

Recommendation for PCB assembly of BGA using Copper Cored Solder Sphere

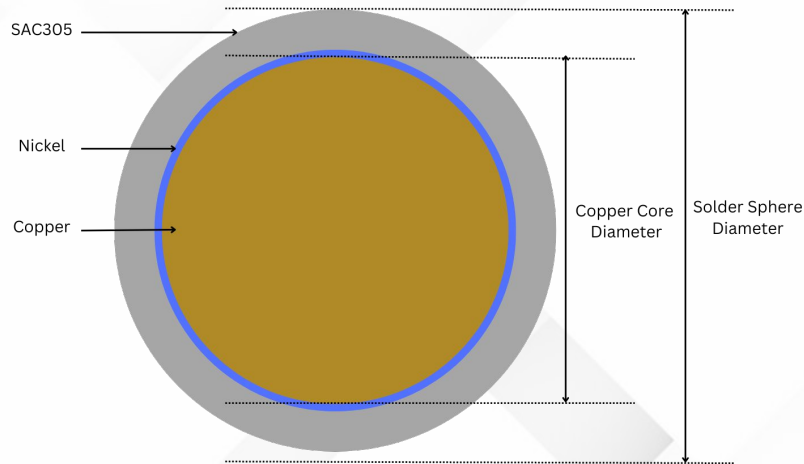
Design rules and process recommendation

Copper Cored Solder Spheres

Why use them?

Copper-cored solder spheres are advanced solder interconnect materials used primarily in Ball Grid Array (BGA) and wafer-level packaging to **improve mechanical reliability and thermal performance**. Unlike conventional all-solder balls, these spheres consist of a solid copper core encapsulated in a solder alloy shell (typically SAC or SnAg). Typical copper-cored solder sphere diameters range from 0.15 mm to 0.76 mm, with common sizes including 0.25 mm, 0.3 mm, 0.35 mm, and 0.45 mm, **depending on the pitch and design of the BGA package**.

Copper-cored solder spheres offer significant advantages in BGA assembly, particularly in achieving a **better and more controlled stand-off height**. This precise stand-off control ensures accurate BGA placement, thereby preventing several potential problems such as solder bridging, connection failures and mechanical stress, BGA misalignment, and potential cracking caused by temperature variations — especially beneficial for high-performance or harsh-environment applications like automotive, server, and mobile devices.



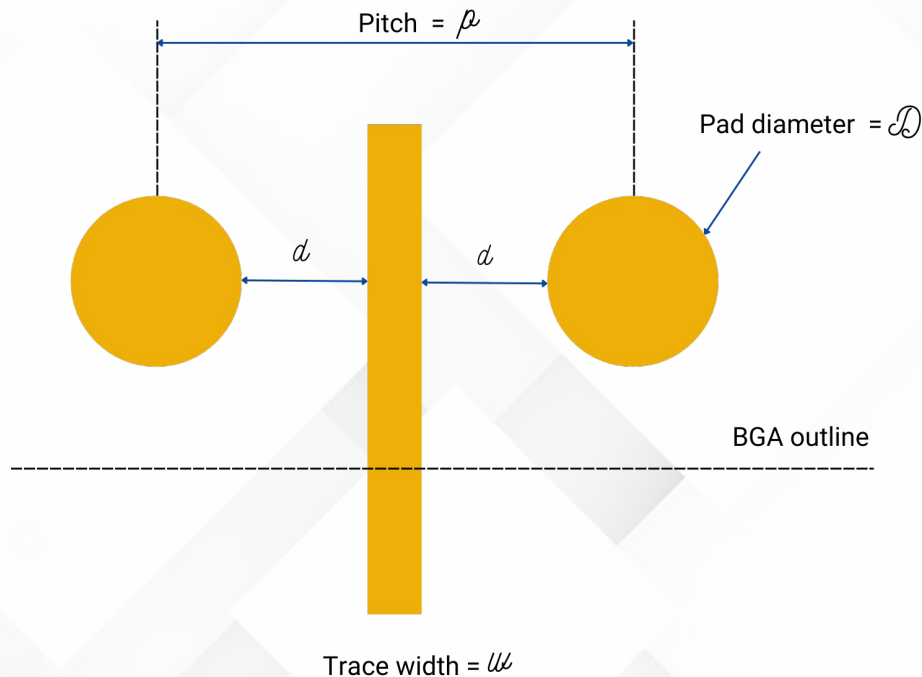
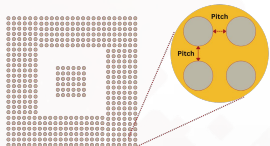
- 1) Nickel barrier thickness : $2\pm 1\mu\text{m}$
- 2) SAC305 barrier thickness : $40\mu\text{m}$

Pad design rules

Pitch

Pitch for copper cored solder spheres typically ranges from **0.4mm to 1.0mm**. The specific pitch used depends on the particular application and the design of the Ball Grid Array (BGA). Smaller pitches like 0.4mm are used for high-density applications requiring fine-pitch components, while larger pitches such as 1.0mm are suitable for applications where higher clearances and more robust connections are needed. The choice of pitch **influences the pad design rules, solder mask openings, and the overall assembly process** to ensure reliable electrical and mechanical connections.

