), Sleep mode (low current, no output, fast startup), and Active mode (normal operation).

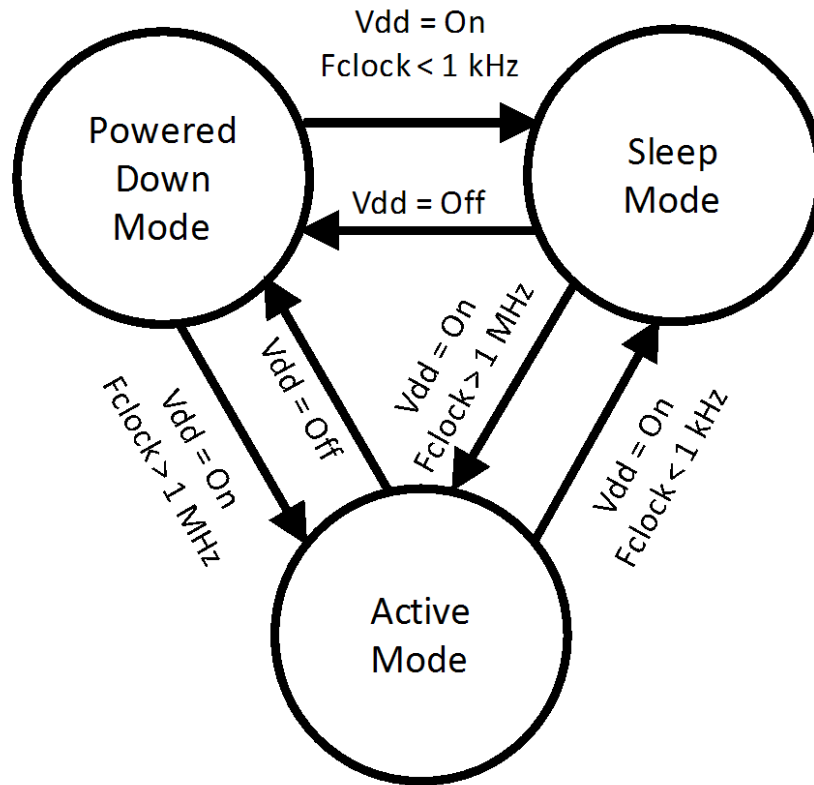
³ Time from F_{clock} < 1 kHz to Sleep Current specification is met when transitioning from Active to Sleep mode.

⁴ Time from F_{clock} ≥ 1 MHz to all applicable specifications are met when transitioning from Sleep to Active mode.

