Process Doctor

Terry Munson

Activate That Flux!

Moisture absorbed by poorly activated flux residues coupled with other ionic residues can cause failures.

Flux residues are a common cause of product reliability concerns. When fluxes are left on boards and not fully activated, great reliability risk occurs. Flux residues come from wave soldering on the topside of the board, reflow soldering or rework and repair. Fluxes that are not fully activated are not necessarily detrimental on their own, but if left to absorb moisture and come in contact with another area of contamination, such as a component or housing, a corrosion cell can start.

The following case illustrates the problems that fluxes can cause when not fully activated. A client was experiencing field returns on a high reliability, high sensitivity fuel pump driver module. This client desired an investigation of two highly sensitive areas of circuitry on both new and field-returned assemblies to search for contamination problems.

This particular client used a no-clean assembly process with some selective soldering techniques around specific components. Due to the highly sensitive nature of this circuitry, it was advantageous to look individually at the components of interest, as well as their housings, through a localized extraction method. A C3 tool for localized extraction and ionic cleanliness testing was used to examine the client's two specific areas of concern within the circuitry. Localized samples were collected from four modules (two new, two field-returned) in the two sensitive areas and their housings for a total of 16 samples. Of these 16 samples, everything except for one of the components on the field-returned modules passed the C3 electrical test for cleanliness.

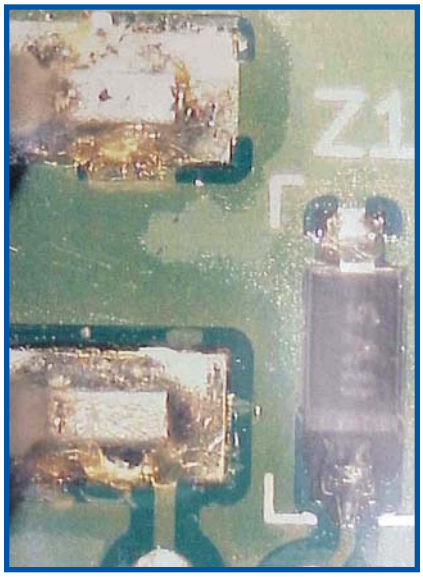

FIGURE 1: Area of heavy flux residue on the module.

Using the 16 samples, ion chromatography analysis was performed on the four modules. The analysis found high levels of chloride around one of the components of concern on both failed boards. All other samples were clean. Chloride levels on the unused boards and all housings fell within acceptable levels. C3 tests corroborated these results, giving the affected area on the field failure modules a "dirty" reading, while validating the same area on the unused boards as "clean."

The same component area showed high levels of weak organic acids on all modules examined. Weak organic acids, such as succinic or abeitic acid, are generally benign, but can prove detrimental if not fully activated, which permits them to absorb moisture. This proved to be the case with the failed modules. The WOAs absorbed moisture, which reacted with the chloride to cause a field failure. The chloride on the affected component would not have been so apt to cause a failure if the WOA flux residues had not absorbed moisture from the air. With the application of a current, the moisture and chloride created a corrosion cell.

One of the client's issues was incoming component cleanliness. The problem was magnified by not fully activating the flux used in assembly. Components should be monitored for cleanliness as-received.

This case is also an example of poorly activated weak organic acids becoming highly detrimental when combined with other ionic elements. The poorly activated flux residues were not a problem on their own, but caused a failure mechanism when they absorbed moisture, which reacted with chloride from the dirty components. When not fully activated, flux residues remain in a state that can absorb moisture and react with other ionic residues when a current is applied. This risk-prone state creates a critical need to make sure that flux residues are fully activated. ■

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