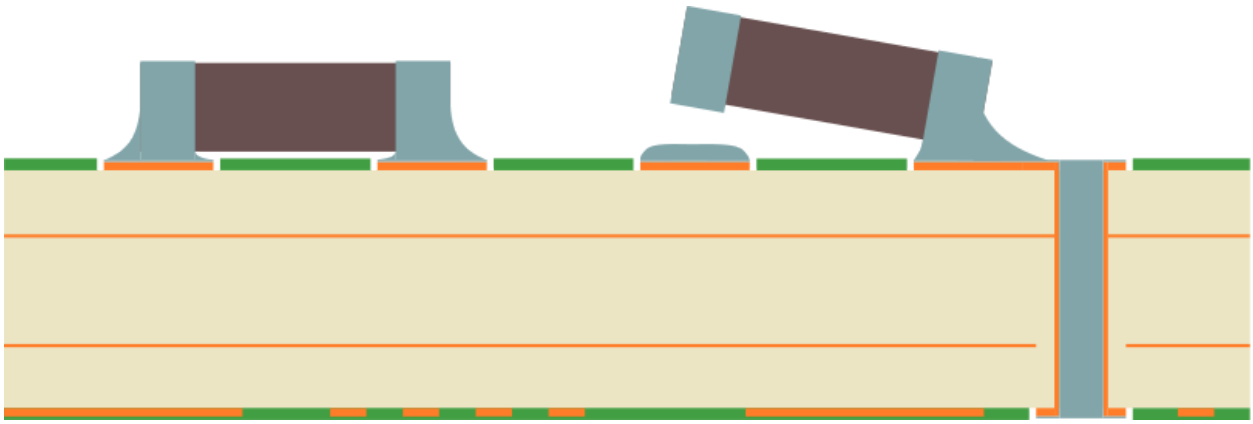
EESA: KNOWLEDGE BOMBS

TOMBSTONING

Looks like it's not just the Undertaker!



Introduction

Tombstoning (also known as Manhattan effect or crocodile effect) usually affects surface mount passive components such as resistors, capacitors and inductors. It is where one end of the component lifts from a pad of the PCB during the soldering process.

Causes

To understand the causes, we will have to understand an integral part of the soldering process known as Wetting.

Wetting is where the Solderpaste becomes fluid or molten and is able to attach itself to the component terminal and to the pad on the PCB. The ideal situation is when all the terminals of a component complete the Wetting process at the same time creating a solid physical and electrical inter-metallic bond. It is important as when the Solderpaste becomes fluid it applies a pulling force to each of the component terminals, known as the Meniscus Pull, something like a Tug-of-War on the component.

This pulling force has the benefit of helping self-center the component between its pads if the Wetting process is completed at the same time.

Basically, the pad that completes the Wetting process first will win the Tug-of-War and may pull the component vertically resulting in Tombstoning. What it really comes down to is the difference in thermal mass between pads of the same component. This will define how quickly the Solderpaste is heated and becomes fluid then, how quickly the heat dissipates and the solder becomes solid.

Apart from the manufacturing troubles(which apparently are not in our control), some of the common mistakes that we can take care of to avoid tombstoning of our PCB are listed below.

PCB Layout mistakes:

Footprint and Pad sizes-

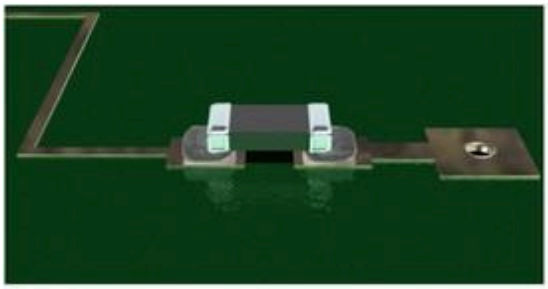
If the pad sizes for your small passive parts are incorrect, it could affect the thermal mass of the solder joints. A pad with less mass will cause the solder to reflow sooner than larger pads.