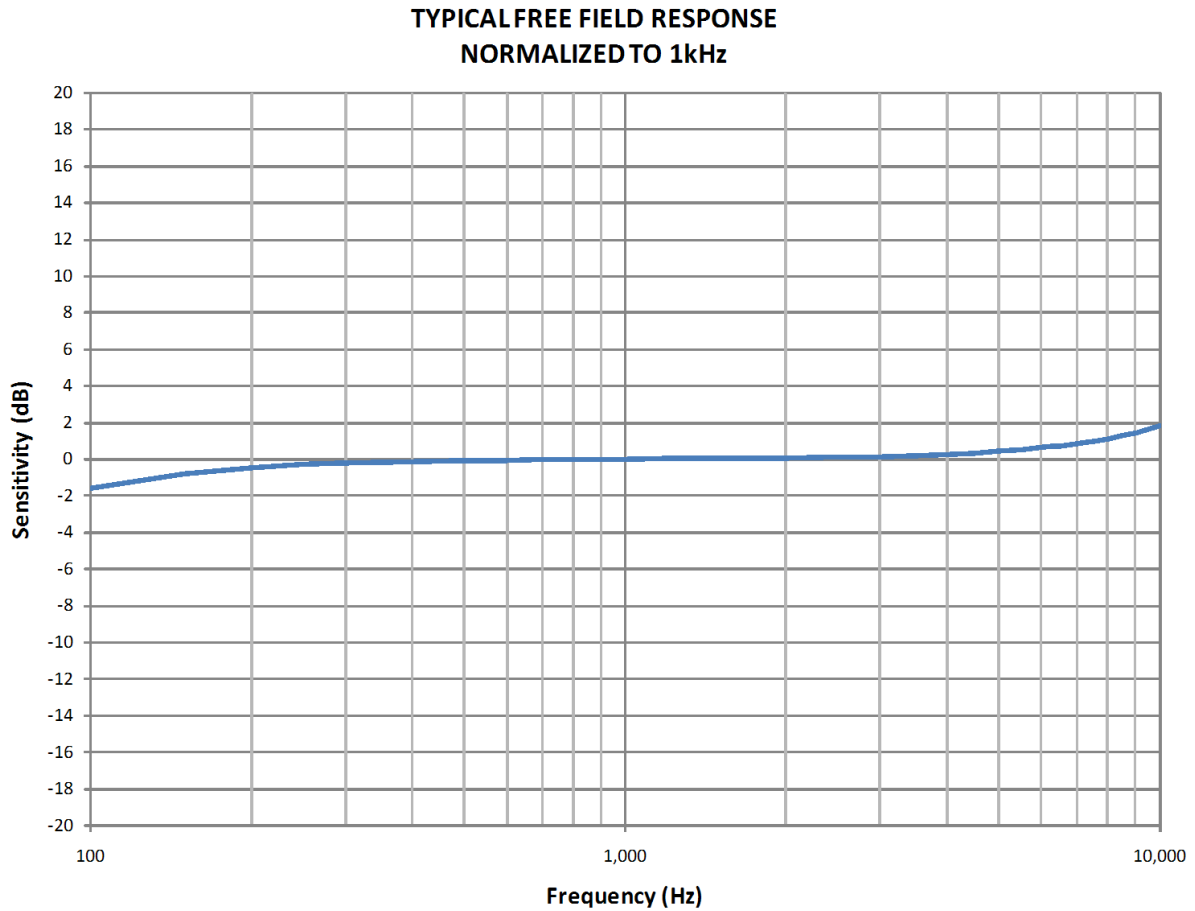
⁵ ΔI_{DD} = 0.5 * V_{DD} * C_{LOAD} * F_{CLOCK}

