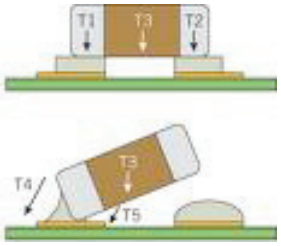
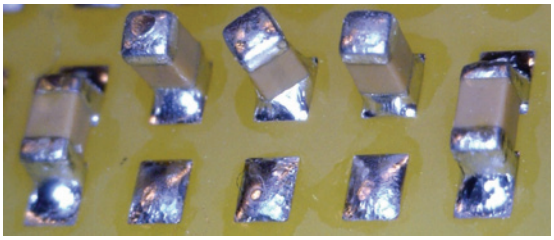
Suggestions to Minimize Tombstoning

APPLICATION NOTE

The tombstoning effect (also known as Manhattan effect, drawbridge effect, or Stonehenge effect) is considered a common soldering defect in surface mount electronics assembly involving small leadless components, such as resistors and capacitors. The trend in electronics assembly toward miniaturization to achieve smaller, lighter, and higher performing products has resulted in the rapidly increasing use of small leadless passive and active components. Until recently, 0603 components, which have been prevalent for years in high volume production, have produced very high yields and few defects. The 0402, 0201, and 01005 components have recently been used more frequently and have presented electronics assemblers with the tremendous challenge to minimize defects.

The tombstoning effect is due to an imbalance in the surface tension of the molten solder at both ends of the component during reflow soldering. Because of the small dimensions of these 0402, 0201, and 01005 components, the intricate balance of the surface tension may be more easily disturbed by either a change in the solderability of the components or by the differences of time at which the solder paste begins to melt at each end of the component.





Common Tombstoning Solutions

Design

- Use a larger width and area of metallization under the chip component
- Use adequate spacing between the two pads of the chips
- Use the proper extension of the solder pad beyond the chip ends; circular pads appear to be more promising than rectangular or square pads
- Reduce the width of the solder pads
- Minimize the uneven distribution of thermal mass, including the connection of pads with heat sinks or thermal ground planes
- Minimize the shadow effect with an adequate design of the PCB and proper selection of reflow methods

Process

- Reduce the contamination or oxidation level of the component termination or PCB pad metallization
- Improve component placement accuracy
- Use a thinner solder paste print thickness
- Use a milder heating rate during reflow
- Use a profile with a long soak zone just below the liquidus phase to reduce the outgassing rate of the fluxes and minimize thermal gradient
- Use solder paste with a retarded melting temperature or with a wide pasty range
- Use a profile with a very slow ramp rate across the melting temperature of the solder

The most common solutions to tombstoning include modifying the reflow profile and/or using a solder paste alloy with a retarded melting temperature or with a wide pasty range. These techniques may eliminate the issue, but may be more of a temporary Band-Aid® than a permanent solution. It is important to understand the root cause of the issue so that adjustments can be made in future designs and processes. In many cases, increased communication between the board designers and the manufacturing engineers can bring about a resolution by helping the designers to understand the issues that engineers face day-to-day.

Further Information

http://www.indium.com/techlibrary/whitepapers/conquer-tombstoning-in-leadfree-soldering
http://www.indium.com/techlibrary/whitepapers/control-leadfree-tombstoning-via-alloy-composition
http://www.indium.com/techlibrary/whitepapers/leadfree-controlling-tombstoning-behavior
http://www.indium.com/products/alloy_sorted_by_indalloy_number.pdf
http://www.indium.com/services/technicalsupport/servicedirectory.php

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Form No. 98690 R0

www.indium.com **askus@indium.com**

ASIA: Singapore, Cheongju: +65 6268 8678
CHINA: Suzhou, Shenzhen, Liuzhou: +86 (0)512 628 34900
EUROPE: Milton Keynes, Torino: +44 (0) 1908 580400
USA: Utica, Clinton, Chicago: +1 315 853 4900

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