

SMT MANUFACTURING GUIDELINES FOR SISONIC™ MICROPHONES



Knowles' SiSonic™ microphones are compatible with standard Surface-Mount Technology (SMT) manufacturing processes. However, transducers within these microphone assemblies must not be inhibited from motion if they are to reliably measure sounds.

This document provides manufacturing and handling guidelines for Knowles' SiSonic™ microphones to maintain as closely as possible the performance that the microphones had when leaving the Knowles factory. Included are recommendations for solder paste, land patterns, stencils, reflow profiles, handling and storage procedures, and pick-and-place settings, among others. Beyond initial manufacturing, microphones may be subject to additional "reworking" which can have an impact on performance and are also discussed in this document.

Following these guidelines will help assure proper microphone operation when assembled into an application. While these guidelines may work well for many designs, we expect that optimizations will be necessary due to the many variables that can impact microphone performance.

SOLDER PASTE

Many different solder formulations will work well, and we expect every customer's factory will use different solder formulations. Knowles uses and recommends a lead-free solder paste to meet the requirements of the European RoHS directive 2011/65/EC as amended. A good example is solder paste consisting of 96.5% Sn, 3.0% Ag, and 0.5% Cu. This is a typical SAC305 formulation having a melting point of 217°C. For any solder paste, care must be taken to optimize reflow profiles and stencils.

For initial trial runs, it is best to reflow sets of PCBs utilizing different reflow profiles and parameters (as applicable) and then visually inspecting and X-raying assembled boards to assess how well the microphones have been soldered to the application's PCB or flex.

LAND PATTERNS AND STENCILS

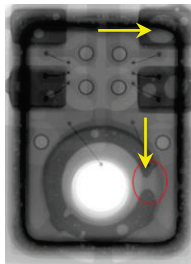
The solder stencil and land patterns should be designed incorporating standard PCB design rules, taking into consideration solder type, reflow profile, solder stencil thickness, and the stencil itself. Design optimizations to consider include, but are not limited to:

1. Initial land pattern design should follow microphone pad design as recommended in the product datasheet. Typical optimizations often reduce the stencil size to a land-pattern-to-stencil ratio in the range of 1.0 : 0.85 - 0.9.
2. Clearance between the PCB hole of a bottom port mic and inner solder ring diameter should be between 0.1mm and 0.15mm (with the exception of SPU0410LR5H).
3. Start the stencil pattern dimensions identical to the land pattern, then optimize the stencil, typically making it smaller than the land pattern—approximately 85-95% the size of the land pattern.
4. For bottom-ported microphones, split the round pad (the ground ring) into 2-4 distinct blocks to allow for better outgassing during reflow and reduce the occurrence of solder voids (bubbles) while still assuring a good acoustic seal.
5. For bottom-ported microphones, reduce the PCB hole's diameter and/or increase the solder ring diameter enabling applications to meet customer PCB design rule requirements.
6. Optimize the solder reflow profile for each unique board design to ensure good solder joints between the microphone and PCB.
7. For bottom-ported microphones, prevent solder and excessive flux or flux residues from entering the microphone port hole during reflow.
8. Increase the solder stencil thickness if inadequate solder volume is present to assure good solder joints and contiguous acoustic seals.
9. Reduce the solder stencil thickness to minimize the occurrence of solder balls caused by excess solder volume or significant amounts of solder vapors potentially entering the acoustic port and contaminating the microphone diaphragm.
10. Optimize the stencil using "overprinting" to help reduce the chance of flux entering the port hole (in addition to 7



and 9 above). This entails increasing the solder stencil ring's inner and outer diameters pushing the sections of the ring partially onto the solder mask of the land pattern. The solder paste will still reflow onto the pads, but be further from the port-hole. This should not alter solder volume. If solder volume needs to be decreased, then the stencil's inner diameter can be increased and/or outer diameter can be decreased. For processes and solder formulations similar to Knowles', it is typically helpful to increase the ground ring's inner diameter and decrease the outer diameter. An example is shown in Figure 1 below.

11. For bottom-port microphones, a complete seal around the port hole is important for optimal acoustic performance. Use X-ray inspection as a useful tool to inspect the seal formed by the soldered ground ring. To the right is an example X-ray showing an incomplete ground ring seal (acoustic leak) and pads with excessive voiding (see top right pad).



STENCIL PARAMETERS

If a historical stencil does not exist, we recommend following stencil parameters as a basis for further optimizations based on the Knowles SiSonic™ microphone pad size and the distance between pads:

- Stencil solder paste thickness: 3-7 mil (75-175 μm)
- Stencil type: Laser-cut
- Stencil material: Steel
- Basic squeegee settings:
 - speed 50mm/s
 - pressure 3N/cm
 - angle 60°

Note that improper squeegee settings can cause an uneven distribution of solder paste resulting in poor soldering performance.

Figure 1. SPA Bottom Port Analog Microphones

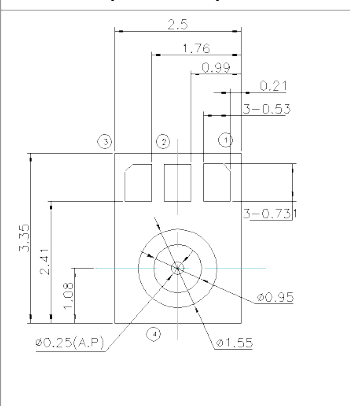
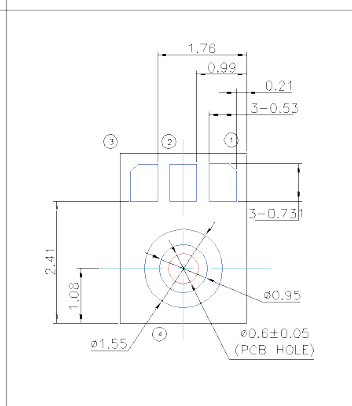
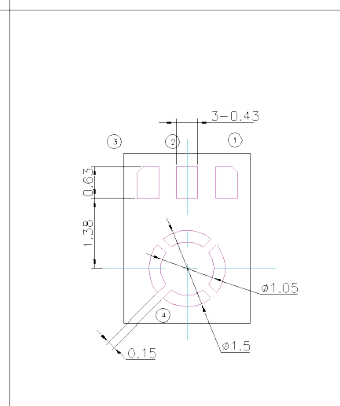
EXAMPLE LAND PATTERNS AND STENCILS

