XBSC/UBDC/UBSC/BBSC/ULSC 100 µm & 400 µm - Assembly

Rev. 1.6

General description

This document describes the attachment techniques recommended by Murata* for their pre-bumped and un-bumped silicon capacitors on the customer substrates. This document is non-exhaustive. Customers with specific attachment requirements or attachment scenarios that are not covered by this document should contact Murata.

Handling precautions and storage

Silicon die must always be handled in a clean room environment (usually class 1000 (ISO 6)) but the assembled devices don't need to be handled in such an environment as the product is already well packed. The remaining quantities have to be repacked immediately after any process step, in the same conditions as before the opening (ESD bag + N2).

Store the capacitors in the manufacturer's package in the following conditions without a rapid thermal change in an indoor room:

- Temperature: -10 to 40 degree C
- Humidity: 30 to 70%RH

Avoid storing the capacitors in the following conditions:

(a) Ambient air containing corrosive gas. (Chlorine, Hydrogen sulfide, Ammonia, Sulfuric acid, Nitric oxide, etc.)
(b) Ambient air containing volatile or combustible gas
(c) In environments with a high concentration of airborne particles
(d) In liquid (water, oil, chemical solution, organic solvents, etc.)
(e) In direct sunlight
(f) In freezing environment

To avoid contamination and damage like scratches and cracks, our recommendations are:

- Die must never be handled with bare hands
- Avoid touching the active face
- Do not store and transport die outside protective bags, tubes, boxes, sawn tape
- Work only in ESD environments
- Plastic tweezers or a soft vacuum tool are recommended to remove the silicon die from the packing.

Standard packing is tape & reel for die size larger than 0201 but silicon capacitors can be provided within waffle pack, gelpak or sawing frame. Please contact the Murata sales contact for drawing and references (mis@murata.com).

*Murata Integrated Passive Solutions

Pad opening

The top surface of the Murata silicon capacitors are protected with a mineral passivation. The finishing of the contact pads are in nickel gold (generally 5µm nickel and 0.2µm gold) conforming with the soldering process.

Murata recommends having an opening on the board which matches the pad of the capacitor (size, position and spacing) – see figure 1. On the substrate, the metal layer can be larger than the varnish coating opening size but in this case, the varnish coating opening has to be mirror with the pad size of the capacitor. No need to change the metal landing pad of the PCB, only the opening in the varnish coating needs to be adjusted (see Figure 1). These recommendations will improve the die placement, tilting and will avoid the contact between the solder paste and the bare silicon die - see Figure 2.

Solder paste after reflow:

