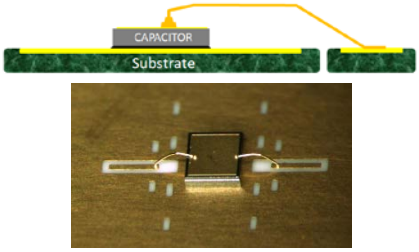
WB/WT/WXSC 250µm/WLSC100µm - Assembly by Wirebonding

Rev. 1.7

General description

This document describes the attachment techniques recommended by Murata* for their vertical 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.



Murata Silicon capacitor W type

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 environments

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

- Never handle the die with the bare hands
- Avoid touching the active face
- Do not store or transport die outside protective bags, tubes, boxes, sawing tape
- Work only in ESD environments
- Use plastic tweezers or a soft vacuum tool 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

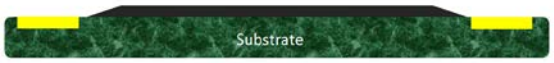
Pad Finishing

The proposed finishing is:

- For top electrode(s):
  - Au (1.5 µm), finishing recommended for gold wire bonding
  - Aluminum (3µm) (Al/Si/Cu: 98.96 %/1 %/0.04 %), finishing recommended for aluminum wire bonding
  - Other finishes are available upon request
- Bottom electrode: Ti(0.1 µm)/Ni(0.3 µm)/Au(0.2 µm)

Process Flow with Glue

Step A - Glue application:



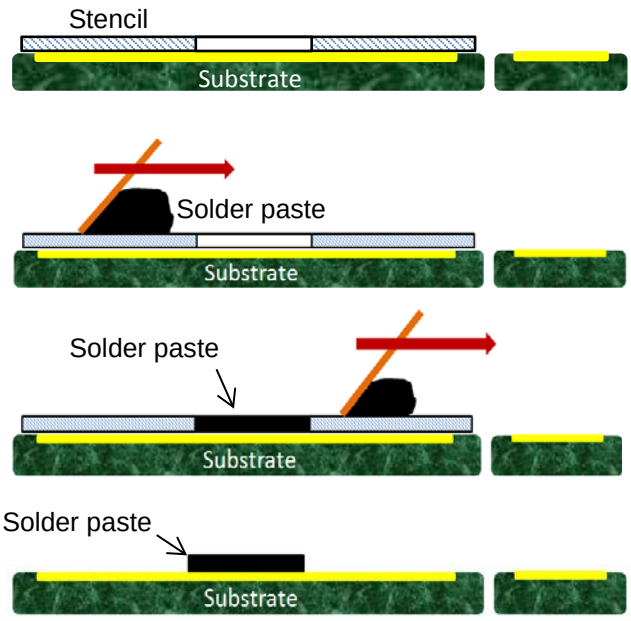
Step B - Pick and place and die bonding:

Step C - Curing of the glue:

Step D - Wire bonding:
(Wedge or ball bonding)

Process Flow with Solder Paste

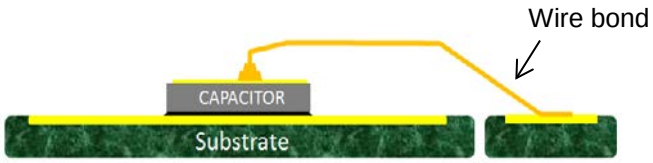
Step A - Solder printing:



Step B - Die bonding:

Step C - Reflow soldering:

Step D - Wire bonding:



Recommendations concerning the Glue for Die Attachment

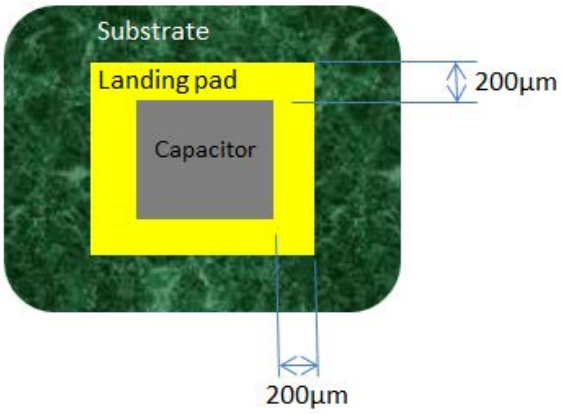
An electrical conductive glue must be used. Murata often uses the following type of glue:

TYPICAL PROPERTIES OF UNCURED MATERIAL:		
Thixotropic index (0.5/5 rpm)		4
Viscosity, Brookfield CP51, 25°C	Speed 5 rpm	30000 mPa.s (cP)
Work life	@ +25°C	2 weeks
Shelf life (from date manufacture)	@ +5°C	3 months
	@ -10°C	6 months
	@ -40°C	1 year
TYPICAL CURING PERFORMANCE:		
Cure schedule	@ 150°C	1 hour
Alternative cure schedule	@ 125°C	2 hours
TYPICAL PERFORMANCE OF CURED MATERIAL:		
Die shear strength	2 x 2 mm² Si die	
	Leadframe substrate Ag/Cu @25°C	19 Kg-f
Lap shear strength, Al to Al	@ 25°C	12 MPa
Lap shear strength, Al to Al	@ 25°C	1500 psi

Landing Pad Opening

Murata recommends that the length and width of the landing pad should be 400 µm greater than the capacitor size because of the overglue.