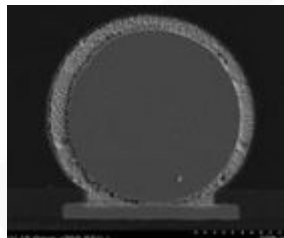
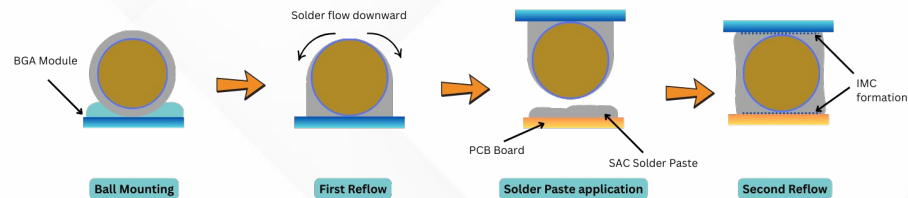
Feature	Description
Pitch Range	0.4mm - 1.0mm
Application	Varies based on BGA design and application density.
Influence	Affects pad design, solder mask openings, and assembly.



Reflow temperature

Recommended reflow temperature profile of CC-SAC305 Solder Sphere with SAC305 Solder Paste

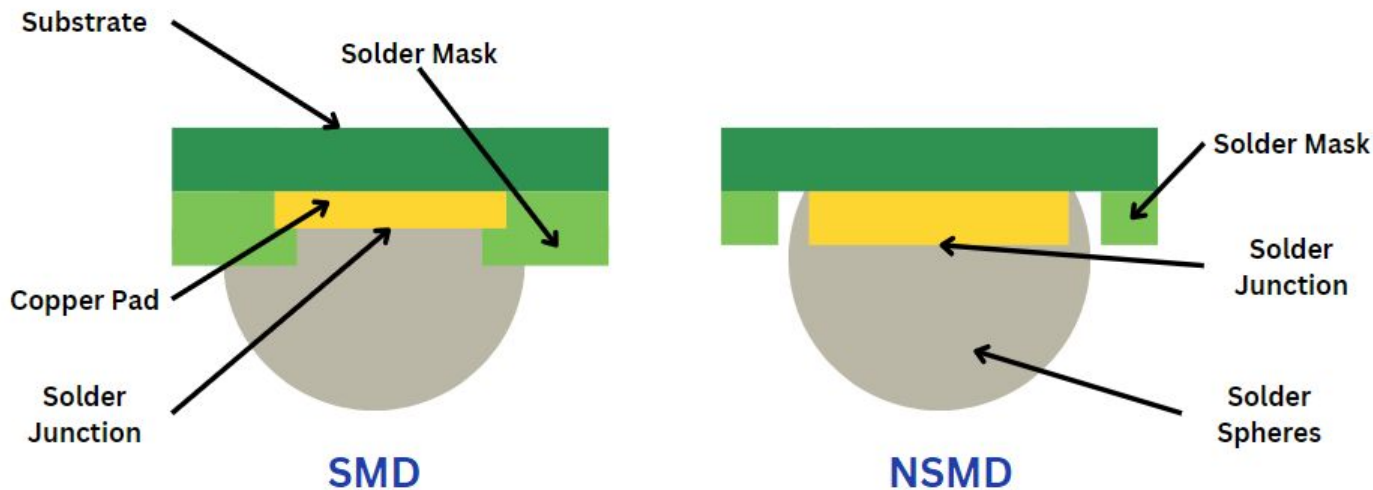
Integrating BGAs with copper cored solder spheres into electronic assemblies requires a **two-stage soldering process**. First, the solder spheres are attached to the BGA substrate with a specific reflow profile, ensuring proper **IMC formation** for robust connections. Second, the BGA module is mounted onto the PCBA using solder paste, applied via stencil, and another reflow process tailored to both the BGA and PCBA. **Flux, either in the paste or applied separately**, cleans surfaces and aids wetting. The second reflow melts the paste, allowing spheres to wet the PCBA pads. Optimal IMC layer formation, crucial for joint strength and conductivity, is achieved through **precise temperature control** during both reflow cycles, considering solder alloy and copper metallization. This process ensures reliable, high-quality soldered interconnections.