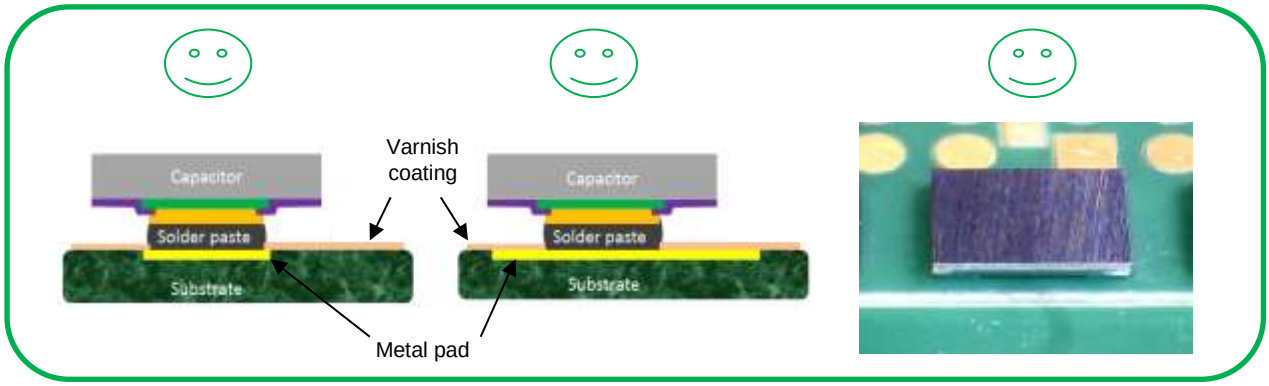


Figure 1: Solder paste after reflow - Targeted

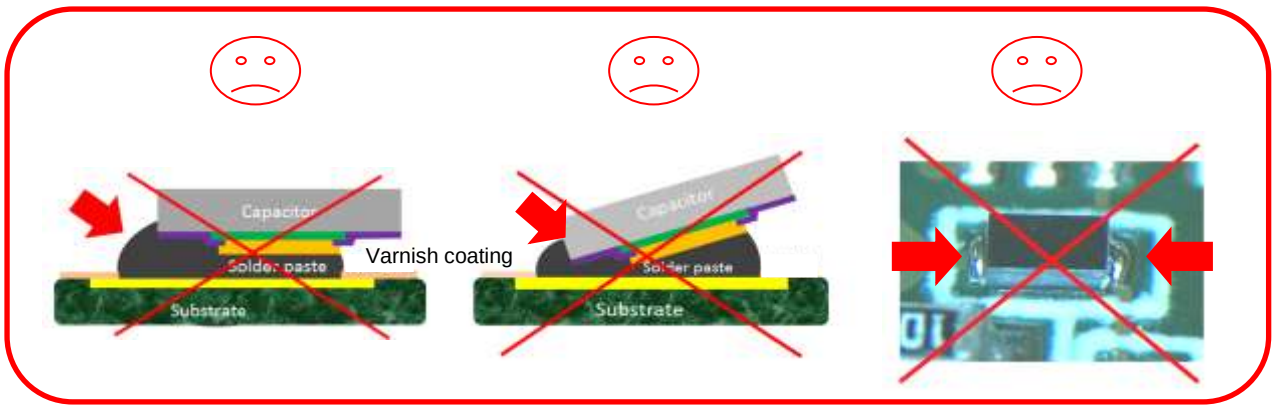


Figure 2: Solder paste after reflow - Rejected

Metal track width recommendations:

For best broadband performances (impedance matching), Murata recommends having a specific width between the PCB signal track and capacitor (see figures 1.1 to 1.6)