Top view:

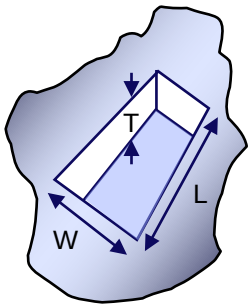


Solder Print Material and Stencil Printing Recommandations

SnPb63/37, SAC305, AuSn 80/20 or SnPb 95/5 solder pastes are generally used by Murata and the typical powder size is type 6 to limit the tilting of the die. Water soluble flux or no-clean flux can be used. If water soluble flux is used, the cleaning must be done immediately after reflow.

ALLOY	COMPOSITION	SOLIDUS	LIQUIDUS	COMMENTS
Sn63	63Sn, 37Pb	183 °C	183 °C	Eutectic
SAC305	96.5Sn, 3Ag, 0.5Cu	217 °C	217 °C	Eutectic
AuSn	80Au20Sn	280 °C	280 °C	Eutectic
SnPb	95Sn5Pb	308 °C	312 °C	Eutectic

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

Die Picking

The most common approach is with automatic equipment using vision inspection to correct die placement after picking and before placement. Manual picking can also be carried out. Use of a rubber or Torlon® tip is strongly recommended for the die picking. A metal tip could damage the capacitor.

Die Bonding

If automatic equipment is used, it is best to use the same tool as for picking. The placement force will depend on the die size. A minimum placement force is required in order to cover all the die back side with glue. Too much force can damage the die.

Recommended forces with recommended glue:

Silicon Capacitor Type	Capacitor size (µm²)	Capacitor thickness	Placement force (grams)
W0101	250 x 250	100 µm minimum	100
W0202	500 x 500		200
W0303	800 x 800		300
W0402	1000 x 700		350
W0504	1400 x 1000		450

Reflow Soldering

Murata recommends convection reflow but vapor phase reflow and infrared reflow can be also used. Reflow must be carried out in accordance with the JEDEC standard.

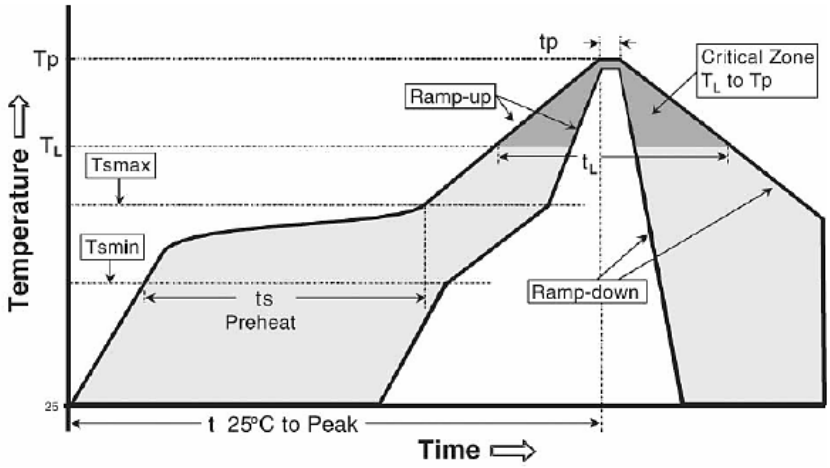


Figure 1: Generic reflow profile according to JEDEC J-STD-020-C

For example:

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

For high temperature, Murata usually used SnPb 95/5 or AuSn 80/20 but other solder pastes are also compatible.