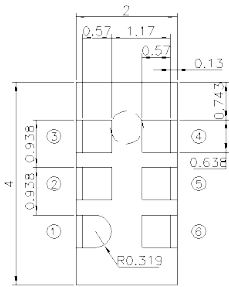
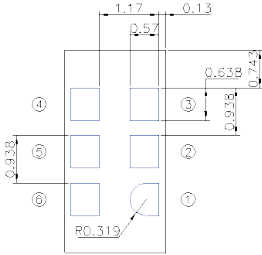
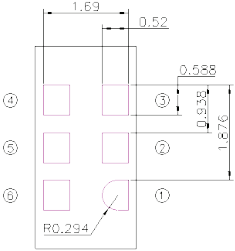
Below are example land patterns and stencils. Dimension tolerances in the examples are $\pm 0.05\text{mm}$. Examples include:

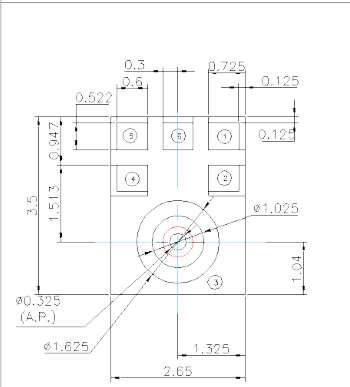
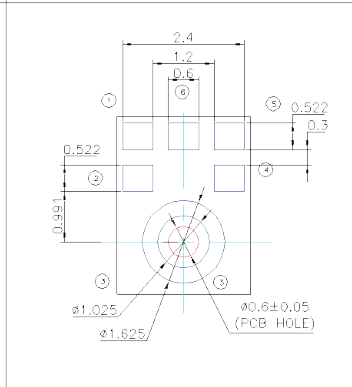
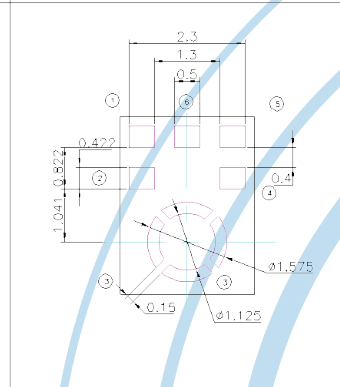
- SPA Bottom-Port Analog Microphone
 - eg. SPAxxxxLR5H
- SPA Bottom-Port Differential Microphone
 - eg. SPAxxxxLR5H
- SPG Top-Port Microphone
 - eg. SPGxxxxHM4H
- SPH Bottom Port Digital I2S Microphone
 - eg. SPHxxxxLM4H
- SPH Top and Bottom-Port Analog or Digital Microphone
 - eg. SPHxxxxHT5H
 - eg. SPHxxxxLM4H
- SPK Top and Bottom-Port Microphone
 - eg. SPKxxxxHT4H
 - eg. SPKxxxxLM4H
- SPM Top-and Bottom Port Microphone
 - eg. SPMxxxxHM4H
 - eg. SPMxxxxLR5H
- SPQ Top-Port Microphone
 - eg. SPQ1410HR5H
- SPU Top and Bottom-Port Microphone
 - eg. SPUxxxxHR5H
 - eg. SPUxxxxLR5H
- SPV Bottom-Port (3 Pins) Microphone
 - eg. SPV08A0LR5H
 - eg. SPV0842LR5H
- SPW Top and Bottom-Port Microphone
 - eg. SPWxxxxHR5H
 - eg. SPWxxxxLM4H

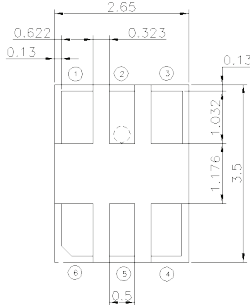
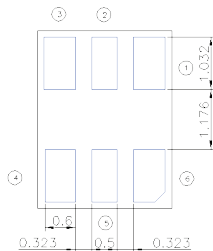
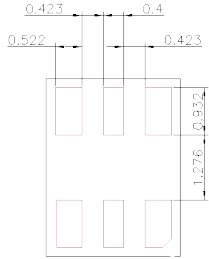
MECHANICAL SPECIFICATIONS (BOTTOM VIEW)	LAND PATTERN	STENCIL PATTERN
Diagram showing mechanical specifications (bottom view) with dimensions: 2.5, 0.68, 0.54, 0.3, 3.35, 1.07, 1.08, $\phi 0.9$, $\phi 1.55$, $\phi 0.25(A,P)$, 1.25.	Diagram showing land pattern with dimensions: 0.88, 0.54, 0.9, 1.07, $\phi 0.6 \pm 0.05$ (PCB HOLE), $\phi 0.35$, $\phi 1.55$.	Diagram showing stencil pattern with dimensions: 0.58, 0.64, 0.8, 1.12, 1.05, 0.15, $\phi 1.45$.