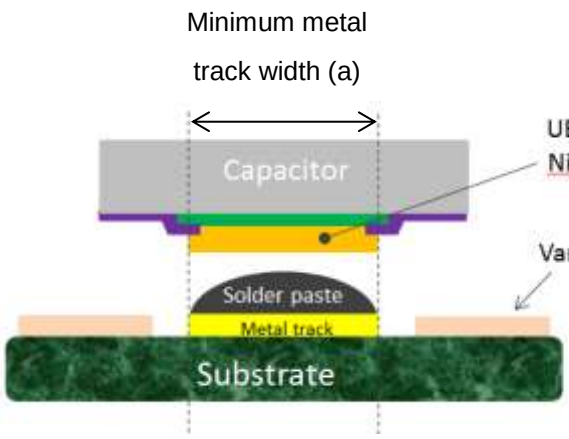


Figure 1.1: unbumped capacitor

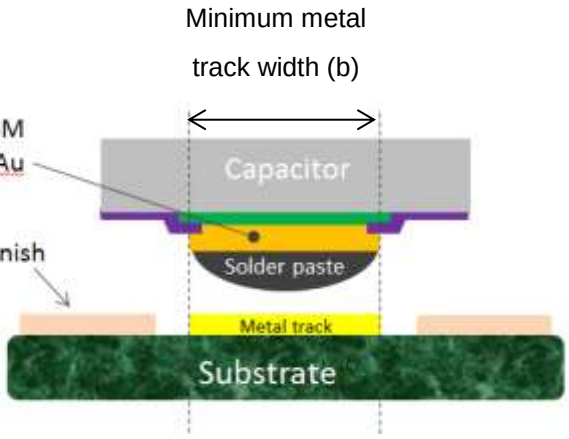


Figure 1.2: bumped capacitor

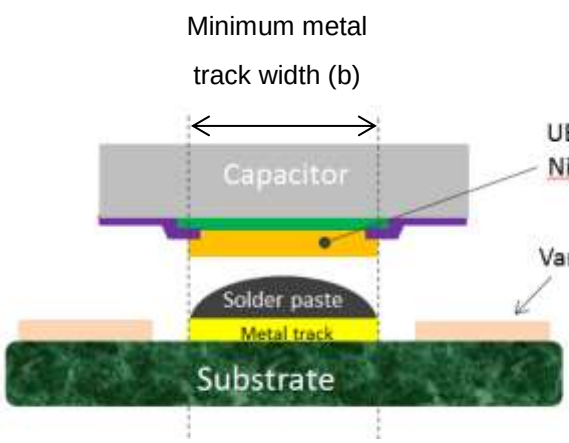


Figure 1.3: unbumped capacitor

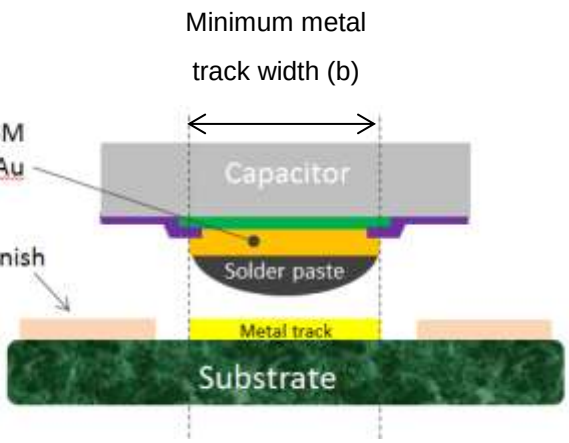


Figure 1.4: bumped capacitor

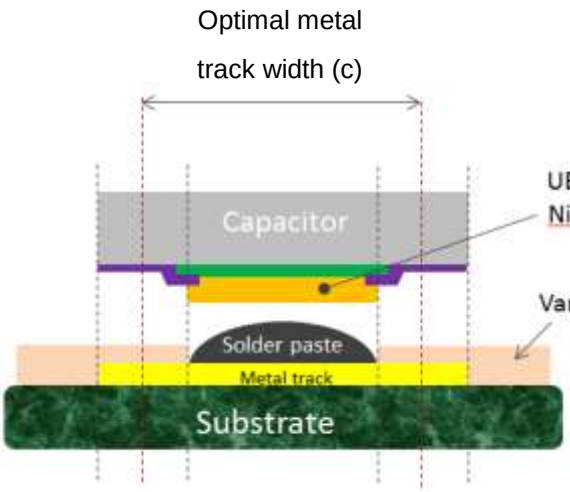


Figure 1.5: unbumped capacitor

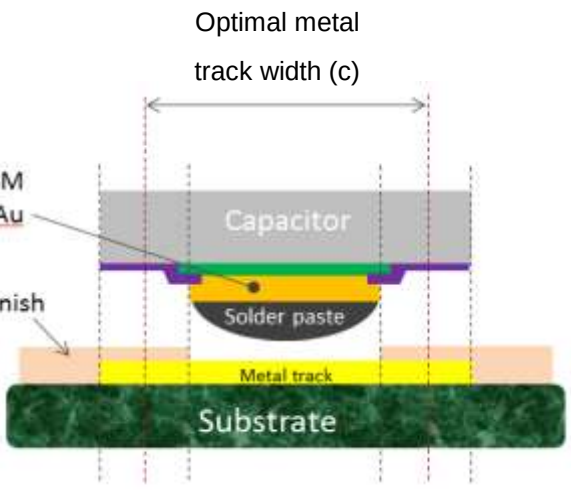


Figure 1.6: bumped capacitor

