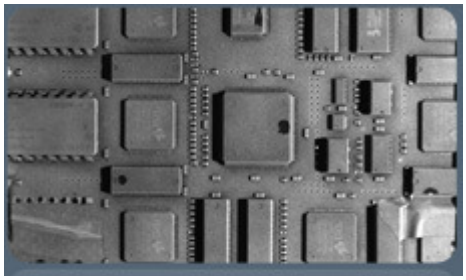
APPLICATION FILE
PCB ASSEMBLY

TDM
TOPOGRAPHY AND DEFORMATION MEASUREMENT

When looking at process design, PCB assembly is one of the most critical tasks. Several serious failure sources have to be taken into account :



Component deformation :

Due to internal CTE differences (between silicon, copper, mould compound, etc.), components deform more or less strongly under varying temperatures. In the worst case, those deformations may cause that at the solder temperature some of the components' contacts are not in touch at all with the PCB. Additionally, delamination at the components' internal interfaces may appear.

PCB deformation :

Modern multi-layer PCBs, eventually equipped with embedded components, also contain various materials with different CTEs, and are therefore subject to deformations during temperature variations, too. In the worst case the deformations of the components and the PCB might be in opposite sense, such as concave for some components and convex for the PCB.

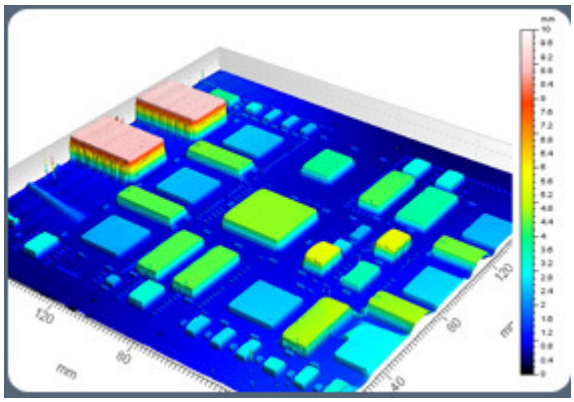
Stress transfer between components and PCB :

An additional failure source occurs during the cool down period, once the solder is solid. Then, each deformation of a component will induce additional stress on the PCB via the solder joints, and vice versa. Therefore, even limited deformations of the components and the PCB may become fatal for the assembly, if those deformations are in the opposite sense (e.g. concave deformation of the component, and convex deformation of the PCB at the place where this component is soldered).

For those reasons, one of the most important requirements for the failure analysis on assemblies is the capability of the measurement tool to acquire absolutely calibrated 3D topographies, with a depth of view at least as large as the height difference between PCB level and the highest component's top level. TDM, the only commercially available instrument to be able to measure the absolute height of vertical

steps simultaneously to realistic reflow profiles, is particularly well suited for those tests : **Full 3D topography rendering, even in presence of vertical steps, holes, or very fine contact structures**

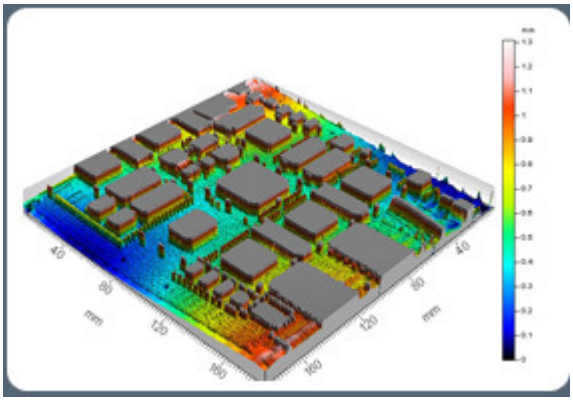
- ***Optical and numerical zoom to focus exactly on the area of interest***
- ***Fast and homogeneous heating and cooling even on large samples***
- ***Numeric topography subtraction tool, for visualizing small deformations on assemblies with large z-amplitude***

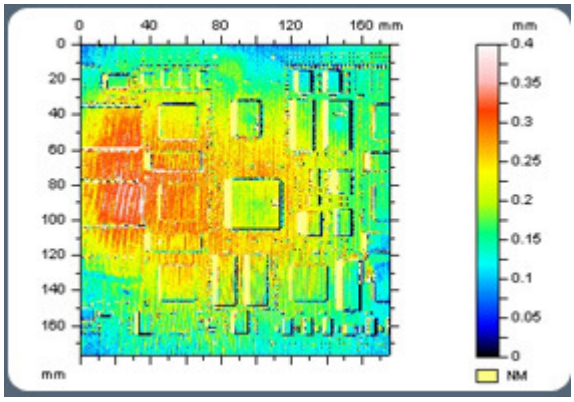


Topography of a 180×180mm assembly, at 220°C, acquired by TDM.

The topography of the PCB and all components is accessible in high resolution. Note that all height levels are correctly represented on an absolute scale, with a depth of view of 10mm.

Same topography as presented above, but with a height scale limited to 1.3mm. This scale is adapted to highlight the PCB warpage, whereas the topography of the components can no longer be assessed. Note that no specific masking of the components is necessary to obtain this view.





Visualization of the assembly deformation Δz(x,y) during cooling down from 220°C to 30°C, corresponding to the cooling down process after solder solidification. This image is obtained by subtraction, pixel by pixel, of the topography obtained at 220°C from the one obtained at final room temperature. A warp up of the central part of the assembly is observed during the cooling process, with a total amplitude of 300-400µm. The reliability of solder joints of components which are present in areas with strong deformation might be questionable. Note that this representation is obtained without any masking of the component, and that the components follow the deformation of the underlying PCB.