⁶ Specified max. v values are measured at V_{DD} = 3.6V

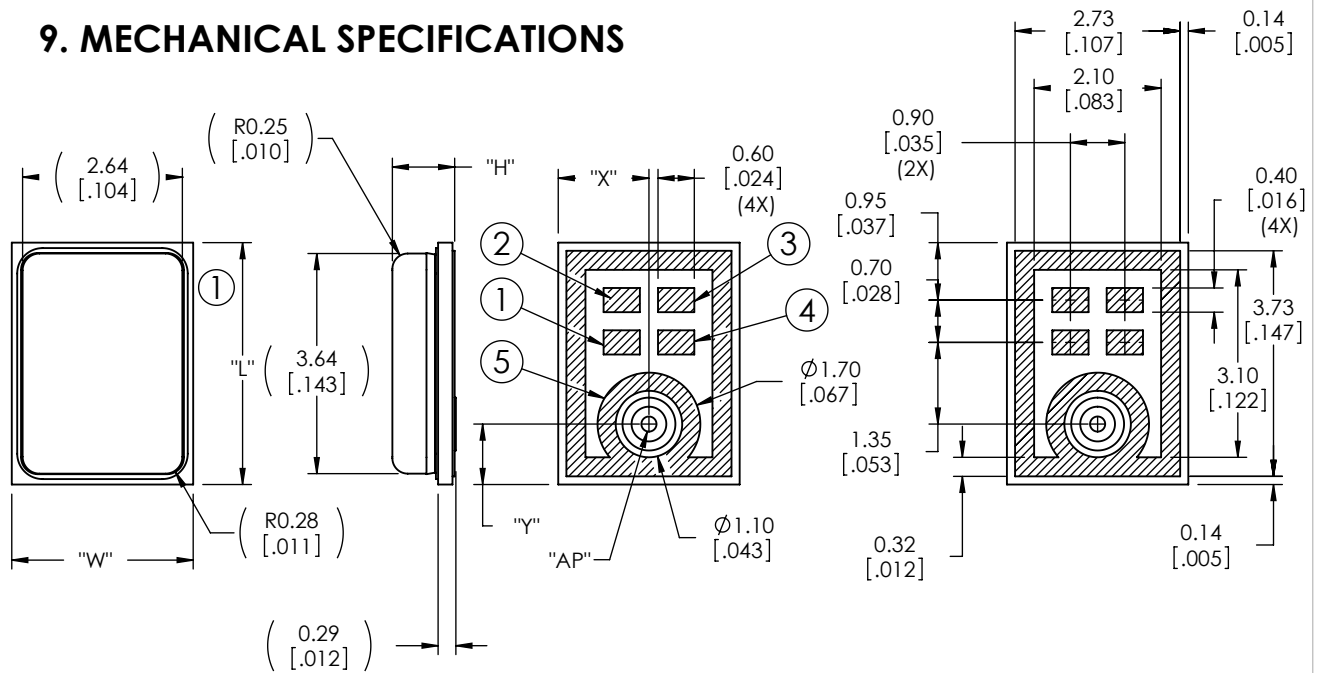
7. MICROPHONE STATE DIAGRAM



8. FREQUENCY RESPONSE CURVE



9. MECHANICAL SPECIFICATIONS



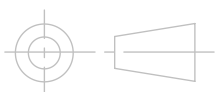
| ITEM | DIMENSION | TOLERANCE | UNITS |
|--------------------|-----------|-----------|-------|
| LENGTH (L) | 4.00 | ±0.100 | mm |
| WIDTH (W) | 3.00 | ±0.100 | mm |
| HEIGHT (H) | 1.00 | ±0.100 | mm |
| ACOUSTIC PORT (AP) | Ø0.25 | ±0.050 | mm |
| AP LOCATION (X) | 1.50 | ±0.200 | mm |
| AP LOCATION (Y) | 1.00 | ±0.200 | mm |

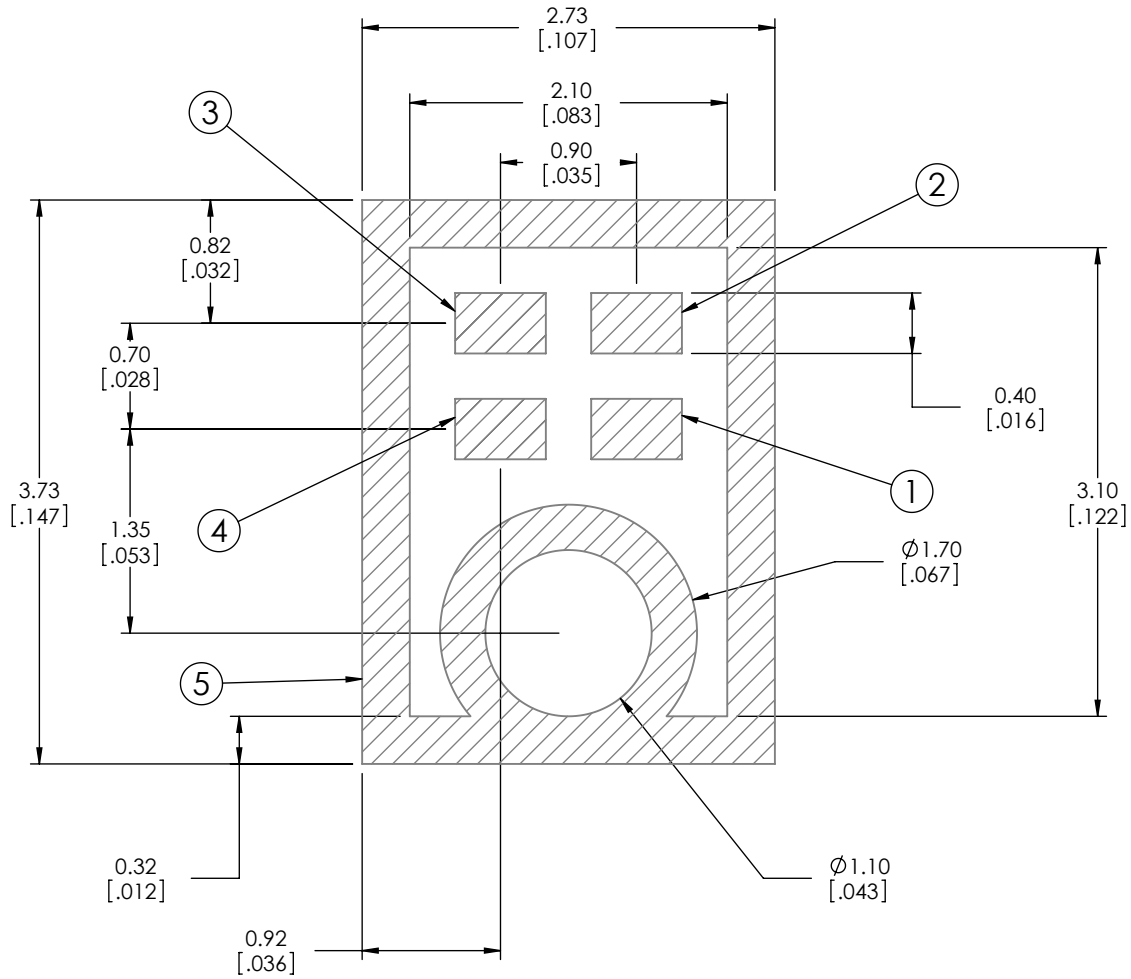
| PIN OUTPUT | |
|------------|--------------------------|
| PIN # | FUNCTION |
| 1 | POWER (V _{DD}) |
| 2 | OUTPUT (DATA) |
| 3 | CLOCK (CLK) |
| 4 | SELECT |
| 5 | GROUND (GND) |