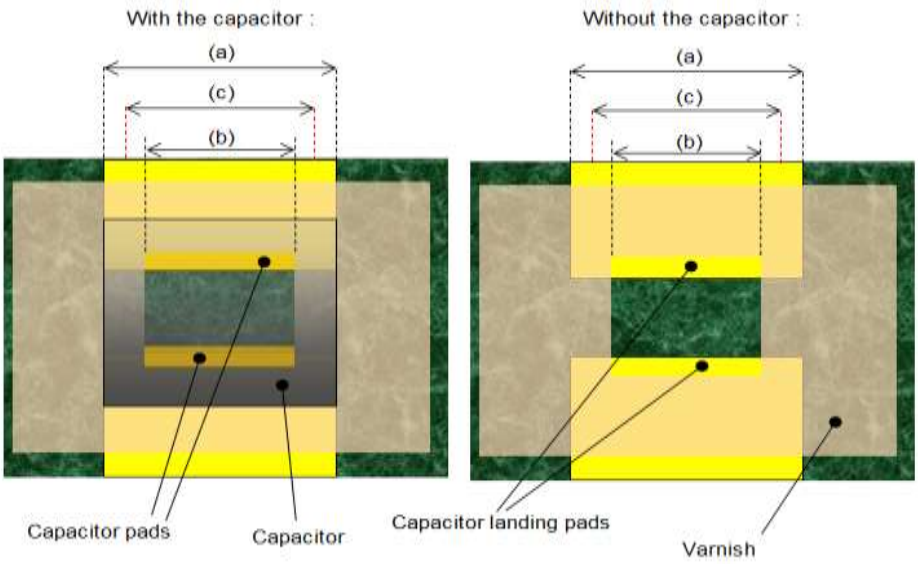


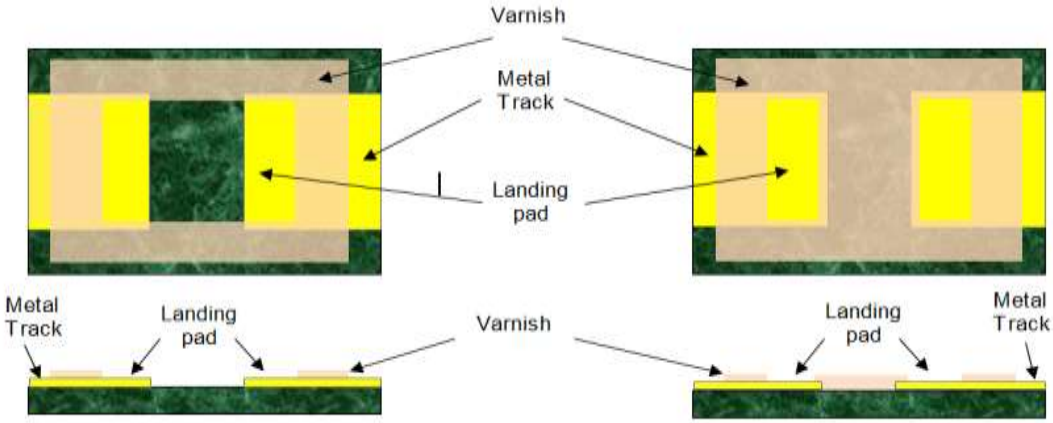
Figure 1.7: design of the substrate

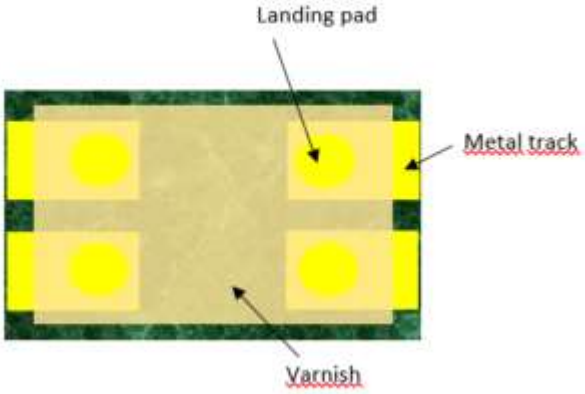
Silicon Capacitor Type	Capacitor size (µm)	Die pad size (µm)	Metal track width (µm)		
			Max (a)	Min (b)	Optimum (c)
0201M	600 x 600	150 x 100	300	150	225
0201	800 x 600	400 x 150	600	400	500
0402M	1000 x 500	Diam 90	200	100	150
0402	1200 x 700	500 x 300	700	500	600
0603	1800 x 1100	900 x 400	1100	900	1000

