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HOW TO DEAL WITH PROBLEM AREAS FOR SELECTIVE CONFORMAL COATING

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ABSTRACT
Today's electronics are more and more used in environments that are not friendly to electronic circuits. The fast growth of the use of outdoor electronic applications results in an increased volume of electronic circuits that need to be coated. Often humidity and pollution problems only show after the first introduction on the market. Unfortunately during the design of the PCB no attention has been given to the coat ability of the circuit boards resulting in problem areas for selective conformal coating.

INTRODUCTION
When going into coating of electronics, you can be confronted with some problem areas that need special attention.

These can be split up into three areas:
- PCB is not designed for coating
- Fine pitch connectors
- Open connectors

Most of the coating materials and especially those that are solvent based, are low in viscosity. Meaning that in most cases they are almost as liquid like water. The flow of the material in this case becomes major importance and needs special attention.

Capillary action, or capillarity, refers to certain phenomena associated with the behaviour of liquids in thin tubes or in porous materials. Liquids, such as water, will tend to move "up-hill" (against the force of gravity) which does not normally occur in large containers. The interface between liquids, or a liquid and a gas, can form a meniscus or crescent shape.
The capillary flow can cause the material to flow in directions that don't allow any coating as we will try to explain in the following examples.

PCB IS NOT DESIGNED FOR COATING
In many cases (if not all) the design of a PCB is not based on the fact that in the end conformal coating needs to be applied. What you than typically find are situations in which components that require coating are placed at the edge of an area that can absolutely not be coated. Test points and grounding areas that are surrounded by components are such an example. (Figure 1 and 2)

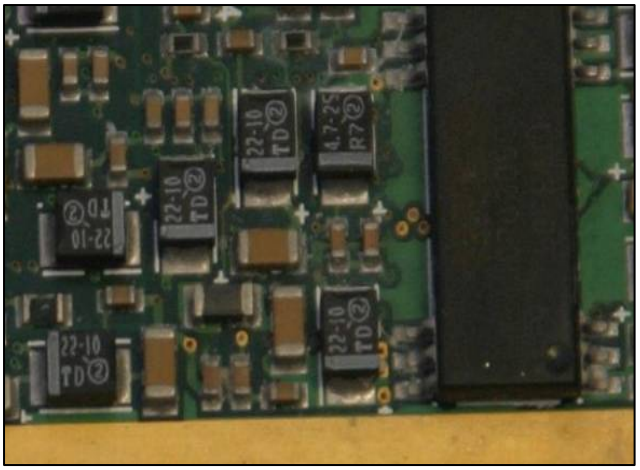

Figure 1. Components against a ground edge

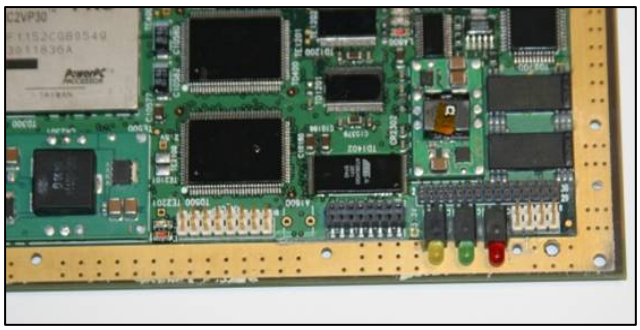

Figure 2. Components against a ground edge

Sometimes components that need to be coated are covered by other components and you need to reach underneath. (Figure 3 and 4)