Note:

Dimensions are in millimeters unless otherwise specified.

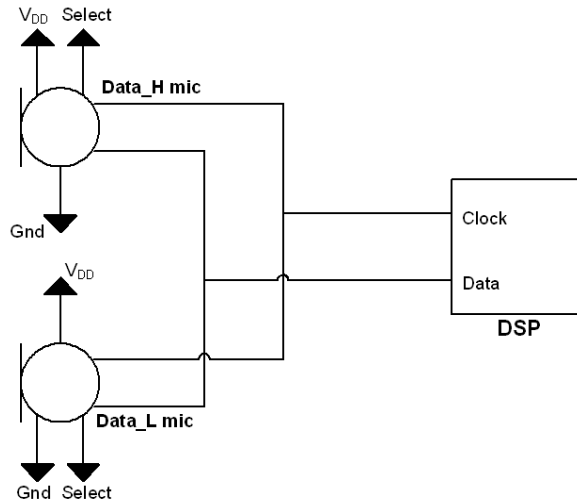
Tolerance ±0.15mm unless otherwise specified.



10. RECOMMENDED CUSTOMER LAND PATTERN


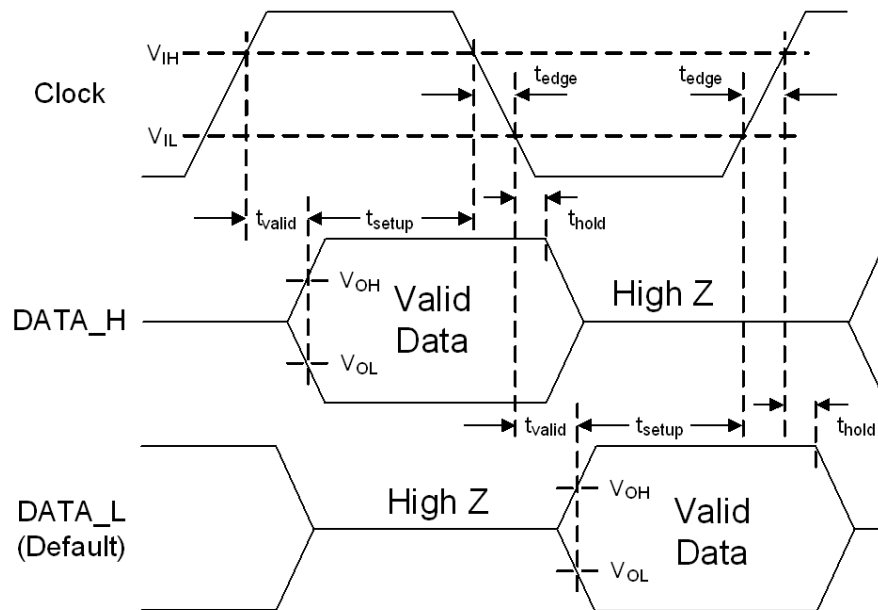
Note: Contact Knowles for Solder Stencil Information