Solder mask design:

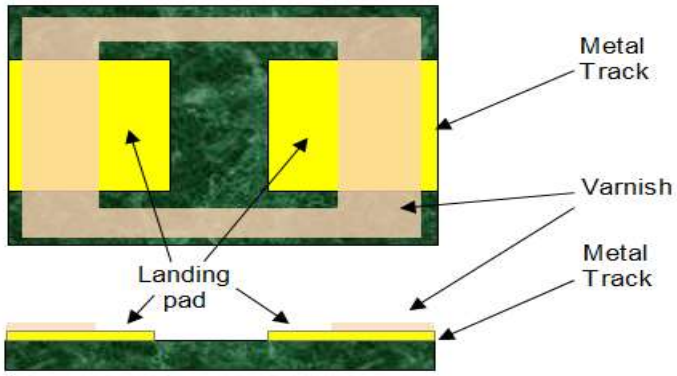
On the customer substrate, Murata recommends SMD (Solder Mask Defined) to control the solder flowing on the tracks.

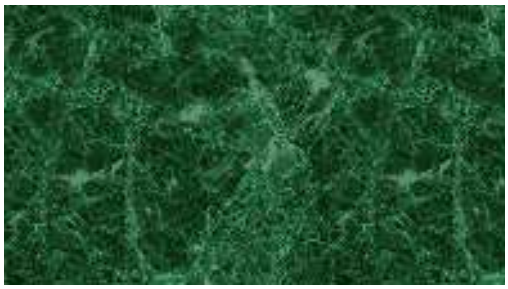
Solder Mask Defined (SMD):





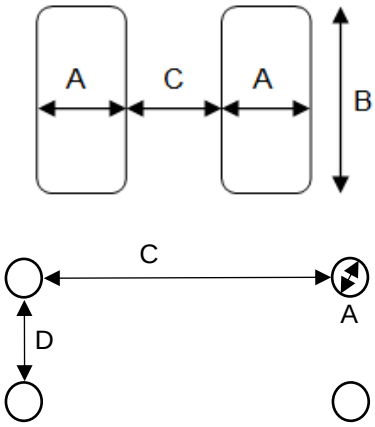
None Solder Mask Defined (NSMD) is also possible:





Note: No varnish between two landing pads can be done.

Landing pad for the substrate and die pad dimensions for the Murata silicon die:



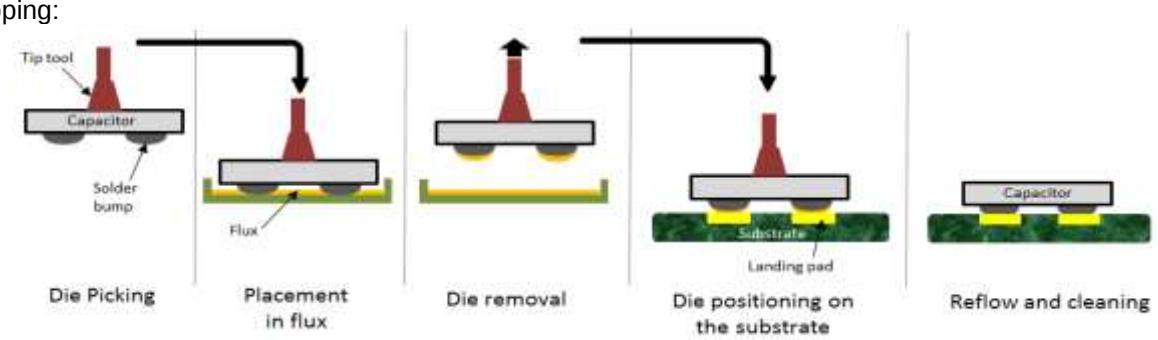
Silicon Capacitor Type	Capacitor size (µm)	A (µm)	B (µm)	C (µm)	D (µm)
0201M	600 x 300	100	150	200	
0201	800 x 600	150	400	300	
0402M (SMD)	1000 x 500	90		610	160
0402	1200 x 700	300	500	400	
0603	1800 x 1100	400	900	800	