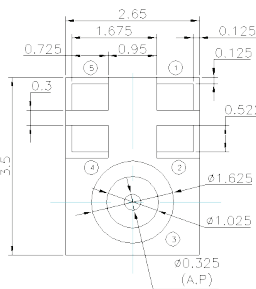
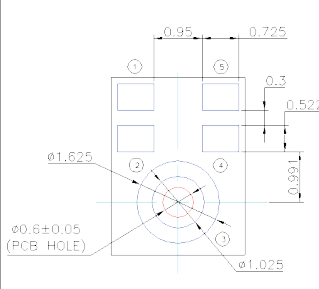
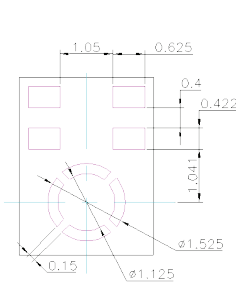


MECHANICAL SPECIFICATIONS (BOTTOM VIEW)	LAND PATTERN	STENCIL PATTERN
 Diagram showing the mechanical specifications of the bottom view of the component. Key dimensions include: - Overall width: 2.5 - Distance between mounting holes: 1.76 - Distance from mounting hole to center: 0.99 - Mounting hole diameter: $\phi 0.21$ - Mounting hole tolerance: $3-0.53$ - Overall height: 3.35 - Distance from bottom edge to mounting hole: 2.41 - Distance from bottom edge to center: 1.08 - Center hole diameter: $\phi 0.95$ - Center hole tolerance: $3-0.73$ - Bottom hole diameter: $\phi 0.25(A.P)$ - Bottom hole tolerance: $\phi 1.55$	 Diagram showing the land pattern for the component. Key dimensions include: - Overall width: 1.78 - Distance between mounting holes: 0.99 - Mounting hole diameter: $\phi 0.21$ - Mounting hole tolerance: $3-0.53$ - Overall height: 3.35 - Distance from bottom edge to mounting hole: 2.41 - Distance from bottom edge to center: 1.08 - Center hole diameter: $\phi 0.95$ - Center hole tolerance: $3-0.73$ - Bottom hole diameter: $\phi 1.55$ - Bottom hole tolerance: $\phi 0.6 \pm 0.05$ (PCB HOLE)	 Diagram showing the stencil pattern for the component. Key dimensions include: - Overall width: 3-0.43 - Distance between mounting holes: 0.63 - Mounting hole diameter: $\phi 1.05$ - Mounting hole tolerance: $3-0.43$ - Overall height: 1.38 - Distance from bottom edge to mounting hole: 0.15 - Distance from bottom edge to center: 0.15 - Center hole diameter: $\phi 1.5$ - Center hole tolerance: $3-0.43$ - Bottom hole diameter: $\phi 1.5$ - Bottom hole tolerance: $3-0.43$

MECHANICAL SPECIFICATIONS (BOTTOM VIEW)	LAND PATTERN	STENCIL PATTERN
 Diagram showing the mechanical specifications (bottom view) of the component. The layout is a 3x3 grid of pads. Dimensions include overall width 4, overall height 2, and individual pad dimensions: 0.57, 1.17, 0.57, 0.13, 0.74, 0.638, 0.938, and 0.938. A circular feature is labeled R0.319. Callouts 1 through 6 are present.	 Diagram showing the land pattern for the component. The layout is a 3x3 grid of pads. Dimensions include overall width 1.17, overall height 0.13, and individual pad dimensions: 0.57, 0.638, 0.938, and 0.74. A circular feature is labeled R0.319. Callouts 1 through 6 are present.	 Diagram showing the stencil pattern for the component. The layout is a 3x3 grid of pads. Dimensions include overall width 1.69, overall height 0.52, and individual pad dimensions: 0.558, 0.938, and 1.876. A circular feature is labeled R0.294. Callouts 1 through 6 are present.

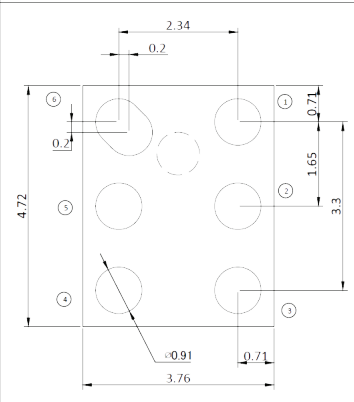
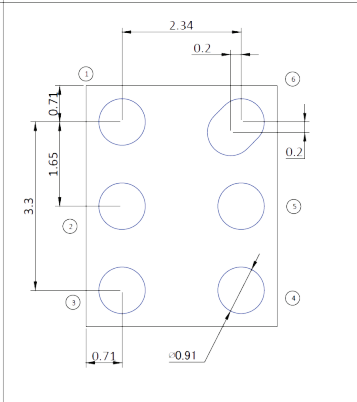
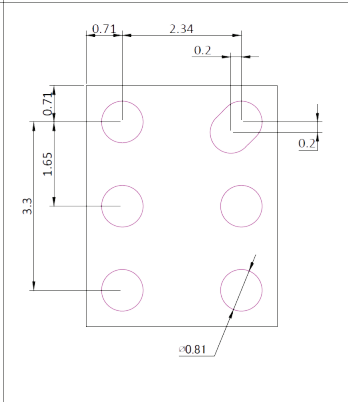
MECHANICAL SPECIFICATIONS (BOTTOM VIEW)	LAND PATTERN	STENCIL PATTERN
 Technical drawing of the bottom view of the component. It shows a central circular feature with concentric circles. Dimensions include: overall width 2.65, overall height 3.5, central hole diameter $\phi 1.025$, and various offsets and radii such as 0.3, 0.6, 0.725, 0.125, 0.522, 0.947, 1.513, 1.04, 1.325, 1.625, and 0.325 (A.P.).	 Technical drawing of the land pattern. It shows the component footprint with dimensions for the land area. Dimensions include: overall width 2.4, overall height 2.4, central hole diameter $\phi 1.025$, and various offsets and radii such as 1.2, 0.6, 0.522, 0.5, 0.991, 0.522, 0.3, 0.422, 0.4, 1.041, 0.822, 0.15, 1.125, and 1.575. A note indicates $\phi 0.6 \pm 0.05$ (PCB HOLE).	 Technical drawing of the stencil pattern. It shows the component footprint with dimensions for the stencil. Dimensions include: overall width 2.3, overall height 2.3, central hole diameter $\phi 1.575$, and various offsets and radii such as 1.3, 0.5, 0.522, 0.5, 0.991, 0.522, 0.3, 0.422, 0.4, 1.041, 0.822, 0.15, 1.125, and 1.575.

