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Failure Analysis of Printed Circuit Boards (PCB)

The electronics world depends on a Printed Circuit Board (PCB) to connect devices to systems. There are many assembly steps and materials involved during the assembly of the components on the PCB. All of which can result in electrical issues. There are many techniques that can be utilized to check for issues, defects, and contamination. Failure analysis, materials characterization, reliability testing, and critical dimensions measurements are used to characterize and understand potential problems with PCBs.

PCBs can range from being just a couple of layers to even more complex with 30+ layers. These layers are required to connect discrete devices such as resistors, capacitors, and fuses to the IC devices using solder balls, leads, and pillars. Failures can also occur during the curing process. The complexity of PCBs can result in a high number of potential failure areas.

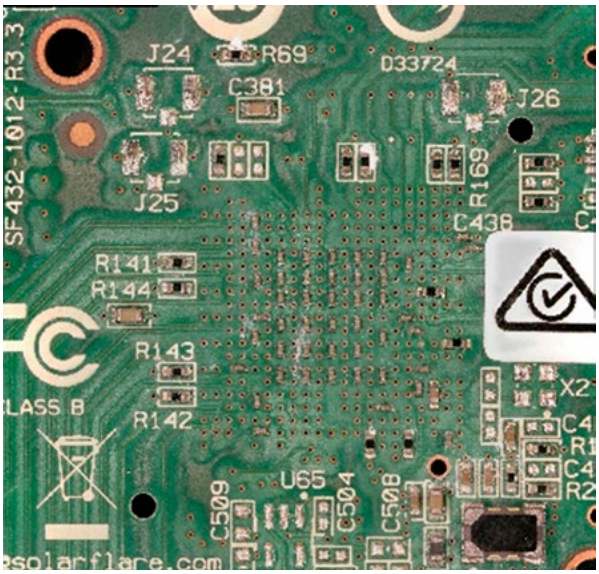

Figure 1. Optical microscopy inspection can zoom into an area to get an initial idea of the failure.

As shown in figure 2, x-ray imaging can be utilized to examine the PCB for stray solder or other materials inside the layers non-destructively. This can be used to zoom in on problem areas such as an examination of the solder balls and bumps.

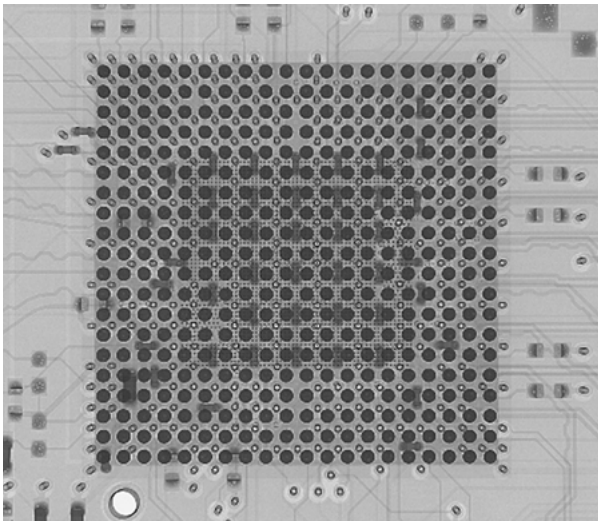

Figure 2. X-ray imaging

Cross sectioning of a device on the PCB can be useful to look at the solder attachment of the lead foot. The cross section allows examination by optical and Scanning Electron Microscopy (SEM). Note the voids in the solder shown in figure 3.

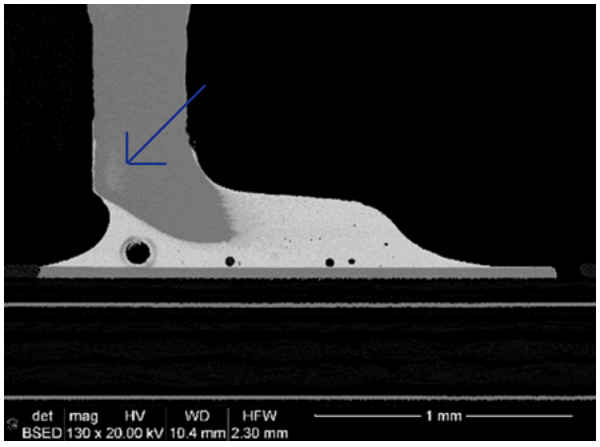

Figure 3. Void in solder.

Parallel lapping from the bottom of the PCB (P-lap) can be implemented so that a device is freed from the PCB. This process involves cutting out the device of interest from the area of the PCB, which then allows for the electrical inspection of each layer for shorts, leakages, and openings of the PCB. Polishing all the way has removed the device from the PCB. With this process, the device is still intact and ready for additional failure analysis and electrical testing (see figure 4).