Mounting Process Flow

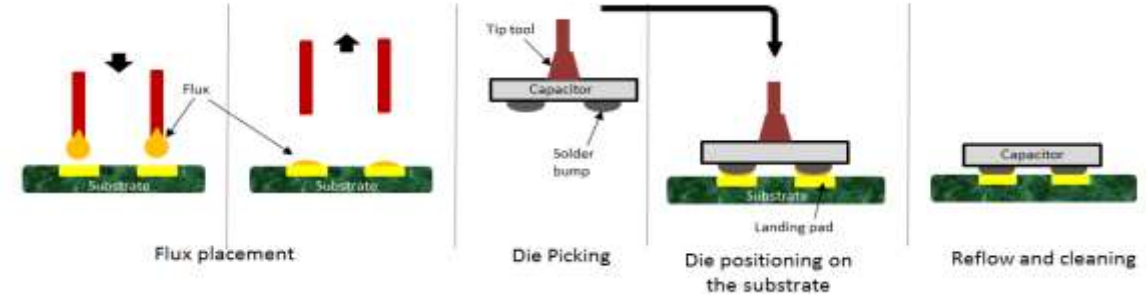
With prebumped capacitor:

The bumps need flux to activate the soldering reflow. The following processes are compatible:

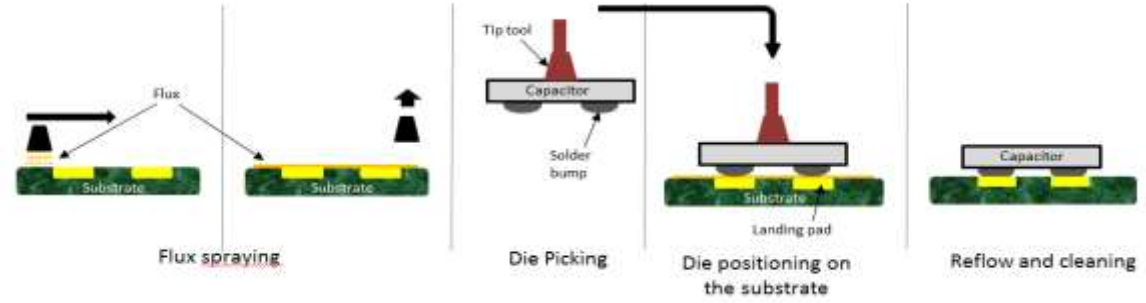
Flux dipping:



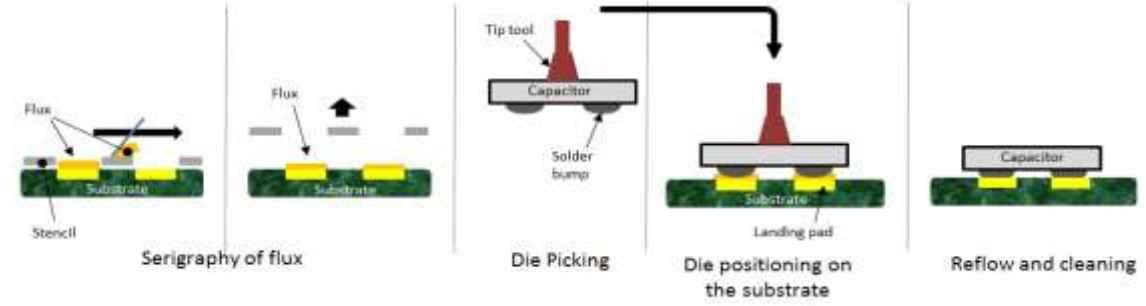
Fluxing by stamping:



Fluxing by spraying:

