Process Doctor

组装程序教育

Clean It Up!

Incoming board and component cleanliness is crucial in building reliable product.

Dirty bare boards and components are some common culprits when ionic cleanliness is in question. Plating processes and tap water rinse cycles are known to introduce harmful ionic contaminants such as sulfate, chloride and methane sulfonic acid (MSA). If not properly neutralized through good cleaning procedures, they will carry through assembly to the final product, and if mixed with moisture and an applied voltage, the residues can create electromigration or electrical leakage failures.

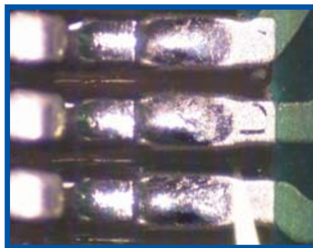

FIGURE 1: Ten-pin DIP area before electromigration test.

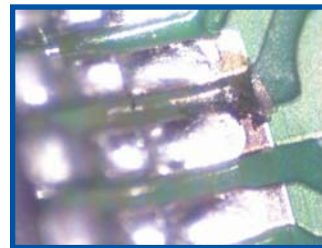

FIGURE 2: Ten-pin DIP area after electromigration test.

A manufacturer of sensors for an automotive applications saw units failing in a 10-pin DIP area after shipment but before installation into a vehicle. There was visible dendrite growth and a gooey residue at the power to ground leads of pins 8 and 9 on 10-pin DIP microprocessors in the failing area, which sees a constant 3V. These assemblies were built on immersion silver boards using a hydrochloric acid micro-etch prior to plating, and a tap water rinse. The assembly process included single-sided reflow with no-clean SnPb paste using a 0.006" stencil and a seven-zone reflow oven. A battery was then attached with a spot weld using no flux or cleaning. Units were then functionally assessed and readied for potting, which used a two-part silicone crosslinked elastomer injected into the housings with the assemblies in place. The potting compound cured for 15 minutes, then the units were transported to a drying area for 24 hours. The units were then assembled with a valve stem, functionally tested and readied for shipment.

To investigate this failure mechanism, Foresite examined two failing units and one working unit. We performed a full visual inspection and tested for shorts using a multimeter. On the failing units, we noted slimy coating areas in the failing 10-pin DIP areas at the lead interface. A visible dendrite was also seen between pins 8 and 9 on the DIP at the board surface. There was a heavy white residue present between most leads of the DIP, and there were measurable shorts between pins 7 and 8 and pins 8 and 9. There was also adhesion loss at the lead surfaces, but good cross-linking. We examined several other areas of the failing assemblies for reference, and found no evidence of visible residues or shorts. Looking at the good unit, we saw good adhesion of the DIP part to the board surface and good cross-linking.

We then conducted ion chromatography with standard and C3 localized extraction techniques to inspect the failing DIP area, reference areas, and incoming bare boards and components. High levels of chloride and sulfate were found on incoming bare boards (**Table 1**), probably due to the tap water rinse. We also found a heightened level of sulfate and MSA on the components, most likely attributable to a plating process. Finally, we found high levels of chloride, sulfate, MSA and weak organic acids in the failing 10-pin DIP lead areas of the final assemblies, indicating that incoming cleanliness issues carried through the assembly process. The WOA levels were due to heavy flux deposition that was not solublized effectively for this SMT process.

For remediation, we recommended cleaning the incoming bare boards through a saponified inline wash, and gas plasma batch cleaning of incoming components. With these protocols in place, the customer was able to effectively lower the contamination levels. The customer also monitored flux deposition and is ensuring all solvents are fully volatilized so that the only residue left on the board is benign and non-moisture-absorbing. ■

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Table 1. Chloride and Sulfate Levels on Incoming PWBs

	-------------- Ion Chromatography Data ----------------				----- C3 Spot Testing -----	
Sample Description	Cl-	SO4-	WOA	MSA	Results	Time (in sec.)
Failing Unit #1 - 10 pin DIP lead area	10.23	7.19	49.35	1.2	Dirty	22
Failing Unit #2 - 10 pin DIP lead area	9.36	6.94	37.12	1.5	Dirty	19
Good Working Unit - 10 pin DIP area	3.56	2.31	19.25	0.3	Clean	89
Incoming Bare Board	6.8	9.12	0	0	Dirty	37
Cleaned Bare Board (same unit)	0.87	0.54	0	0	Clean	180
Incoming 10 pin DIP microprocessor component	0.59	5.29	0	5.3	Dirty	42
Gas plasma cleaned 10 pin DIP component	0.09	0.14	0	0.1	Clean	180