11. RECOMMENDED INTERFACE CIRCUIT



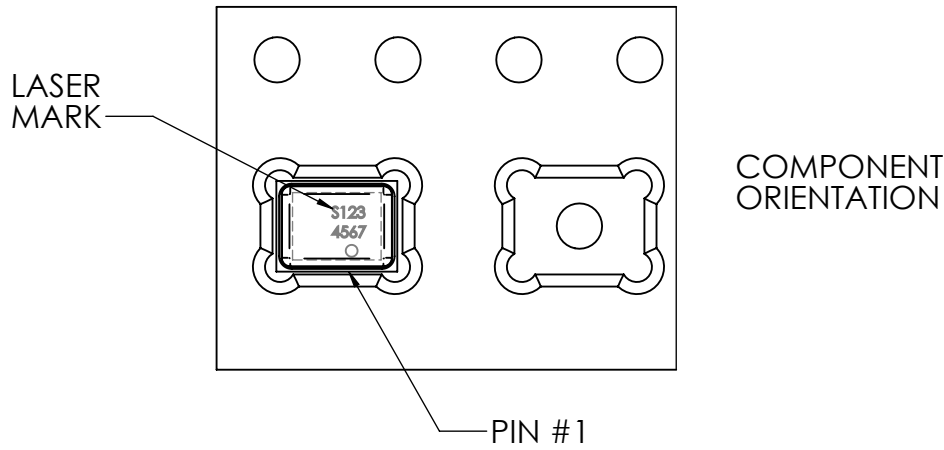
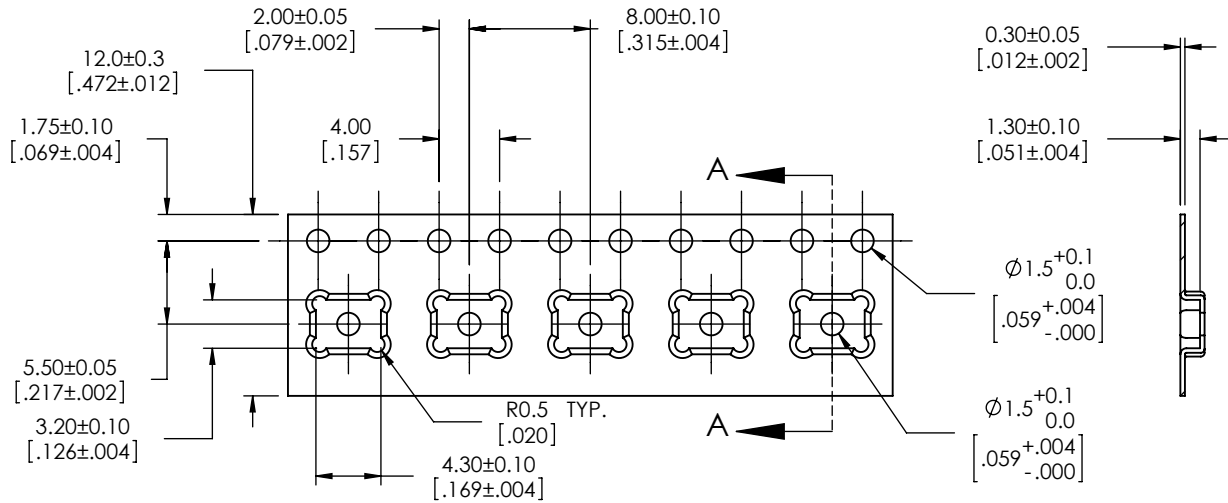
| LABEL | Select | Drives data after | High-Z after |
|--------|---------------|--------------------|--------------------|
| Data_H | High | Rising clock edge | Falling clock edge |
| Data_L | Low (Default) | Falling clock edge | Rising clock edge |