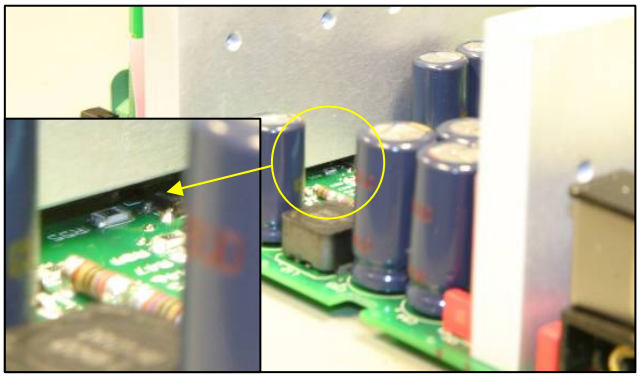

Figure 3. Components underneath cooling block

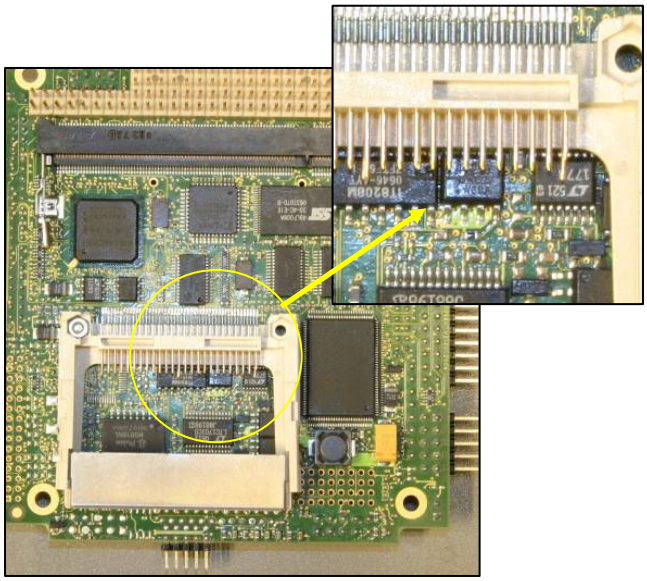

Figure 4. Components underneath connector pins

FINE PITCH CONNECTORS

Fine pitch connectors can very easily soak up coating material. This is caused by the capillary flow of the low viscosity coating materials. During coating the material is nicely applied on the solder joints of these fine pitch connectors, but because of the capillary flow the coating material runs inside the connector polluting the contacts of the connector that should stay clear of coating. (Figure 5 and 6)

Figure 5. Fine pitch DRR connector

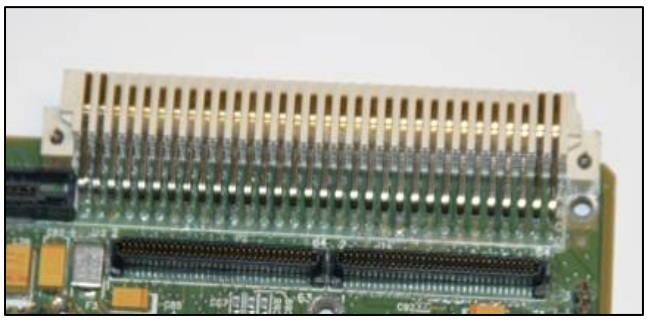

Figure 6. Fine pitch edge card connector

OPEN CONNECTORS

A third problem area is the open connector. The open connector has the body of the connector free of the board. The gap between the board and the body of the connector leaves space for the capillary flow of the low viscosity material to easily flow inside the connector and pollute the contacts. Below you will see some typical examples of such connectors. (Figure 7, 8, 9 and 10)

