Keys to Component Lead Tinning Success

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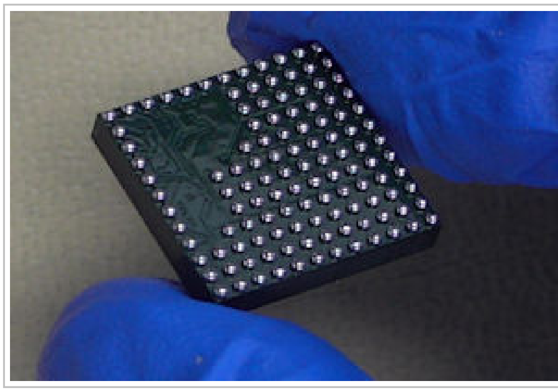
The motivation behind component lead tinning is to facilitate the removal of gold plating to eliminate the risk of gold embrittlement, tin whisker mitigation, or processing components for applications that require refinishing with lead-free solder for RoHS compliance. The component lead tinning process produces a homogeneous intermetallic layer with the base metal of the component leads or terminations increasing the overall solderability, thus facilitating improved reliability of printed circuit board assemblies.

All leaded through-hole components, such as axial, radial, dual-inline package (DIP), or single-in-line package (SIP) devices, can be successfully re-tinned using the solder dip process. Surface mount components that usually have terminations or pads but without leads, such as chip components, SOTs, SOICs, leaded chip carriers (LCC), or plastic leaded chip carriers (PLCC), can be re-tinned using the solder drag process. In many cases, fixturing is required when automatically re-tinning surface mount components to ensure parallelism is maintained during the re-tinning process.



LGA device after pad tinning and solder ball attachment.

Formed multi-side components such as flat pack (FP) and quad flat pack (QFP) devices have delicate leads that can be easily damaged and are re-tinned using a side wave process with the components held in position with a multi-axis articulated robot equipped with a rotary vacuum head. Ball grid arrays (BGA) devices that need to be converted from a lead-free finish to tin-lead to meet the requirements of defense or high-reliability applications need to be re-balled. The first step in this conversion process is deballing, where the original solder balls are removed from the underside of the BGA devices, exposing the interposer pads.

A key issue when re-tinning fine-pitch surface mount devices such as QFPs and quad flat pack, no lead (QFNs) is maintaining coplanarity across all leads while simultaneously assuring bridge-free results. Fine-pitch QFPs as small as 6mm x 6mm with a lead pitch as small as 0.012” and up to 50mm x 50mm can be re-tinned with bridge-free results. Bottom terminated devices such as QFNs as small as 3mm x 3mm with a lead pitch down to 0.5mm can be re-tinned with world-class coplanarity within 0.003” for these leadless devices. Device coplanarity and solder thickness from the re-tinning process should be verified with X-ray fluorescence (XRF) testing and verification of the alloy composition.

Robotic tinning of SOIC devices

The critical process parameters for the component re-tinning process include:

- Control of depth of immersion of piece part in flux bath
- Dwell time of piece part controlled in preheat and solder pot within ± 0.1 sec

- Control of entrance speed into solder pot to within ± 0.3 cm/sec
- Depth of immersion of piece part in solder pot to within ± 0.1mm
- Optimum dwell time of piece part in solder pot to achieve intermetallic bond
- Control of exit speed out of solder pot to within ± 0.3 cm/sec

When removing through-hole or surface mount components from the solder bath, the temperature, flux chemistry, and extraction speed are critical. These parameters play a significant role in controlling the solder thickness applied by the re-tinning process.

It has been observed that some within the electronics assembly industry use a single static solder pot for both alloy removal and component re-tinning. This is not recommended since organic contaminants, flux buildup, and accumulation of gold can be transferred to the re-tinned component leads or terminations. Those using this practice rely on outdated standards and procedures that do not comply with the GEIA-STD-0006 or IEC TS-62647-4 component re-tinning industry requirements.

The ideal method to facilitate the removal of gold plating and mitigate tin whiskers from SMT and through-hole components is to use the robotic hot solder dip (RHSD) process. It is recommended that this re-tinning operation be carried out using a lead tinning machine using controlled flux application, preheating, single or dual solder pots, nitrogen inserting, and defined process control. A defined process of this type is highly recommended in place of manually dipping components into a standalone static solder pot to reduce solder contamination, minimize non-wetting issues and enhance solderability.

Robotic Hot Solder Dip machine.

Robotic hot solder dip (RHSD) machines can use either single or dual static or dynamic solder pots, with the first pot used to remove gold plating, oxidation, or other residues, and the second pot used for precise control over solder depth. An inert nitrogen atmosphere helps the appearance of the resulting solder finish while mitigating icicles and dross buildup. Immersion of the component lead or termination into the flux and solder should be controlled to allow the flux and solder to flow up the lead or termination to a controlled depth. A defined withdrawal or extraction speed should be used in the second solder pot to control the re-tinning solder thickness, and solder pots should be tested regularly for copper, nickel, and other contaminants.

Robotic hot solder dip tinning services can remove gold plating from through-hole and SMT component leads or pads to minimize the risk of gold embrittlement as a potential failure mechanism. When using these robotic hot solder dip tinning services, it is recommended to also use a batch wash system for post-process cleaning as well as the following procedures:

- Component moisture sensitivity level (MSL) dry bake per J-STD-033
- Component moisture sensitivity level (MSL) packaging per J-STD-020
- Tape and reel packaging per EIA-481

If available from your robotic hot solder dip tinning service provider, the following testing services are beneficial and recommended to ensure process integrity:

- Ionic cleanliness (ROSE) testing per IPC-TM-650-2.3.25
- X-ray fluorescence (XRF) for alloy composition and finish thickness per JESD 213
- Solderability testing per J-STD-002
- Visual inspection

For ultra-high reliability, mission-critical applications such as military, security, defense and/or aerospace, additional component testing services can be required utilizing the following test protocols:

- SAM (scanning acoustic microscopy) testing per J-STD-035
- Destructive physical analysis (DPA) per MIL-STD-1580
- Hermeticity testing (fine and gross leak) per MIL-STD-883
- Temperature, humidity, and bias testing
- Parametric testing