MECHANICAL SPECIFICATIONS (BOTTOM VIEW)	LAND PATTERN	STENCIL PATTERN
 Diagram showing the mechanical specifications (bottom view) of the PCB. Dimensions include overall width 2.65, overall height 3.5, and various component footprints labeled 1 through 6. Specific dimensions include 0.622, 0.323, 0.13, 1.032, 1.176, and 0.5.	 Diagram showing the land pattern for the PCB. Dimensions include overall width 2.65, overall height 3.5, and various component footprints labeled 1 through 6. Specific dimensions include 0.622, 0.323, 0.13, 1.032, 1.176, and 0.5.	 Diagram showing the stencil pattern for the PCB. Dimensions include overall width 2.65, overall height 3.5, and various component footprints labeled 1 through 6. Specific dimensions include 0.622, 0.323, 0.13, 1.032, 1.176, and 0.5.

MECHANICAL SPECIFICATIONS (BOTTOM VIEW)	LAND PATTERN	STENCIL PATTERN
 Technical drawing of the bottom view of the component. It shows a square footprint with a central circular feature. Dimensions include a total width of 2.65, a central hole diameter of $\phi 1.025$, and a central feature diameter of $\phi 0.325$ (A.P). Various other dimensions like 0.725, 0.95, 0.125, 0.3, 0.522, and 1.675 are specified for the layout.	 Technical drawing of the land pattern. It shows the same footprint with dimensions for the land area. Key dimensions include a central hole diameter of $\phi 0.6 \pm 0.05$ (PCB HOLE), a central feature diameter of $\phi 1.025$, and a land diameter of $\phi 1.625$. Other dimensions like 0.95, 0.725, 0.3, 0.522, 0.991, and 1.625 are also shown.	 Technical drawing of the stencil pattern. It shows the same footprint with dimensions for the stencil. Key dimensions include a central hole diameter of $\phi 1.525$, a central feature diameter of $\phi 1.125$, and a land diameter of $\phi 1.625$. Other dimensions like 1.05, 0.625, 0.4, 0.422, 1.041, 0.15, and 0.991 are also shown.

[illegible]

[illegible]

MECHANICAL SPECIFICATIONS (BOTTOM VIEW)	LAND PATTERN	STENCIL PATTERN
 Diagram showing the mechanical specifications for the bottom view of the component. The overall dimensions are 4.72 (width) and 3.76 (length). The layout includes six circular features arranged in a 3x2 grid. Key dimensions include: 2.34 (distance between top features), 0.2 (offset), 0.71 (radius/offset), 1.65 (distance between middle features), 3.3 (total height), and 0.91 (feature diameter). Features are numbered 1 through 6.	 Diagram showing the land pattern for the component. It includes the same layout as the mechanical specifications but with additional dimensions for the land pattern: 0.71 (radius/offset), 1.65 (distance between middle features), 3.3 (total height), and 0.91 (feature diameter). Features are numbered 1 through 6.	 Diagram showing the stencil pattern for the component. It includes the same layout as the mechanical specifications but with additional dimensions for the stencil pattern: 0.71 (radius/offset), 1.65 (distance between middle features), 3.3 (total height), and 0.81 (feature diameter). Features are numbered 1 through 6.

MECHANICAL SPECIFICATIONS (BOTTOM VIEW)	LAND PATTERN	STENCIL PATTERN
MECHANICAL SPECIFICATIONS (BOTTOM VIEW)	LAND PATTERN	STENCIL PATTERN

