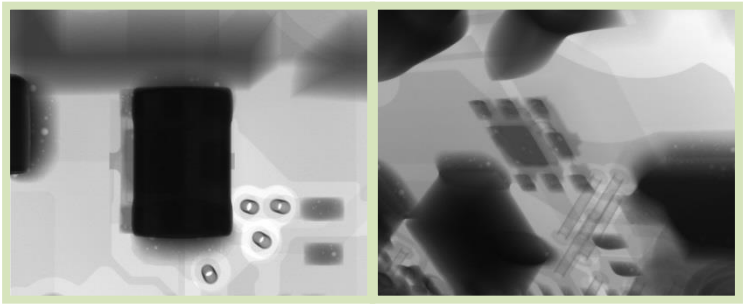
SILICON FOREST ELECTRONICS

Making a positive and profound impact.

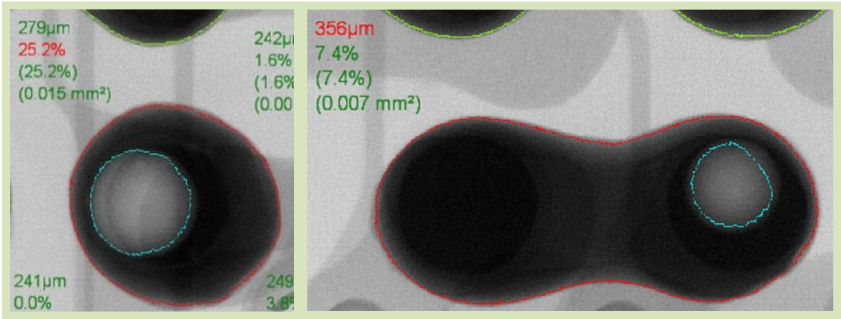
Process Engineering Notebook | November 2018 | 3D X-Ray… Nowhere to Hide

X-ray inspection in the electronics industry is a process that has been around for a long time, starting with simple 2D radiography. In recent years the capabilities of X-ray equipment has skyrocketed for electronics due to more and more complex assemblies, where 2D X-ray inspection is no longer feasible for certain components. That is why here at Silicon Forest Electronics we have made the investment towards a new 3D X-ray, the Dage Quadra 5. This piece of equipment puts our X-ray inspection in a whole new ball park as compared to our previous 2D X-ray machines. The Dage is closed tube X-ray with a maximum power of 20 watts, a maximum voltage of 160 kV and feature recognition of 0.35 µm. It gives better image quality, rotational viewing of the sample, solder joint voiding calculation, automated inspection routines, and failure analysis capabilities via laminography scanning.

A rotational capability in new X-ray equipment is often referred to as 2.5D. With the ever increasing lack of space on PCBAs, this rotational viewing gives many different possibilities when inspecting components. One example would be the ability to see around those pesky resistors and capacitors that are often placed directly opposite a BGA component. Our X-ray provides oblique viewing angles of up to 70° by rotating the detector and sample tray simultaneously; keeping the X-ray tube stationary. This also allows the region of interest to stay centered in the viewing screen while rotating. Components that were once hidden from inspection can hide no more.



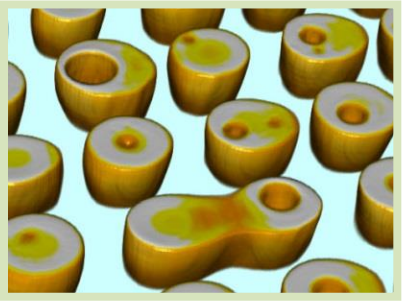
Component hidden by thick capacitor inspected using an oblique angle viewing.



Examples of failures found for bridging and excessive voiding.

With our new 3D X-ray we can automatically check whether or not a solder joint meets IPC requirements. In fact, now we probably know more than we would ever want to know about those solder joints. We now have the capabilities to automatically check the diameter, roundness, area, overall voiding percentage, and largest singular void for every BGA ball. These checks can be put within an automated inspection routine, which can be programmed to check specified components on an assembly. The inspection routine uses fiducial alignment, so after the routine is created it is as simple as setting the board in the same general area within the sample tray and running the routine. Once completed, it will output a handy report for easy viewing of all data found within the routine. Thresholds can be set that will flag the component for failure within the report if they are not met. The routine will likewise automatically check and fail for bridging and missing balls as well. These capabilities allow us to quickly and accurately inspect assemblies, while a giving us data for any future analysis if needed.

In addition to the radiography (2D or 2.5D) inspections mentioned above, our system includes laminography capabilities. Laminography is a scan that will take multiple images at a set angle around a specified location, and use those images to create a form of 3D reconstruction using many different 2D images layered together. These 2D images, often referred to as slices, can be used to step through each layer of a solder joint. This allows examination of the solder joint at its most critical areas, or the ability to see where a void within the solder joint volume is located. Using software these slices can be used to create a 3D reconstruction to give better visualization of the area in question. Our X-ray is capable of performing laminography scans at oblique angles between 20-60˚, while images can be taken every 0.5-10˚ around the target. Laminography is a feature that is very helpful in any failure analysis project where the point of failure is hidden from 2D X-ray inspection.



3D laminography reconstruction of the BGA balls shown in above calculation examples.

Qualification of our new 3D X-ray has been completed and it is currently being used for inspection on our production lines. As always, please don't hesitate to contact us for any questions or further information.

Thanks for reading!

Contributed by:
Colin Campbell | Process Engineer | Silicon Forest Electronics
colin.campbell@si-forest.com