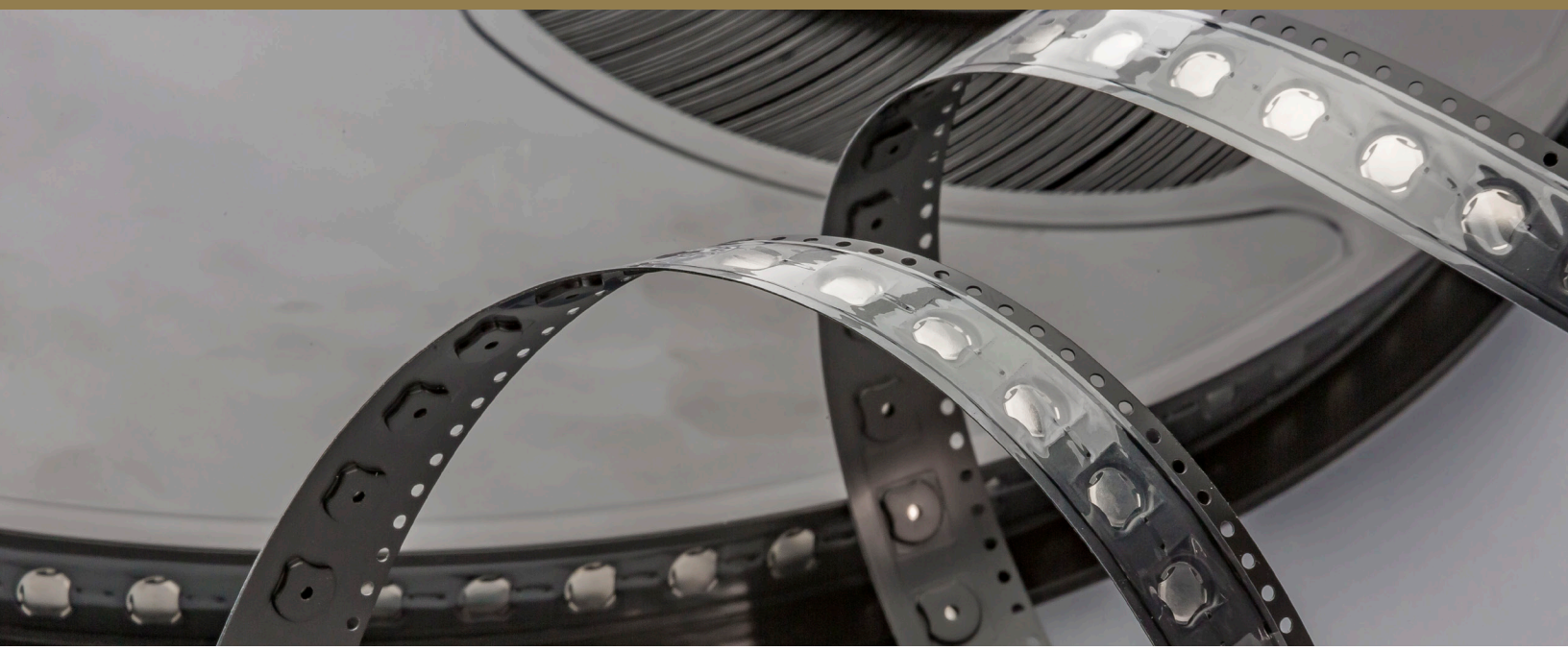
snaptron



SNAPTRON S-SERIES DOMES PROVIDE THE ABILITY TO SOLDER IN A SMT PROCESS

WHITE PAPER

Prepared by: Kevin Albertsen, Director of Engineering

Issue Date: November 20, 2024

OVERVIEW

Snaptron's S-Series domes are a standard four-leg metal dome switch with two solderable tabs. The tabs allow the dome to be soldered directly to a printed circuit board or flex circuit with a surface-mount technology (SMT) machine. Like standard tactile domes, the solder dome is a normally open momentary contact (SPST) that provides a crisp tactile feel, letting the user know a button was pressed.