Figure 11. SPQ Top-Port

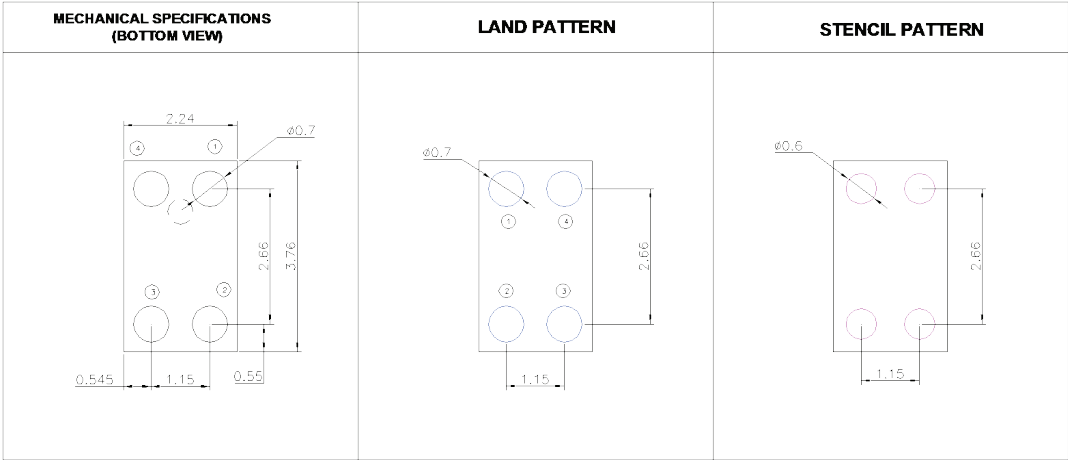


Figure 12. SPU Top Port

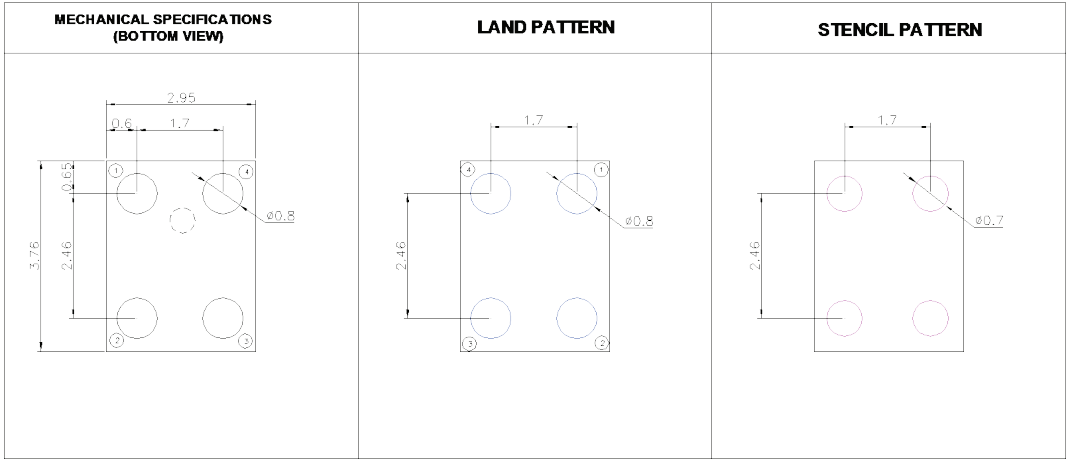


Figure 13. SPU Bottom-Port

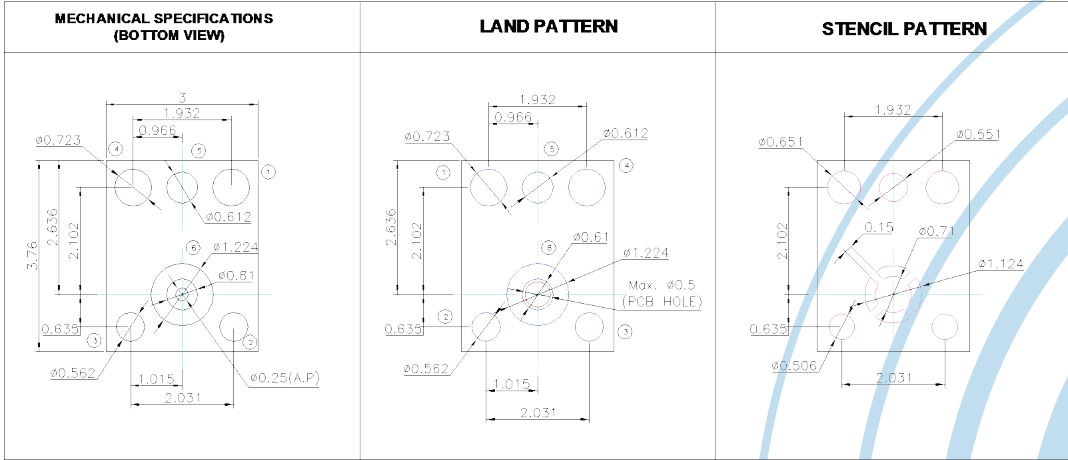


Figure 14. SPV Bottom-Port (3 Pins, eg. Tochi/SPV08A0LR5H-1)

NOTE: If footprint compatibility between SPV08A0LR5H-1 and SPV0842LR5H-1 is desired, use the SPV08A0LR5H-1 land pattern and stencil.

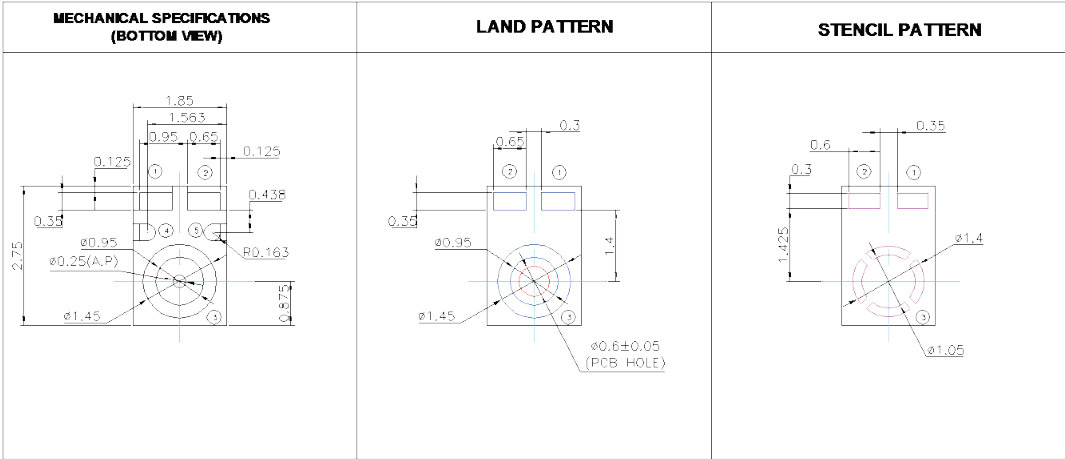


Figure 15. SPV Bottom-Port (3 Pins, Ford/SPV0842LR5H-1)