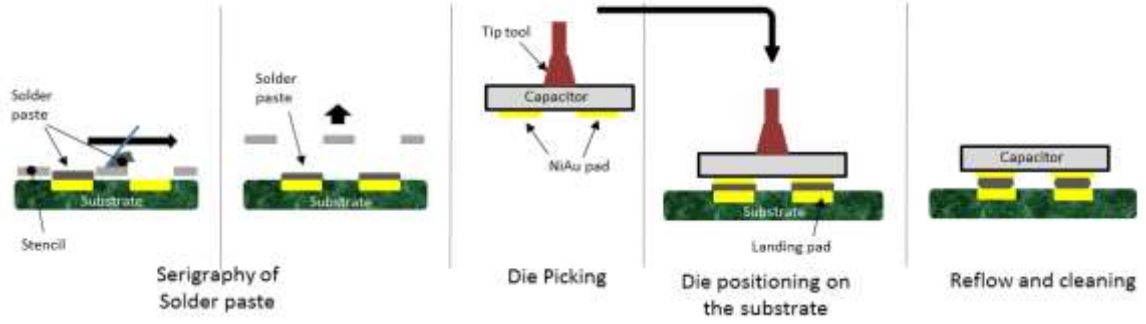


Fluxing by serigraphy:



With unbumped capacitor:

We recommend placing the solder paste by serigraphy directly on the substrate landing pads:



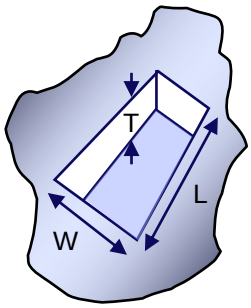
Solder print material and stencil printing recommendations

Solder pastes SnPb63/37 or SAC305 are usually used and recommended but other materials compatible with the die pad finishing are also possible.
Depending on the die pad size, powder size could be adjusted. However, type 6 compared with type 3 limits the risk of tilting of the capacitor (see Figure 2).

ALLOY	COMPOSITION	SOLIDUS	LIQUIDUS	COMMENTS
Sn63	63Sn, 37Pb	183°c	183°c	Eutectic
SAC305	96,5Sn, 3Ag, 0.5Cu	217°c	217°c	Eutectic

Water soluble and no clean flux can be used. In case of water soluble flux, remove the flux immediately after reflow to avoid the potential issue of leakage current between pads.

Stencil design rules in function of the quality :



