Vitronics Soltec

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The mechanisms of solderbridging

General

When the PCB exits from the soldering unit, it sometimes appears that the process did not quite proceed as we wished. Below we will discuss the cause of solder bridging.

The main reason for this kind of defects lies in the inappropriate solder drainage conditions. This can have several reasons. One of the most common reasons is remaining oxides from the solder at the exit area from the soldering wave due to lack of flux activity, e.g. because of a wrong composition or distribution.

Solderjoint formation in wave soldering

Assuming that the solderability requirements of the parts to be joined are fulfilled, they will be wetted by the solder as they come in contact with the solderwave. During this contact with the solderwave all parts that are in the solderwave, are now bridged by solder. So at this stage in the process solderbridging is the normal situation. The amount of solder on a joint during separation from the solderwave can hardly be influenced by the soldering conditions, since the amount of solder on a joint depends mainly on the joint design in combination with the surface tension of the solder, according to the law of Young and Laplace.

Mono-stable solderjoints

A mono-stable solderjoint is a solderjoint that never will create a solderbridge in a stable solderprocess. At a mono-stable solderjoint the design of such joints in combination with its surrounding joints makes it impossible to create solderbridges between such joints during separation from the solderwave. That is why they are called mono-stable, because there is only one stable situation. Even relative large deviations from the optimal process settings will have no effect on such joints. REMARK: A good design will give sound joints without unwanted solderbridging. In other words: "Solder quality starts with design quality."

Bi-stable joints / bridges

There are layouts where the solder might give sound joints without solderbridging, or create a solderbridge with the same process settings for what seems no clear reason. Nothing was changed in the soldering process, but for one "unclear" reason, now and then a solderbridge occurs, however always at the same area or at the same layout. This "unclear" reason might be explained by the fact that some joints, due to their design, shows a bi-stable behaviour. This phenomena can be explained by the surface tension behaviour with soap models with a cubic metal frame, these also show a bi-stable behaviour in a full symmetrical model.

Trials to improve this bi-stable behaviour by changing the soldering process parameters might often be very frustrating if one does not recognize this bi-stable behaviour. One often blames the solderprocess, because it is difficult to understand that this can happen in a stable process.

Information Sheet 016

Exit from the solder wave

When the PCB exits from the soldering unit, the flux should still be sufficiently active to remove the oxide film which is continuously forming on the solder. This flux should so to speak be conveyed from the PCB material to the wetted joints. As the joints are wetted with solder, no flux can be present there. For large metal surfaces the supply of flux is usually insufficient in this stage, which leads to soldering defects e.g. icicles (peaks) and flags.

These defects on large metal surfaces, can be avoided e.g. by applying solder resist over these metal surfaces. In that case however it is necessary to build also at the soldering side, heat barriers into the related metal surfaces if plated-through holes are applied. Moreover, the apertures (spots) in the solder resist will have to be sufficiently large to allow sufficient wetting of the joint during the soldering process. During soldering the solder resist also acts as a heat barrier, and this may impede the soldering process (hole filling).

The design requirements imposed on a multilayer board are even more strict than for the normal bi-layer. Particularly in case of conductor linkage between the intermediate layers it is necessary to build in a heat barrier, e.g. by local conductor narrowing at the terminal spot.
This prevents the heat from being prematurely extracted from the joint to be formed. The application of larger holes would also have a favourable effect for better hole filling.