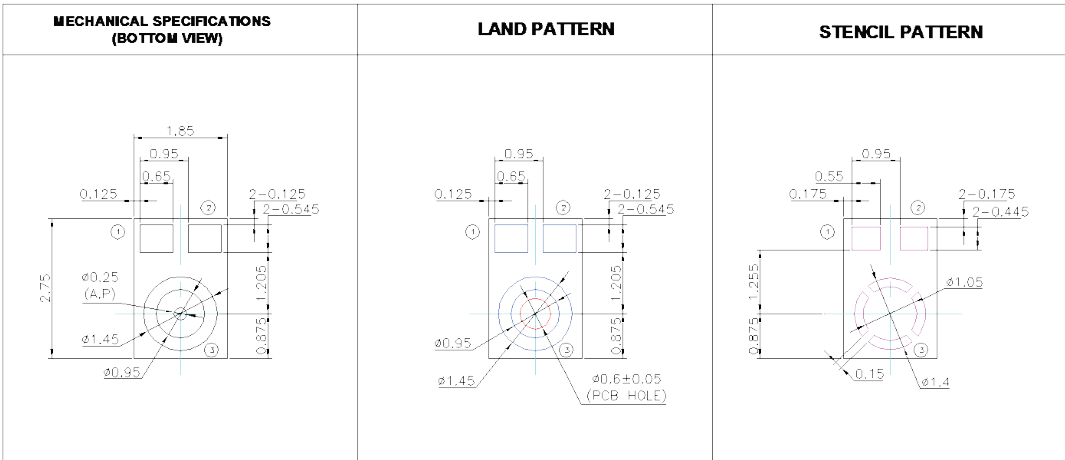


Figure 16. SPW Top-Port

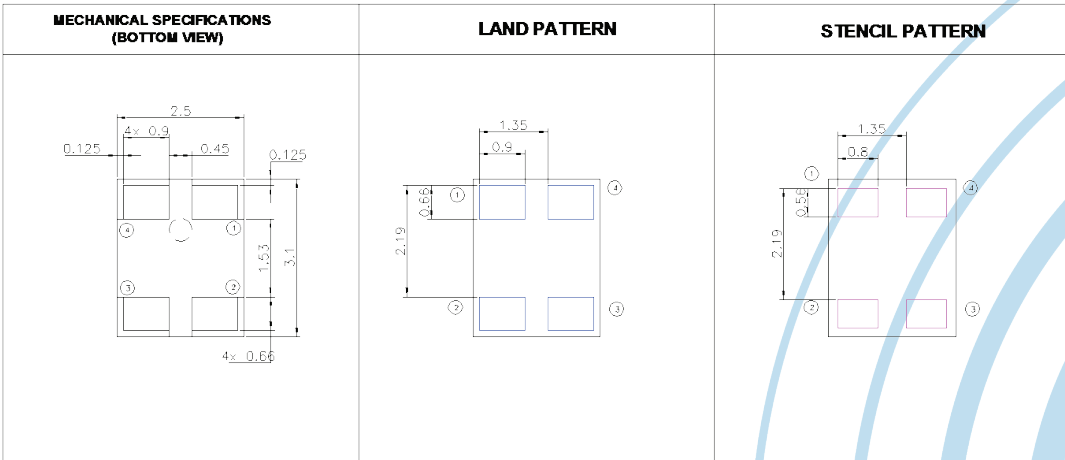
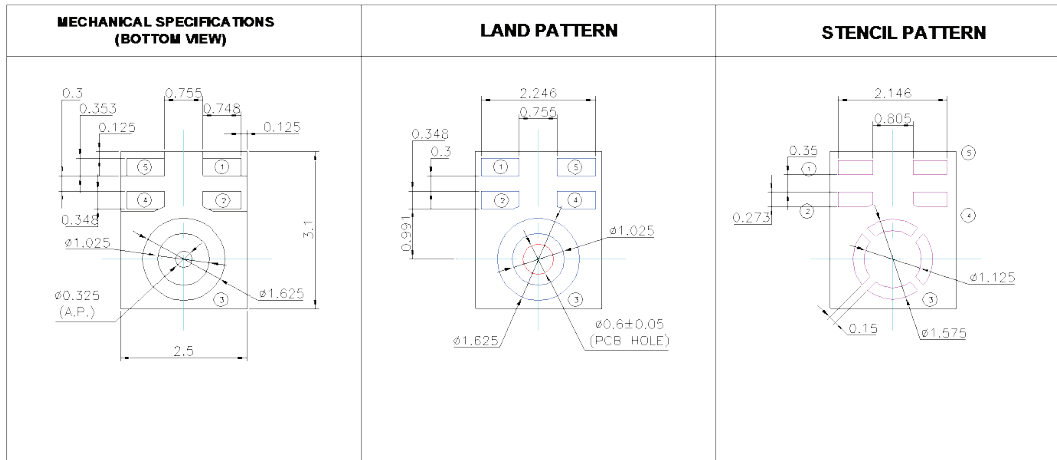


Figure 17. SPW Bottom-Port



REFLOW PROFILE

Below are general suggestions and comments pertaining to reflow profiles. Some recommendations may need to be tailored to the exact application as many factors impact the best reflow profile to use. Some of these factors include the board composition (FR4 or flex), board characteristics (thickness, mass and ground plane configuration, for example), and other components placed on the same PCB.

The reflow profile shown below reflects the recommendations of IPC/JEDEC J-STD-020 Revision C ("Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices") for typical lead-free solder having a melting point of 217-220°C. For the reliability tests called out in the Knowles datasheet, a reflow profile reflecting this standard is followed as a "supplier". Customer applications should follow the standard as a "user". Regardless of the solder paste used, we suggest adhering to the manufacturer's recommendation. All temperatures refer to the topside of the microphone measured on the package body surface.

- SiSonic™ microphones have gold-plated solder pads designed for use with lead-free solders.
- The recommended solder stencil thickness range is 0.075 to 0.175mm. Stencil thickness can be used to help control solder volume and the reflow profile.
- We recommend following the guidelines of the solder paste manufacturer. If multiple profiles are called out in the solder paste's technical specifications, we recommend using one with a more gradual pre-heat ramp (optimally < 0.83°C/sec), provided this is compatible with all components on the board. This will help avoid solder splash, excessive voiding and flux contamination inside the microphone. This recommendation is shown as the "straight ramp" profile for the example profile in Figure 19.
- The JEDEC standard calls out a 260°C peak temperature as a maximum for "users". Unless a 260°C peak temperature is necessary, we recommend using a lower temperature (240-245°C). Implementing a lower peak temperature (eg. below 240-245°C) will lower the amount of voiding. Note that lower peak temperatures may require longer Time above Liquidus (T_L). Following the guidance provided by the solder paste manufacturer should yield the best results, though optimizations may still be needed as these recommendations are generally made as ranges.
- We recommend keeping reflow ovens and fixtures clean and well-maintained, minimizing air flow inside of the reflow oven used, and using an exhaust system to adequately remove flux vapors thus reducing the opportunities to introduce contamination inside the microphone.
- SiSonic™ microphones are guaranteed for up to 3x passes through a lead-free solder reflow profile. During product launch, each microphone model is tested to withstand 5x reflows at the maximum profile conditions. Additionally, as part of On-going Reliability Tests (ORTs), reflow testing is performed regularly to assure microphone quality. However, we recommend minimizing the number of times a microphone goes through a reflow cycle. Subjecting the microphone to excessive heat outside the limits in the above reflow profile can lead to degraded performance and compromise the microphone's mechanical integrity.
- The exact reflow profile should be optimized for each design adhering to the recommendations of J-STD-020. The reflow profile outlined in the standard is shown in the figure on the left below. An example solder paste manufacturer's recommendation is shown on the right below.