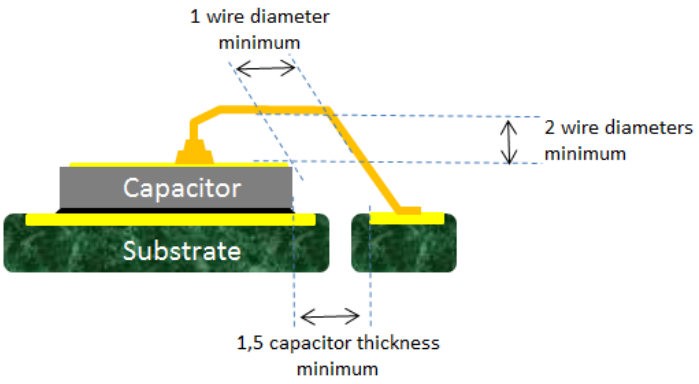
Flux removes tarnish films, maintains surface cleanliness and facilitates solder spreading during the attachment operations. The flux must be compatible with the soldering temperature and soldering times. Please refer to the solder paste supplier for the cleaning and flux removal. Flux residues could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

Wire Bonding

Materials used and bonding conditions:

- Wire lead: diameter 20 to 25 microns, Au/Al wire
- Wire bonding temperature for gold wire bonding: 150 to 200 °C
- Wire bonding methods: Ball bonding or wedge bonding

Wire bonding specifications:

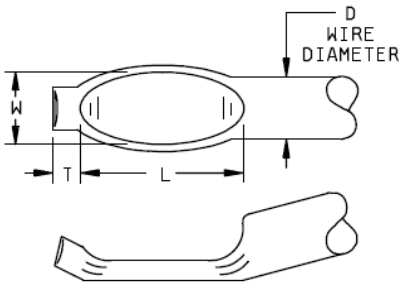


Ball bonding specifications:

- The gold ball diameter must be between 2 and 5 times the wire diameter.
- The wire exit must be completely within the periphery of the ball.
- 100 % of the ball must be on the die pad metallization.

Wedge bonding specifications:

- The wedge bond on die pad must between 1.2 and 3 times the gold wire diameter in width.
- The wedge bond must be between 1.5 and 6 times the gold wire diameter in length.
- The bond width must be between 1 and 3 times the aluminum wire diameter.
- The tool impression on wedge bond must cover the entire width of the wire.
- 100 % of the wedge (tail not included) must be on the die pad metallization.

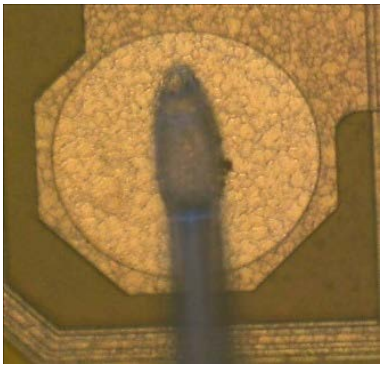


Wire Bonding Parameters

Wire bonding parameters will be adjusted in function of the tool and the wire references, as well as the type of equipment. These data are given to help our customers to define the parameters area.

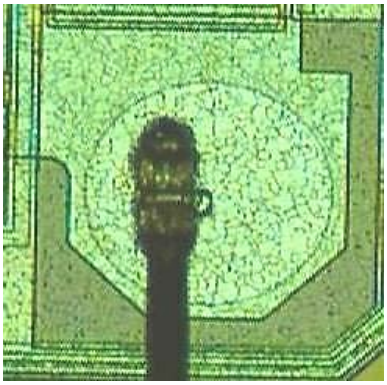
Wedge bonding with aluminum wire (25 µm):

Bonding process : Wedge Alu	
Bonder	BJ820
Bonding Tool	CCNOE-1/16-1"-45-C-2020-MP
Wire	AL1%Si-SR-25-1-4%-17-19gf-12AL (SPM)
US	20% (400-440 mW)
Force	17 cN
Bonding time	10 ms - 20 ms
Deformation	25 - 35%
Temperature	Ambiant



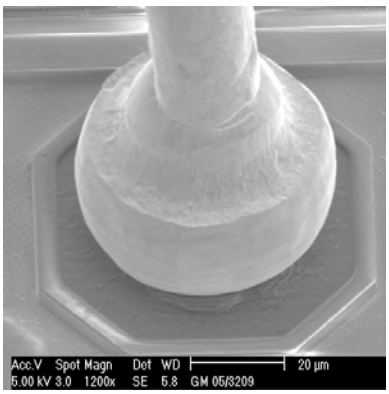
Wedge bonding with gold wire (25 µm):

Bonding process : Wedge /Gold wire	
Bonder	BJ820
Bonding Tool	FP45B-TI-2015-1.00-CGM
Wire	Heraeus Au AW14 (>17cN at 0,5-3%)
US	20 – 30% (420 -600 mW)
Force	20 – 30cN
Bonding time	20ms
Deformation	25 – 35%
Temperature	115°c



Ball bonding with gold wire (25 µm):

Ball bonding /Gold wire	
Bonder	5810 BONDTEC
Bonding Tool	UTS-38HG-AZM-1/16 16mm (SPT)
Wire	Heraeus HD2 (>7cN,2-6%)
US	215 – 230 mW
Force	30 – 40 g
Bonding time	24 ms
Temperature	125°c



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