12. TIMING DIAGRAM



$$T_{clock} / 2 = T_{edge} + T_{valid} + T_{setup}$$

13. PACKAGING DETAIL



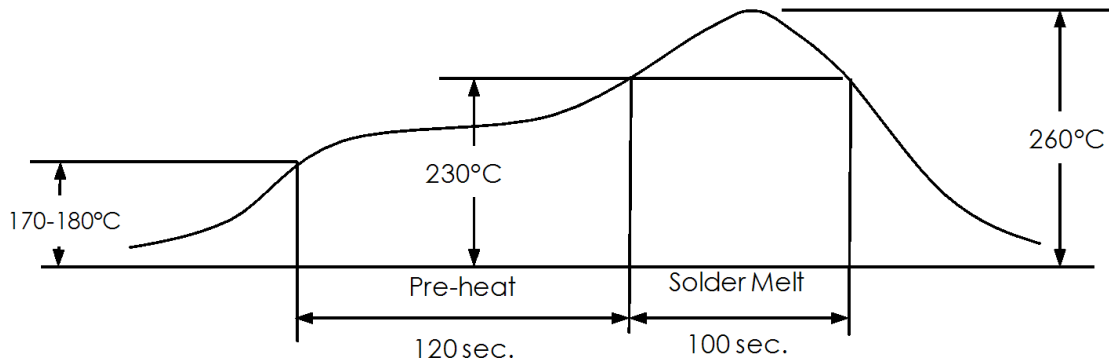
| MODEL NUMBER | SUFFIX | REEL DIAMETER | QUANTITY PER REEL |
|---------------|--------|---------------|-------------------|
| SPK0833LM4H-B | -7 | 13" | 5,700 |

| | |
|-------------|---|
| TAPE & REEL | PER EIA-481 |
| LABEL | LABEL APPLIED TO EXTERNAL PACKAGE & DIRECT TO REEL. |

Note:

Dimensions are in millimeters unless otherwise specified.

14. SOLDER REFLOW PROFILE



| Stage | Temperature Profile | Time (maximum) |
|-------------|---------------------|----------------|
| Pre-heat | 170 ~ 180°C | 120 sec. |
| Solder Melt | Above 230°C | 100 sec. |
| Peak | 260°C maximum | 30 sec. |

15. ADDITIONAL NOTES

- (A) 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.
- (B) MSL (moisture sensitivity level) Class 2a.
- (C) Do not pull a vacuum over port hole of the microphone. Pulling a vacuum over the port hole can damage the device.
- (D) Do not board wash after the reflow process. Board washing and cleaning agents can damage the device. Do not expose to ultrasonic processing or cleaning.
- (E) Do not brush board after the reflow process. Brushing the board with/without solvents can damage the device.
- (F) Do not insert any object in port hole of device at any time as this can damage the device.
- (G) Number of reflow - Recommend no more than 3 cycles.
- (H) Do not apply air pressure into the port hole. Air pressure over 30 psi can damage the device.

16. RELIABILITY SPECIFICATIONS

Note: After test conditions are performed, the sensitivity of the microphones shall not deviate more than 3dB from its initial value.

| 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 | 4 cycles lasting 12 minutes from 20 TO 2,000 Hz in X, Y and Z direction 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) |
| Reflow | 5 reflow cycles with peak temperature of +260°C. |
| Mechanical Shock | 3 pulses of 10,000g in the X, Y and Z direction. (IEC 68-2-27, Test Ea) |