BENEFITS

1. Easily integrate the solder dome into your existing SMT automation process
2. Reduce overall build time and eliminates steps to final product assembly
3. Improve placement accuracy due to elimination of manual placement
4. Eliminate the use of adhesive or tape to simplify assembly
5. Lower the cost of labor for dome placement

> *"Snaptron's dome are very reliable. More importantly, their pre and post sales service is very good and dependable–this is a key factor to the success of our supply chain and business.*
>
> -STEVEN WEE, PRODUCTION MANAGER

AT A GLANCE

- Diameter - 6.3 to 14mm
- Force - 280g to 550g
- Plating - Nickel
- Life - 1,000,000 cycle
- Material - SSTL

DOME APPLICATION AND ASSEMBLY

PLACEMENT AND ADHERING DOMES WITH SOLDERING

Traditional methods of adhering metal domes to the circuit board require the use of adhesive tape or placement into spacer pockets. This process is typically done semi-automatically or manually and requires an assembler. A major benefit of a solder dome is the ease of assembly and the ability to use automated equipment to place these domes. This takes the time and cost of manual labor out of the equation and eliminates the mandatory use of cover tape on loose domes during the assembly process.

The dome's design has tabs that get soldered to the substrate in two locations without impacting the performance of the switch. You can either manually or automatically solder the dome in place using SMT assembly systems.

SEVEN STEP SMT ASSEMBLY PROCESS

Snaptron recommends you follow the below steps to solder the dome to the substrate:

1. Solder paste and flux gets applied to the PCB on the pre-determined solder pads either with a stencil or printing machine.
2. An SMT machine automatically places components including the dome on a PCB's appropriate locations.
3. The PCB, either fully or partially populated with components, is then passed through a reflow soldering oven with different heat zones. Many solder pastes require at least three heat zones.
4. The first zone increases the temperature of the board, components, and solder paste. The second zone brings the solder paste to its melting point to create the solder joint with the component. The last zone reduces the components' temperature and allows the solder paste time to solidify creating the solder joint.
5. If additional components need to be added, repeat this process. Snaptron recommends applying the domes in the last reflow process if there is more than one.
6. Before final assembly, the PCB is sent for quality inspection to ensure all components have adhered correctly or need to be reworked manually.
7. At this point and only if needed, a layer of cover tape can be added to seal the dome switches to keep out contaminants.

DOME APPLICATION AND ASSEMBLY

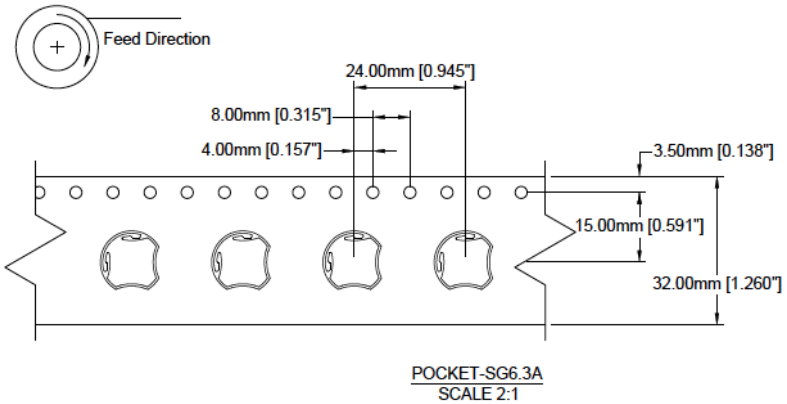
PROCESS CONSIDERATIONS FOR SMD DOMES

The S-Series domes have special considerations for the assembly process. Please consider the following:

1. Mechanical placement will involve a pressing force onto the dome. Please ensure the placement force is less than the rated actuation force of the dome.
2. Snaptron recommends using a 'No-Clean' Flux for dome soldering. Domes can have water spotting. Spot deposits could affect dome performance.
3. If desired, a cover tape layer can be added to seal the switches from components or handling damages after solder reflow.
4. If covered with tape, the dome's tactile feedback is minimally affected. Proper ventilation reduces any slight dampening, ensuring a consistent and reliable response.
5. It is not recommended to use glue or other bonding methods to adhere to the domes before soldering.
6. Ensure the dome's feed direction aligns with the machine's requirements. Misalignment may lead to improper placement or damage. The feed direction is outlined on the drawing. (See chart below)

SMT MACHINE CONSIDERATIONS

The first thing to consider when soldering a dome is to understand the type of SMT machine used in your production process. Some SMT machines support small volumes, such as prototyping, for example. While some machines support large volumes and high-speed production lines. Specific machines are best suited for single-sided components, pass-through components, surface mount, or double-sided soldering. SMT technology also varies by fully automated, manual, multi-head, or a combination of these options. Always be sure to understand the inner workings of your machine before prototyping or production of your final product.

