Assembly Note Silicon Capacitor

Reflow at high temperature

Rev.1.2

This assembly note is dedicated to specific assembly of Silicon Capacitors, with two or more pads, as well as IPD (Integrated Passive Devices), by reflow with high temperature soldering material. By high temperature, we consider materials with a liquidus point over 250°C. For more information about general reflow procedures for Silicon Capacitors, please have a look at the Assembly Note "Silicon Capacitors assembly by reflow". This document is non-exhaustive. Customers with specific attachment requirements or attachment scenarios that are not covered by this document should contact Murata Integrated Passive Solutions (mis@murata.com).

Table of contents

1. Introduction

The general way of working presented in the Assembly Note “Silicon Capacitors assembly by reflow”, remains valid for high temperature except for the soldering material that will be presented in this document. So please be sure to also have this document available with you.

Especially for the manual handling of Silicon Capacitors, metal tweezers cannot be used even for high temperature applications. Please refer to the dedicated application “Recommendations to handle bare dies”.

2. Handling Precautions and Storage

Silicon dies must always be handled with precaution in a dedicated environment for assembly. Regarding silicon capacitors, after opening of the packing, the remaining quantities have to be repacked immediately after any process step, in the same conditions as before the opening (ESD bag + N2 is usually preferred).

Avoid storing the capacitors in the following conditions:

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

For specific storage conditions, please refer to the dedicated Application Note « Storage and shelf life conditions».

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

- Die must never be handled with bare hands
- Avoid touching or scratching the active face with tools that are not adapted
- The mechanical pressure has to be limited
- Do not store and transport die outside protective bags, tubes, boxes, sawn tape
- Work only in ESD-controlled environments

Plastic tweezers or a soft vacuum tool are recommended to handle our Silicon dies.
For more information about handling, please refer to the dedicated application Note "Recommendation to handle bare dies".

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

3. Soldering material selection

Murata suggests Gold-Tin eutectic (Au80Sn20) solder paste to assemble Silicon Capacitors by reflow, please find more details in the next section. However, for some specifically authorized applications, Lead-Tin (Sn5Pb95) usage is also possible and described below.

For other materials or for other assembly procedures related to high-temperature, for instance non-eutectic gold-tin alloys, please read carefully your reference datasheet, the material usage notice to define your own reflow profile and contact Murata.

If your application doesn't have any high-temperature or high-reliability requirements, Murata advises to use regular reflow with SAC305 or equivalent, described in the Assembly Note "Silicon Capacitors assembly by reflow".

4. Reflow process using high-temperature material

High-temperature reflow needs to be achieved above 300°C due to elevated liquidus points of the materials. Also, solder pastes dedicated to those applications contain specific fluxes. Please don't mix high-temperature related materials with materials suitable for lower temperatures during reflow.

Flux removes oxidation, maintains surface cleanliness and facilitates solder spread during attachment operations. The flux must be compatible with the soldering temperature and soldering times. Please refer to section 4 of this document for cleaning and washing recommendations.

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 standards.

4.1. Gold-Tin eutectic solder paste (Au80Sn20)

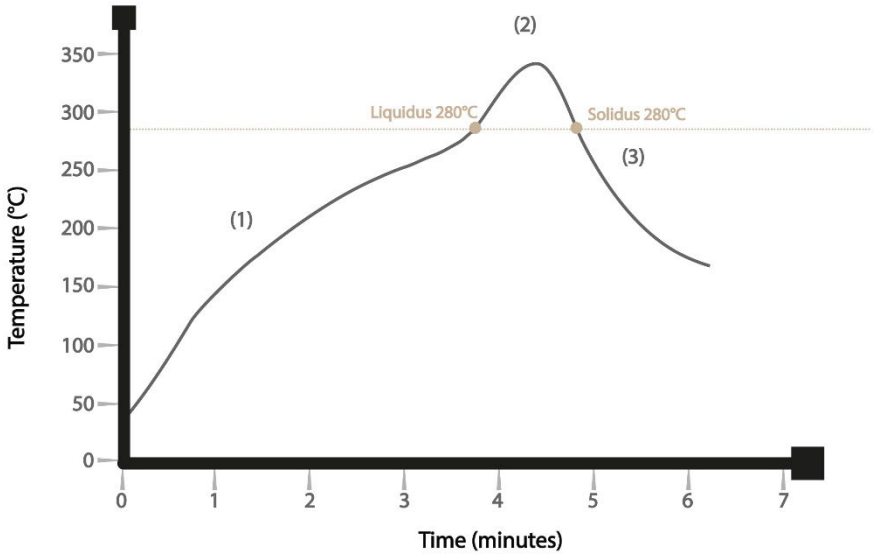

Figure 1: Au80Sn20 advised profile for reflow

This alloy has a liquidus/solidus point at 280°C. Please see Comments on reflow profiles section below for additional information. Values included in the comments section will prevail on the chart.