Observation of CC-SAC305 bump by using SEM

SMD vs. NSMD: Best Practices for BGA Pad Creation

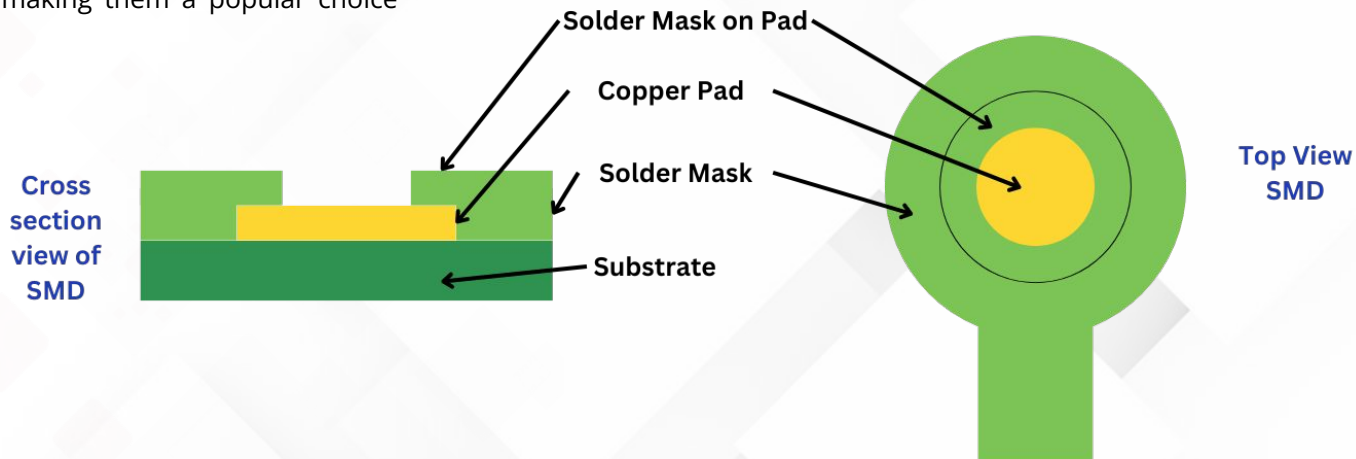
When designing Ball Grid Array (BGA) packages, the choice between **Standard Metal Definition (SMD)** and **Non-Standard Metal Definition (NSMD)** pads is crucial. This decision significantly impacts the overall performance, reliability, and cost-effectiveness of the package. Be caution on the key differences between SMD and NSMD pads, their advantages and disadvantages, and best practices for their creation.



SMD vs. NSMD: Best Practices for BGA Pad Creation

Understanding SMD and NSMD Pads

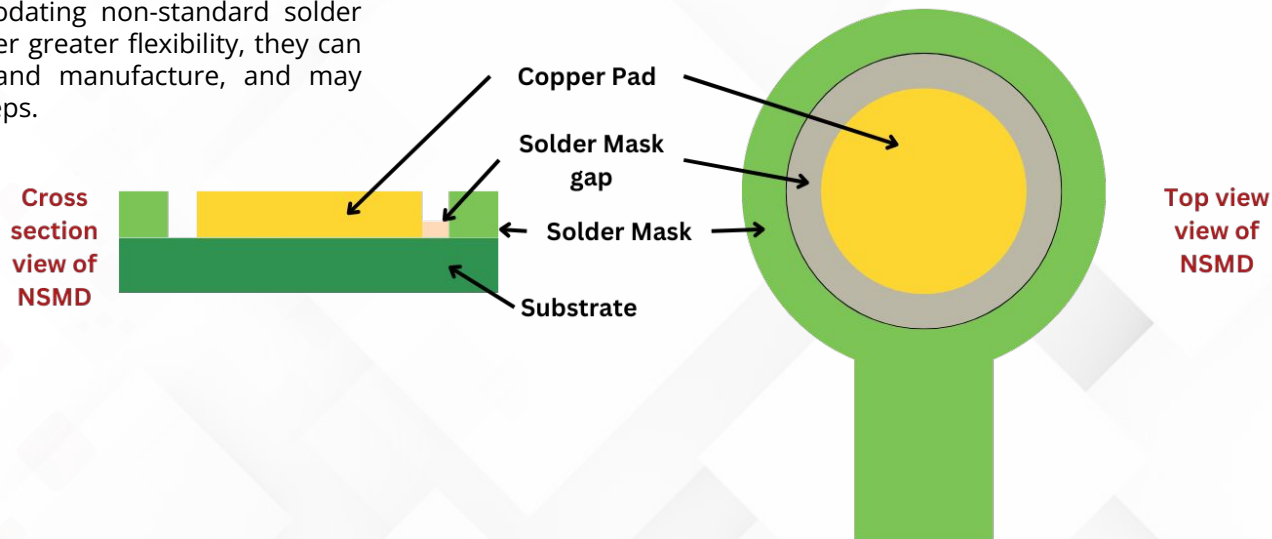
SMD pads are standard, predefined metal pads that are commonly used in BGA packages. They are typically circular or rectangular in shape and are designed to accommodate the solder spheres. SMD pads are relatively straightforward to design and manufacture, making them a popular choice for many BGA applications.