Figure 18. IPC/JEDEC J-STD-020 Reflow Profile

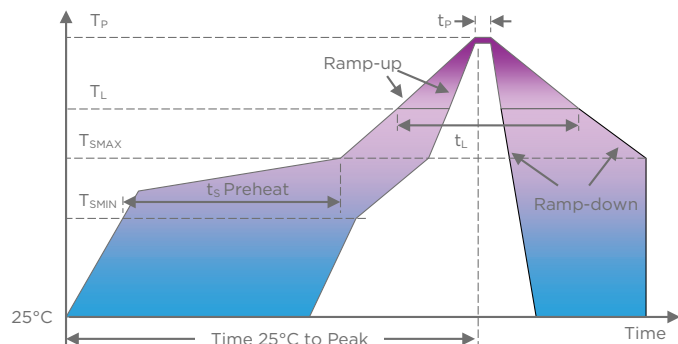
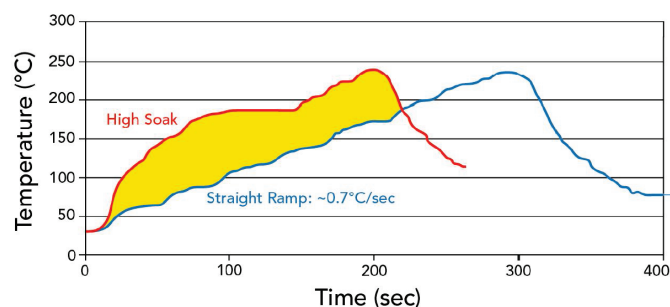


Figure 19. Example Solder Paste Manufacturer's Reflow Profile



Profile Feature	J-STD-020 Pb-Free For "Users"	Figure 19 High Soak Example	Figure 19 Straight Ramp Example
Average Ramp-up rate (T_{SMAX} to T_P)	3°C/second max.	1°C/second	0.7°C/second
Preheat - Temperature Min (T_{SMIN}) - Temperature Max (T_{SMAX}) - Time (T_{SMIN} to T_{SMAX}) (t_s)	150°C 200°C 60-180 seconds	150°C 200°C 100 seconds	150°C 200°C 70 seconds
Time maintained above: - Temperature (T_L) - Time (t_L)	217°C 60-150 seconds	217-225°C 40 seconds	217-225°C 50 seconds
Peak Temperature (T_P)	< 260°C	245°C	245°C
Time within 5°C of actual Peak Temperature (t_P)	20-40 seconds	20 seconds	20 seconds
Ramp-down rate (T_P to T_{SMAX})	6°C/second max	2.25°C/second	2.25°C/second
Time 25°C to Peak Temperature	8 minutes max	3:20 minutes	5 minutes

PICK-AND-PLACE SETTINGS

SiSonic™ microphones come in various sized reels for use in auto pick-and-place machines. Exact packaging information including pocket size and spacing is shown in each model's datasheet. The pick location for top-port models must be chosen so that the pick nozzle does not overlap the acoustic port (AP) of the microphone so as not to damage the internal components of the microphone by excessive and rapid changes in pressure. Bottom-port models may be picked anywhere on the lid. For all models, the pick-and-place location needs to take into account the microphone and pocket tolerances and the pick nozzle shape, size, and placement accuracy. The recommended pick areas for the SPK and SPW top port SiSonic™ packages are shown in the figures below.

Figure 20. SPK SiSonic™ Pick-up Area

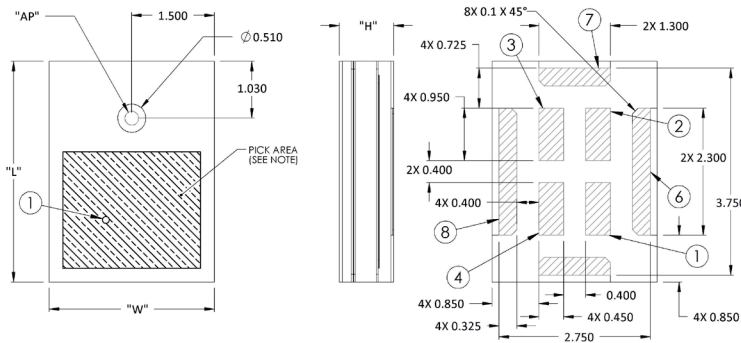
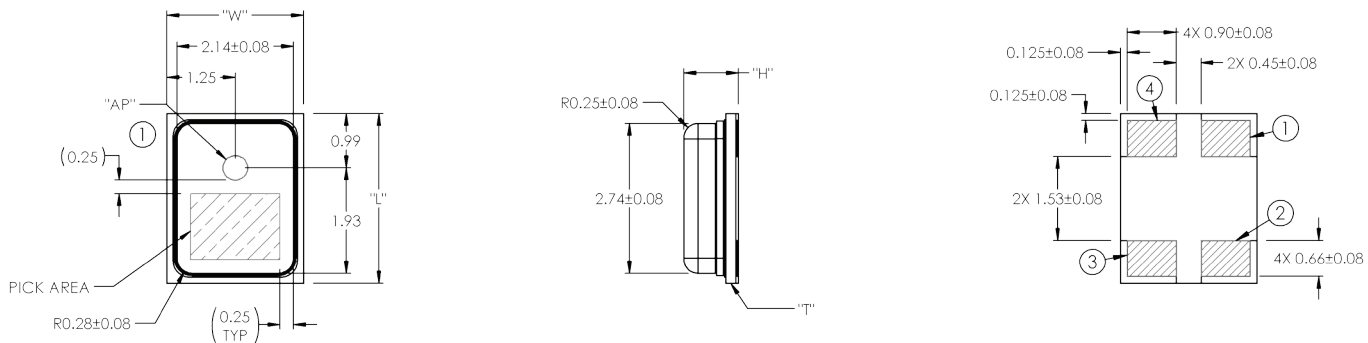