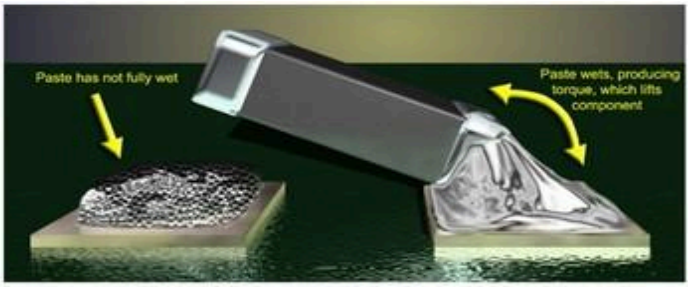
Along with building pads to the correct size, it's also imperative to ensure the entire footprint for the passive parts is correct. Pads also require the correct pitch(pad spacing) and identical size pads for both the terminals of the component.

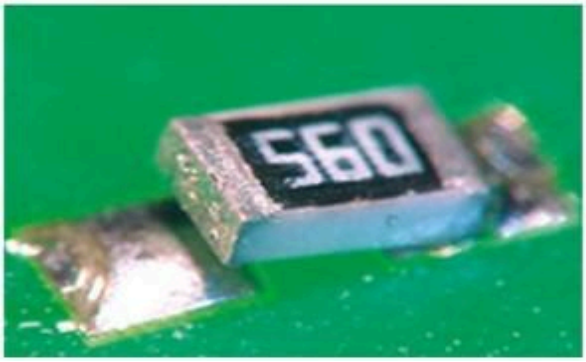
In short, always make sure that you make your component footprints according to the exact specifications in your manufacturer’s datasheet.

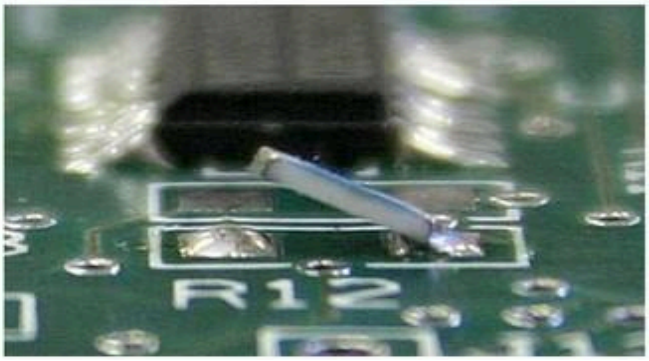
Pads connected to large copper areas:

Large copper areas act as Heat Sinks and therefore connecting a component pad to one as in the graphics above would most likely result in Tombstoning.