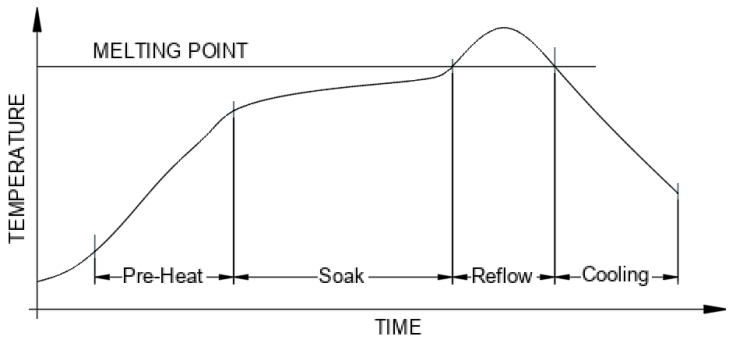


SOLDER TYPES AND THERMAL PROFILES

Solder pastes contain an alloy of metals that, when heated and cooled, create a solder joint between two substrates, in this case, a PCB and metal dome switch. Depending on the type of solder paste, they also require different thermal profiles.

Traditional reflow soldering is performed with either a leaded solder, lead-free solder, low temperature solder, or other, depending on the components being placed and product requirements. In addition, solder pastes vary in particle size. Therefore, it is important to select a solder that adequately adheres to a component while not requiring a temperature that may damage the component, another component, or the PCB.

Leaded solder (SnPb) is a blend of lead and tin that provides a tough solder joint and is often used when the end product is utilized in rugged environments or exposed to harsh environmental conditions. In some cases, leaded solder is easier to work with and more affordable due to its high lead concentration. Leaded solder requires lower heat than many other solder types and typically needs to run through a thermal profile with temperature stages at 120°C/150°C/225°C for a specified time. Although a very reliable option, one key consideration is where your product will be sold. Many regions of the world require that all lead components, including leaded solder, are free from commercially available products due to its negative environmental impact and concerns regarding human health.



Lead-free solder (SnCuAg) is a viable alternative to leaded solder that significantly reduces health concerns and environmental impact. Lead-free solder typically has a high tin concentration, making this the most expensive option. In addition, tin has a higher melting point with a thermal profile of 150°C /190°C /250°C . Lead-free solder works well if the design and components can withstand higher heat exposure.

If you require a lead-free option, but the design includes components sensitive to heat, there are low-temperature solder pastes. These pastes are typically a mixture of Tin and Bismuth (SnBi), although many other alloy options are available. SnBi has a much lower melting point and works well with components that are sensitive to heat exposure. The three-zone thermal profile for SnBi typically falls around 100°C /130°C /180°C . However, due to the chemical makeup of the solder pastes, the solder joint may be weak or insufficient to create a long-term bond. Therefore, it is always important to review the design, components, and solder type options early in development to determine the best solder paste for the product.

DETERMINING SOLDER PASTE AMOUNT

You must understand the space constraints, the distance between components and the footprint of the metal dome to determine an appropriate amount of solder paste. In general, the recommended amount of paste for soldering a dome should be approximately 40% - 50% of the area of the solder pad. If too much solder paste is added, the solder may move into the solder keep-out area and either cause the dome to fail or prevent the dome from making electrical contact. On the other hand, if too little solder paste is added, the solder joint may not be strong enough to withstand the full range of presses and can cause an early switch failure.

SOLDER WICKING OR SOLDER DRAINAGE

Solder wicking or solder drainage can greatly impact the performance of the dome or provide an inadequate solder joint. It is important to inspect the solder movement and solder joints to ensure a long-term bond and long-lasting performance of your SMD dome.

To prevent an over application of solder paste resulting in an increased risk of solder wicking along the dome's solderable tabs, Snaptron recommends using a 5mil (0.13mm) thickness solder stencil with fresh solder paste on every paste application.

We also recommend considering best flux outgassing practices to ensure contaminate flux deposits are removed during reflow. Please follow recommended procedures from the solder paste or flux manufacturer. Snaptron also recommends allowing at least 50mil separation between the dome and other SMT parts near the dome's solder tabs.

DOUBLE-SIDED SOLDERING

In many cases, components are placed on both sides of a PCB. This is performed by soldering one side and then the other in a two-step process. If placing the domes during the first soldering step, adhesive material like Kapton (polyimide) may be added after soldering to hold the domes in place during reflow of the other side. This material may fully cover the domes, but this is not required.