Figure 21. SPW SiSonic™ Pick-up Area



HANDLING AND STORAGE

SiSonic™ microphones are to be installed using solder reflow processes, much earlier in the production line than traditional ECMs. As a result, processes later in the production line must be reviewed to ensure that they have not damaged the microphone. Information on handling and storage for SiSonic™ microphones is listed below:

- 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.
- MSL (moisture sensitivity level) Class 1.
- Maximum of 3 reflow cycles is recommended.
- In order to minimize device damage:
 1. Do not board wash or clean after the reflow process.
 2. Do not brush board with or without solvents after the reflow process.
 3. Do not directly expose to ultrasonic processing, welding, or cleaning.
 4. Do not insert any object in port hole of device at any time.
 5. Do not apply over 30 psi of air pressure into the port hole.
 6. Do not pull a vacuum over port hole of the microphone.
 7. Do not apply a vacuum when repacking into sealed bags at a rate faster than 0.5 atmospheres/second.
 8. Do not intensely blow into the microphone port hole by mouth or other means; this risks introducing particles or

saliva inside microphone impacting performance and/or function temporarily or, in some cases, permanently.

9. Kapton or other tapes can be used to cover the microphone port hole during assembly. In cases where a mic-on-flex is covered with tape delivered from third party manufacturer, take care when removing the tape to avoid excessive negative air-pressure damaging the diaphragm.
10. Do not clean tables or transfer devices with an air-gun during production in the vicinity of an unprotected microphone port hole to avoid introducing particles into the inside of the microphone.

FLEX PCB RECOMMENDATIONS

Solder lift and cold soldering are general issues in flexible PCB (FPCB) assembly. The main reasons for many potential issues are uneven FPCB and inappropriate stencil design, though there are certainly others. Considerations in mic-on-flex applications include:

1. During the SMT process, FPCB near the microphone mounting area must be kept flat, as uneven or warped flex surfaces will be at risk for weak or incomplete solder joints manifested as acoustic leaks or electrical circuit interruptions.
2. The stencil design is a key factor for FPCB assembly. If the stencil thickness is too thin, solder lift can occur; increasing



the stencil thickness to increase solder thickness can improve the quality of solder joints. Guidance from this or similar documentation should serve as the starting point for optimizations.

3. While testing microphone on FPCB/PCB, we recommend testing the DUT while not under compression so that cold solder joints may be detected.
4. Adding a stiffener under the microphone will strengthen FPCB structure. A stiffener of approximately 0.25mm or greater is recommended to avoid uneven FPCB.

IQC RECOMMENDATIONS

We expect that all or some microphones will go through some level of Incoming Quality Control (IQC) testing to verify performance is the same as when the microphones left the Knowles factory. We recommend:

1. Microphones are stored and tested at nominal temperature and humidity ($25 \pm 5^{\circ}\text{C}$, 30-70% R.H.).
2. Assuring no contamination is introduced during transfer of reels or other handling procedures
3. Maintaining proper ESD protection when handling microphones
4. Placing unused microphones in reels back in a static bag and resealing in a vacuum-packed bag for storage. As recommended earlier, the rate of pressure change should be less than 0.5 atmospheres/second.

REWORKING MICROPHONES

SiSonic™ microphones are designed to handle being assembled onto a PCB and also removed and replaced within the guidelines called out in the "Reflow Profile" section of this document. Additional recommendations and comments pertaining to reworking microphones are enumerated below.

1. Do not let flux or other cleaning materials get into microphone through the acoustic port hole during rework. This can contaminate the MEMS diaphragm and cause microphone sensitivity instability.
2. To remove the microphone from the application PCB, use a hot plate at 280°C and remove microphone after 1 or 2 seconds. Heating the microphone too long will weaken the microphone and can cause acoustic leaks.
3. While hot plate removal is recommended, if using a hot air gun to remove a top-port microphone, we suggest use of a high-temperature resistant tape to cover acoustic port hole to keep hot gases and particles out of the microphone.
4. The cover or lid of a SiSonic™ microphone is attached to its base using solder paste, with some models also utilizing black epoxy. The solder and epoxy can soften or melt at high temperatures. When removing the microphone from a customer PCB or flex, the microphone should be held by its base PCB during soldering/unsoldering in order to prevent damaging the microphone (accidental removal of the lid or

addition of acoustic leaks). See Figure 22 and Figure 23 below.

Figure 22. Improper (left) and proper (right) handling of microphones built using FR4 lid and wall construction

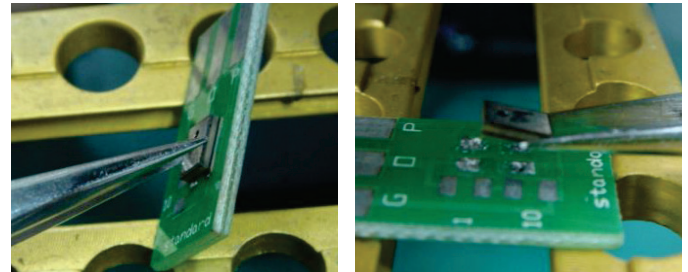


Figure 23. Improper (left) and proper (right) handling of microphones built using metal can construction



SUMMARY

This document has provided recommendations and guidance for assembling Knowles microphones into customer applications. This is based on both internal manufacturing processes as well as feedback from the billions of Knowles microphones that have been used to date. The intent is to help our customers avoid problems introduced during manufacturing through sharing our vast experience over the many years Knowles SiSonic™ microphones have been produced.

REVISION HISTORY

Revision	Description	Date
1	Initial Release	7/27/18

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