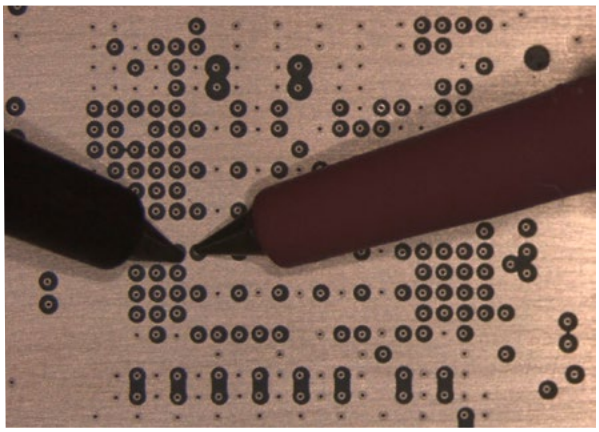

Figure 4. Failure analysis after Parallel Lapping.

Sometimes the PCB can fail due to warpage. Warpage Analysis allows for measurement of warpage and deformation of products that are subjected to thermal stresses. This analysis produces a 3D topographical profile (figure 5). Heights can be measured in a line scan (figure 6). This is a great tool to look for stress and pinch points at various temperatures.

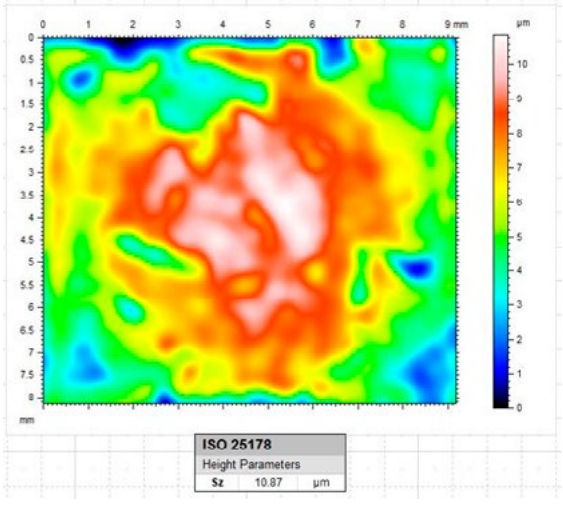

Figure 5. Topological map of a device.

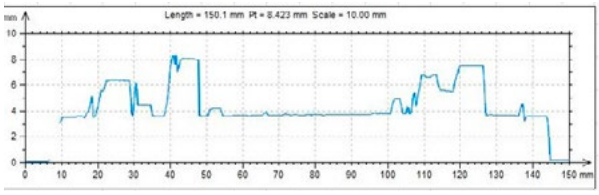

Figure 6. Line scan of device.

C-SAM can be used to examine PCBs and individual devices on the PCB. The technique picks up delamination and voids in the sample.

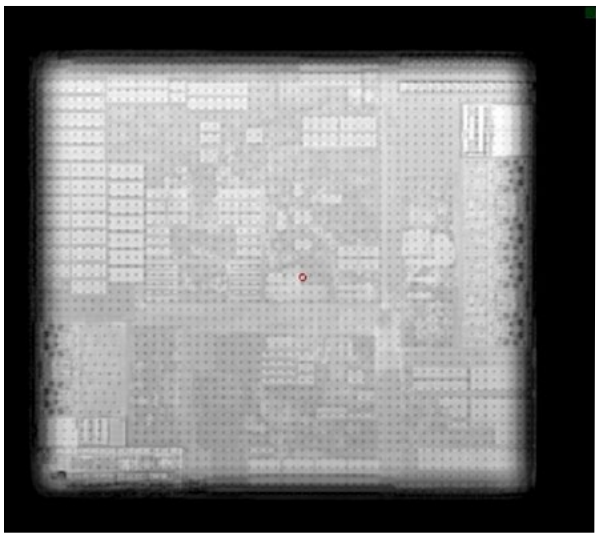

Figure 7. The Flip Chip device looking at the underfill.

EAG's team of failure analysis engineers can enable the understanding of PCB construction, assembly, and materials. With in-depth images and analyses, EAG is able to examine the root cause of failures, critical dimensions, and quality of assembly process. Our experts can assist in PCB improvement resulting in better yields and fewer issues in the field.

One Stop Shop

EAG has over 30 years supporting companies in the total product lifecycle from conception through volume production. An example is our testing services which offer 24/7 production, pilot, prototype test and the capability to rent our tools for onsite program.

Many of our clients are not aware that we can also manage the complete backend process where we receive a fabricated wafer ready for testing, perform electrical testing, return to assembly, and once

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