4.2. For authorized applications only, Tin-Lead (Sn5Pb95)

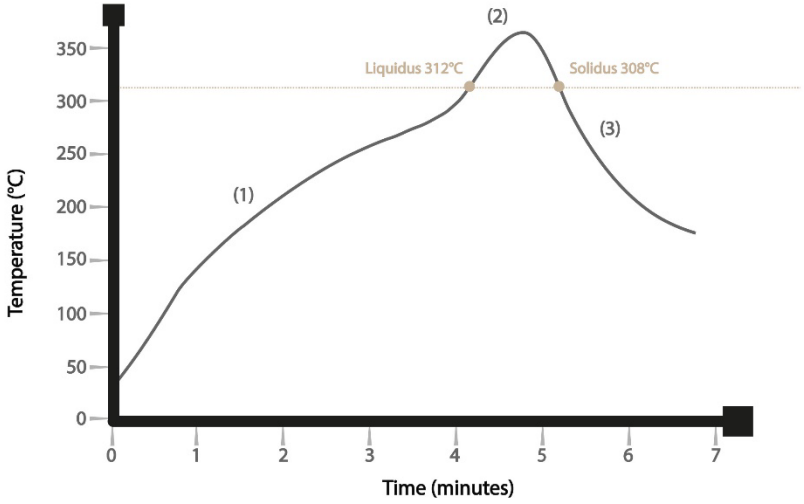

Figure 2: Sn5Pb95 advised profile for reflow

This alloy has a liquidus point at 312°C and a solidus at 308°C. Please see Comments on reflow profiles section below for additional information. Values included in the comments section will prevail on the chart

4.3. Comments on reflow profiles

Those profiles will serve as a general guideline in establishing a reflow profile for your process when using a forced air convection oven. Other reflow technologies including, but not limited to infrared, hot plate or induction, may require significant changes as may varying board geometry's and densities.

Heating Stage (1):

A linear ramp rate of 1–2°C/second allows gradual evaporation of volatiles and helps minimize defects such as solder balling/beading and bridging as a result of hot slump. It also prevents unnecessary depletion of fluxing capacity when using higher temperature alloys.

Liquidus Stage (2):

A minimum peak temperature of 40–50°C above the melting point of the solder alloy is usually needed to achieve excellent wetting and spread to form a quality solder joint. The time above liquidus (TAL) should remain between 45 and 80 seconds. A peak temperature and TAL above these recommendations can result in excessive intermetallic formation that can decrease solder joint reliability and lead to increased difficulty in repair on precious metal surfaces. A ramp rate of 2.5 to 3.5°C/second from liquidus to peak temperature is recommended to quickly reach the peak. A ramp rate of 2 to 3°C/second from peak temperature to solidus is also recommended.

Cooling Stage (3):

This stage refers to the temperature range from peak temperature to approximately 50°C below the liquidus temperature where the cooling rate has a negligible effect. A rapid cool down between 2 and 3.5°C/second is desired to form a fine-grain structure. Slow cooling will form a large-grain structure, which typically exhibits poor fatigue resistance. If excessive cooling of >4°C/second is used, both the components and the solder joint can be stressed due to a high CTE mismatch.

5. Cleaning after reflow

For appropriate removal of residual flux, proper cleaning equipment, conditions and solvent must be used. This prevents any residual flux or other foreign substances causing deterioration of electrical characteristics and the reliability of the capacitors.

Murata advises to use soft cleaning products, even for high-temperature soldering materials. Water soluble and no clean flux can be used. In case of water-soluble flux, please refer to the solder paste supplier for the cleaning and flux removal. For optimum results, it is recommended to remove the flux immediately after reflow to avoid a potential issue of current leakage or short circuits.

However, it is not recommended to use excessive conditions for ultrasonic oscillation, water or air pressure during cleaning which can cause reliability issues. Before starting your production process, please test your cleaning system.

Revision history

Revision	Date	Description	Author
0.1	31/03/2021	Document creation	C Muller
1.0	17/11/2022	Addition of chapter 4 dedicated for cleaning recommendations Formatting update	K. Dubois
1.1	23/01/2023	Added storage recommendations to chapter 1	K. Dubois
1.2	13/04/2023	Updated chapter 2	K. Dubois

Disclaimer / Life support applications

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Murata customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Murata for any damages resulting from such improper use or sale.

www.murata.com

mis@murata.com