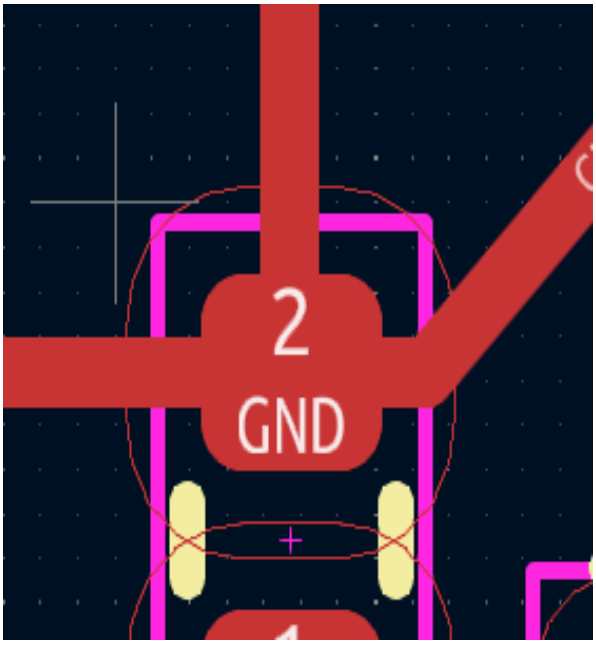




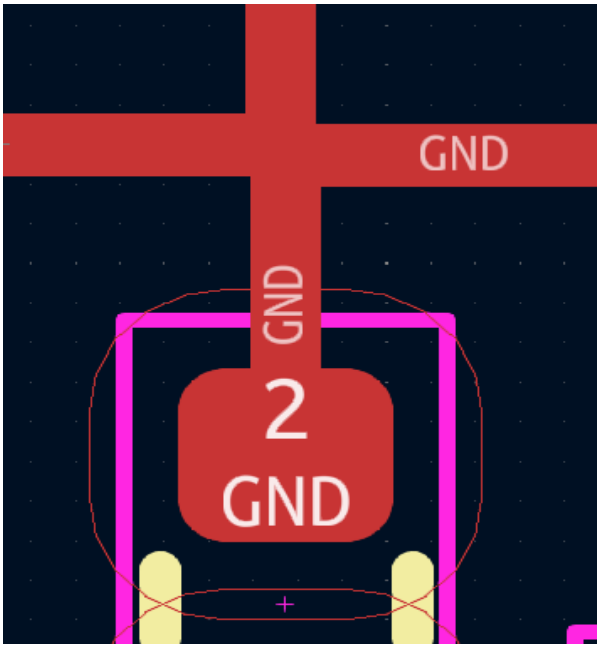




Track to pad issues-



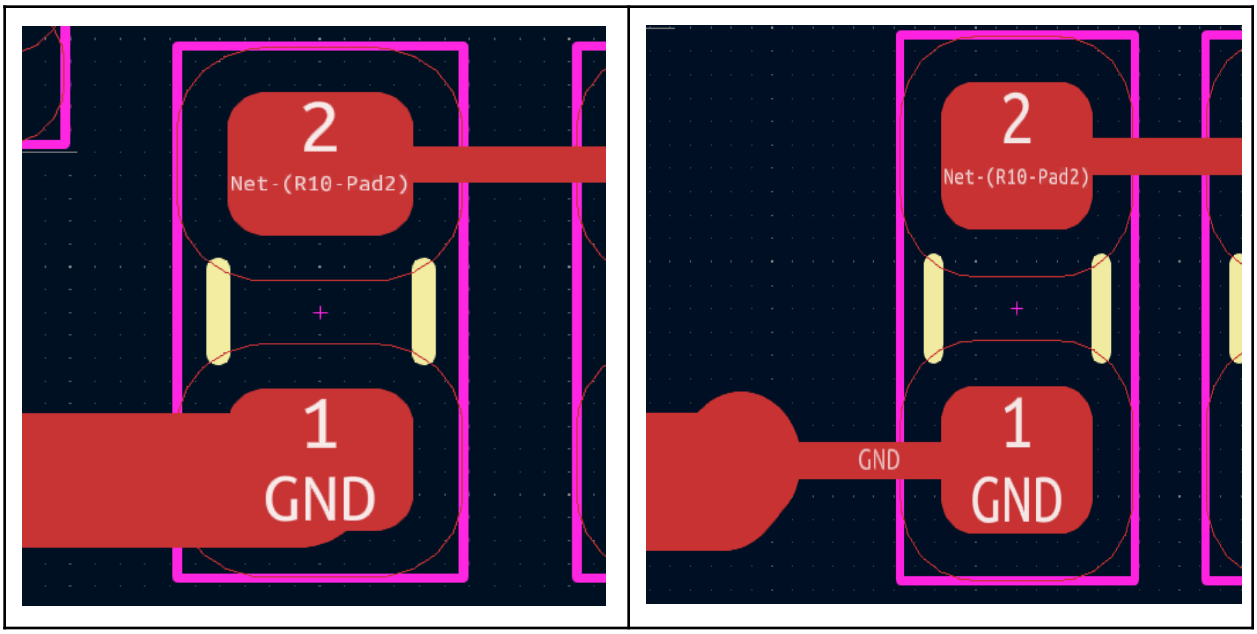
Common Layout



Alternative

Avoid multiple tracks to one pad and only one track to the other pad different track widths to pads of the same component, also avoid different track widths to pads of the same

component. A pad with multiple tracks connected to it will dissipate the heat quicker than with the pad with a single track connected to it. Therefore, the Wetting process will be completed at different times which may result in Tombstoning.



Issue Alternative

When a pad is connected to Power or GND it is common for larger tracks to be used as above. However, this will result in the Wetting process for the pad with the larger track being completed before the pad with the thinner track and may result in Tombstoning. The aim is to make the track width to each pad of the component the same width. An important point to consider is that this unified track width must be run at least 0.25mm from the pad edge before the width changes to help keep the Wetting process in sync.

There are multiple other layout issues but the basic ones are mentioned above. Again, the rule of thumb is to keep the track width to each pad of the component the same width!!

-See you next time with yet another knowledge bomb. Until then, keep the clock ticking!!