SMD vs. NSMD: Best Practices for BGA Pad Creation

Understanding SMD and NSMD Pads

NSMD pads, on the other hand, are custom-designed metal pads that deviate from standard dimensions or shapes. They are often used to achieve specific design goals, such as improving signal integrity, reducing electromagnetic interference (EMI), or accommodating non-standard solder ball sizes. While NSMD pads offer greater flexibility, they can be more complex to design and manufacture, and may require additional processing steps.



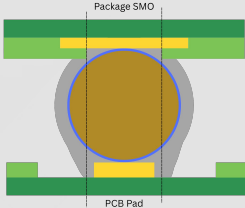
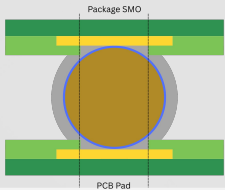
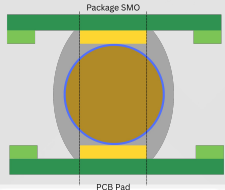
BGA and PCB design guidelines

Recommendation for PCB assembly of BGA using CC-SAC305 Solder Sphere with SAC305 Solder Paste

Diameter	Copper Core diameter	SAC305 Thickness	BGA (Module) - SMD								PCB (Board/Card) - SMD				
			Typical BGA pitch	Solder Mask opening	BGA Copper Pad Diameter	Solder Paste or Flux Stencil "A" Round aperture			Ball Drop Stencil "B" Square Aperture		Solder Mask Opening "E" Diameter	PCB Copper Pad Diameter	Solder Paste Stencil "F" Aperture		
mm	mm	mm	mm	µm	µm	µm (Min)	µm (Max)	µm (Nominal)	µm	Foil thickness, Mils	µm	µm	µm (Min)	µm (Max)	Foil thickness, µm (Range)
0.15	0.11	0.04	0.3	180	120	120	160	180	175 × 175	50 – 75	180	120	120	160	140
0.25	0.21	0.04	0.4	250	200	180	220	250	275 × 275	75 – 100	250	200	180	220	200
0.30	0.26	0.04	0.5	300	250	220	280	300	325 × 325	100 – 120	300	300	220	280	250
0.35	0.31	0.04	0.65	350	300	280	320	350	375 × 375	120 – 130	350	350	280	320	300
0.75	0.71	0.04	1.0	700	650	600	800	700	775 × 775	150 – 200	700	650	600	800	700

PCB and Package Interconnect Opening Dimensions

Examples of based on few selective solder sphere diameters

Package Pad Type	PCB Pad Type	Recommended Package Interconnect Diameter to PCB Ratio	Interconnect Schematic	Package Interconnect Diameter (examples)	Recommended PCB Interconnect Diameter (examples)
SMD	NSMD	1:0.8 (Pkg SMO : PCB pad)		0.28mm (SMO)	0.22mm (pad)
				0.30mm (SMO)	0.24mm (pad)
				0.35mm (SMO)	0.28mm (pad)
				0.42mm (SMO)	0.34mm (pad)
SMD	SMD	1:1 (Pkg SMO : PCB SMO)		0.28mm (SMO)	0.28mm (SMO)
				0.30mm (SMO)	0.30mm (SMO)
				0.35mm (SMO)	0.35mm (SMO)
				0.42mm (SMO)	0.42mm (SMO)
NSMD	NSMD	1:1 (Pkg pad : PCB pad)		0.28mm (pad)	0.28mm (pad)
				0.30mm (pad)	0.30mm (pad)
				0.35mm (pad)	0.35mm (pad)
				0.42mm (pad)	0.42mm (pad)