INOX LASER: [(L*W)/(2*(L+W)*T)] > 0.66 & W > 1.5*T

NICKEL LASER: [(L*W)/(2*(L+W)*T)] > 0.53 & W > 1.2*T

ELECTROFORMED: [(L*W)/(2*(L+W)*T)] > 0.44 & W > 1.0*T

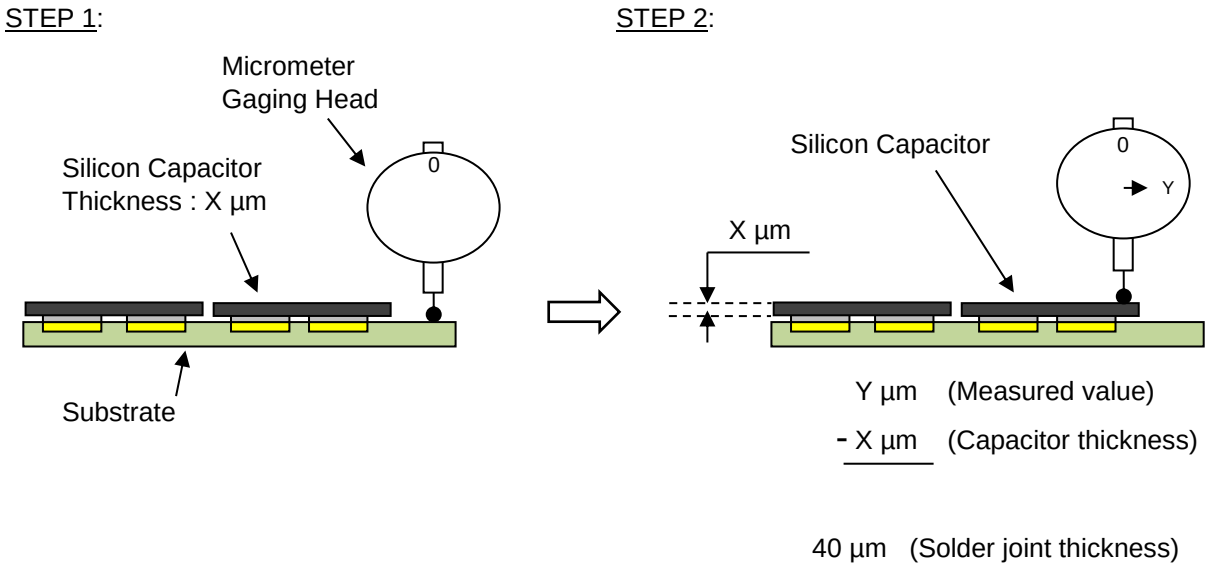
And in all cases : W > 5 * powder size

A solder joint thickness of 40 µm +/-10 is targeted to limit the risk of contact between the solder paste and the side of the capacitor. Such a contact would have a negative effect and would probably create a high leakage or a short circuit. Limited solder joint thickness will also avoid an excessive tilting of the capacitor.

For example, design of stencils done by Murata (SAC305 type 6 with 50% of flux):

Silicon Capacitor Type	Stencil opening size µm	Stencil thickness µm	Stencil quality
0201M	200 x 130	50	EXAKUT TECHNOLOGY
0201	320 x 150	100	ELECTROFORMED
0402M	Diam 114	50	EXAKUT TECHNOLOGY
0402	369 x 260	125	NICKEL LASER
0603	768 x 300	125	NICKEL LASER

Procedure for the solder joint measurement (After reflow):



Pick and Place

The most common approach is with automatic equipment using vision assist to correct placement after picking but manual placement can also be done.

Using a rubber tip is particularly preferred for the die manipulation.

A minimum pressure of 50 grams and a maximum of 150 grams is recommended for the die placement on the solder paste.

Reflow soldering

Murata recommends convection reflow but vapor phase reflow and infrared reflow could be also used.

The reflow must be carried out in accordance with the JEDEC standard.

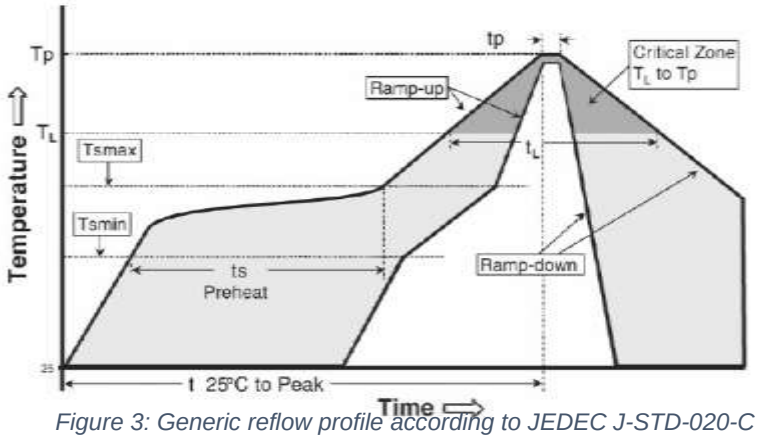


Figure 3: Generic reflow profile according to JEDEC J-STD-020-C

PROFILE FEATURE	SnPb 63/37	SAC305 (Lead-Free Assembly)
Preheat/soak		
Temperature min (Ts min)	100°C	150°C
Temperature max (Ts max)	150°C	200°C
Time (ts) from (Ts min to Ts max)	60 to 120 s	60 to 120 s
Ramp-up		
Ramp-up rate (tL to tp)	3°C/s maximum	3°C/s maximum
Liquidus temperature(TL)	183°C	217°C
Time (tL) maintained above TL	60s to 150 s	60s to 150 s
Peak temperature (Tp)	220°C	260°C
Time 25°C to peak temperature	6 minutes maximum	8 minutes maximum
Ramp-down		
Ramp-down rate (Tp to TL)	6°C/s maximum	6°C/s maximum

Flux removes tarnish films, maintains surface cleanliness and facilitates solder spread during attachment operations. The flux must be compatible with the soldering temperature and soldering times. In case of water soluble flux, please refer to the solder paste supplier for the cleaning and flux removal. Flux residues could be responsible for current leakage or short circuits. For optimum results, clean the circuits immediately after reflow.

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