SEALING COMPONENTS POST-SOLDERING

For use cases in which you anticipate an abundance of contamination due to environmental exposure or board wear, it is important to know that the solder dome is not full sealed. PET or polyimide can be added to create a fully sealed surface over the dome to keep out contaminates. However, there is no need for this adhesive material to be accurately positioned as would be the case when the domes are placed with the adhesive.

PERFORMANCE BEFORE AND AFTER SOLDERING

In general, you can expect minimal changes in the performance of your solder dome before and after soldering. You may see a slight rise in trip force and change in tactile ratio.

While Snaptron recommends using a no-clean flux.

Any process involving a wash cycle should consider the following. Inspect the solder joints after washing to ensure that the solder tabs are adequately adhered and were not damaged during the high-pressure wash cycle. A good way to test this is to measure the resistivity of the dome after soldering and wash to ensure the dome is performing as expected.
On occasion, water or solvent may build up under the dome. This needs to be removed prior to final assembly.
Note: Excessive water or air pressure may damage the dome, solder tab, or break the solder joint.

As a rule, we recommended you test and validate the SMD dome in your SMT machine with the solder paste to fine tune the amount of solder used and thermal profile prior to final product assembly.

SMD PARAMETERS	
Average ramp up rate	4°C/s max
Preheat time	120s max
Soak temperature	155-175°C
Soak time	60-100s max
Peak temperature	265°C (509°F) max
Duration above 217°	60s max
Ramp-down rate	6°C/s max
Moisture Sensitivity Level (MSL)	1
Reflow Cycles	1

PACKAGING OPTIONS

The solder dome is available in tape and reel. Reel sizes include:

DOME SIZE	REEL SIZE	DIMENSIONS	DOME QUANTITY	MINIMUM ORDER	CARRIER WIDTH AND PITCH
6.3mm	13"	Ao 6.02mm, Bo 6.02mm and Ko 0.76mm	5,000 per reel	5,000	16mm with a pocket pitch of 12mm
6.3mm	22"	Ao 6.02mm, Bo 6.02mm and Ko 0.76mm	15,000 per reel	15,000	16mm with a pocket pitch of 12mm
7.0mm	13"	Ao 6.70mm, Bo 6.70mm and Ko 0.88mm	5,000 per reel	5,000	16mm with a pocket pitch of 12mm
7.0mm	22"	Ao 6,70mm, Bo 6,70mm and Ko 0,88mm	15,000 per reel	15,000	16mm with a pocket pitch of 12mm
8.5mm	13"	Ao 8.18mm, Bo 8.18mm and Ko 0.86mm	5,000 per reel	5,000	24mm with a pocket pitch of 12mm
8.5mm	22"	Ao 8.18mm, Bo 8.18mm and Ko 0.86mm	15,000 per reel	15,000	24mm with a pocket pitch of 12mm
10mm	13"	Ao 9.40mm, Bo 9.40mm and Ko 0.94mm	2,500 per reel	2,500	24mm with a pocket pitch of 16mm
10mm	22"	Ao 9.40mm, Bo 9.40mm and Ko 0.94mm	10,000 per reel	10,000	24mm with a pocket pitch of 16mm
12mm	13"	Ao 11.38mm, Bo 11.38mm and Ko 1.04mm	2,500 per reel	2,500	24mm with a pocket pitch of 16mm
12mm	22"	Ao 11.38mm, Bo 11.38mm and Ko 1.04mm	10,000 per reel	10,000	24mm with a pocket pitch of 16mm
14mm	13"	Ao 13.38mm, Bo 13.38mm and Ko 1.00mm	2,500 per reel	2,500	24mm with a pocket pitch of 20mm
14mm	22"	Ao 13.38mm, Bo 13.38mm and Ko 1.00mm	10,000 per reel	10,000	24mm with a pocket pitch of 20mm

Disclosures and product information: The S-Series domes are available exclusively in the feet-down orientation and come packaged in tape and reel, with 13" and 22" reel options featuring a 45-degree dome rotation. Standard domes include Nickel plating, with additional plating options available upon request. All listed specifications apply prior to soldering, as performance may vary slightly afterward. Proper pad design, solder type, and solder amount can significantly impact performance, and Snaptron is available to provide best practices. The domes have life ratings of up to 1 million cycles, depending on the application and design. They are lead-free, RoHS compliant, and the tape and reel packaging conforms to the EIA-418 standard.