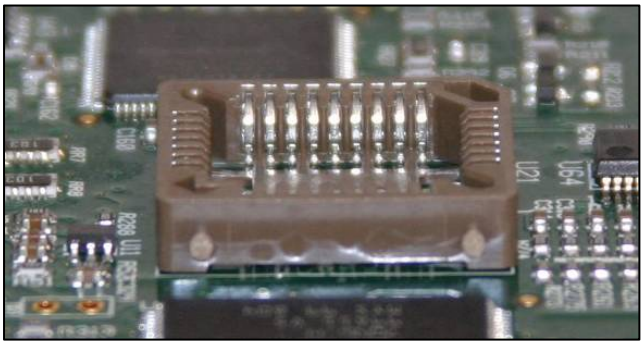

Figure 7. Open Plcc

Figure 8. Open connector

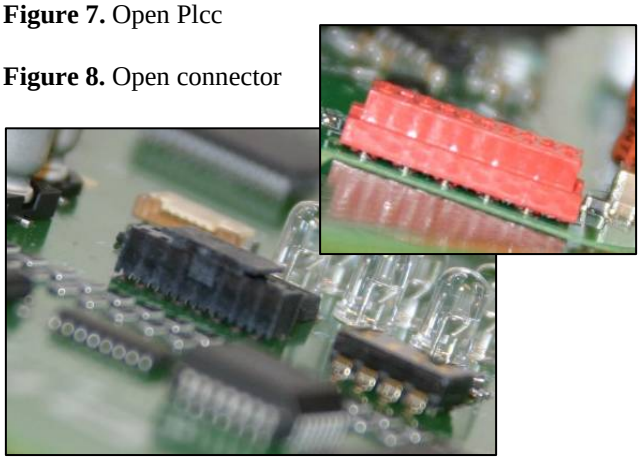

Figure 9. Open connector before coating

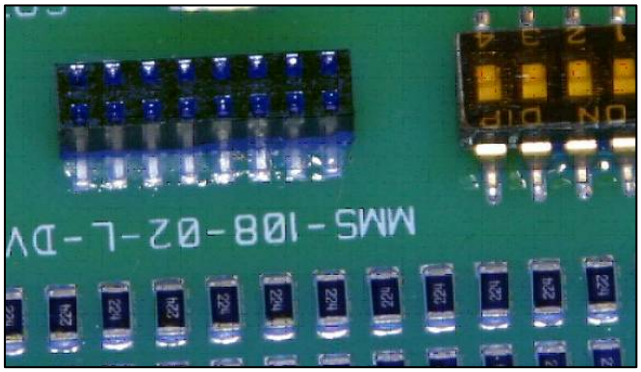

Figure 10. Open connector after coating

Ways To Overcome These Issues

There is always a solution to any problem. Therefore these issues can be tackled using right solution.

PCB IS NOT DESIGNED FOR COATING

The grounding areas can be protected by automatic applying a masking material. The disadvantage of this is that after coating this material still needs to be peeled off. Another solution can be the use of a gel. A gel is a conformal coating material with a higher solid content. This way the viscosity becomes so high that it can act as a

dam. Applying a gel version of the coating material against the edge of the grounding areas and over the components that are placed against this edge will stop the normal conformal coating material from flowing on to the grounding area. Such gel can be applied automatically by a coating machine that can handle more than one head and more than one fluid. For the components that are situated underneath other components, you need a valve that can tilt and rotate in any possible direction. It is important that not only 90, 180, 270 and 360 degree can be reached. The full 360 degrees need to be programmable in order to get enough flexibility for these difficult locations (no dead angles are allowed). Through this tilt and on a board that seem to be impossible. There are machines on the market that can handle up to 4 different valves and up to 4 different materials.

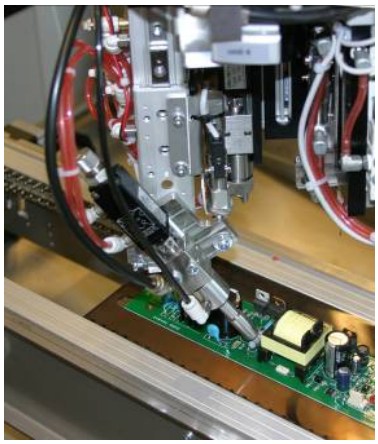

Figure 11. Rotating coating nozzle

FINE PITCH CONNECTORS

Applying a masking material on the solder joints of a fine pitch connector of course is not a solution because than the contacts of the connector will not be coated. Using a pencil and carefully manually applying the coating material is a way to overcome this issue but it is a risky job because the slightest mistake will result in failure of the connector. However automatic applying a gel version of the selected coating material prevents the material to capillary flow inside the connector. It also creates a dam to prevent lower viscosity material to flow inside. Applying coating material by means of a machine prevents any operator failures to occur and provides better repeatability (quality).

OPEN CONNECTORS

Also for open connectors or sockets you cannot use the masking material, but again in this case the gel version of the selected coating material provides a very easy to apply solution which can easily be provided by multiple head machines.

Gel

About 6 years ago we started to see the first attempts of a gel as protective dam during a conformal coating job. At that time the quality of the product was bad and only one manufacture had it available. Due to the huge advantages of the use of such a gel most conformal coating material manufacturers now have a gel type conformal coating available. Getting the gel in a way that it can easily be processed was difficult. Often it came in a can with lots of air bubbles and it was up to the customer to bring it to the right viscosity. Only recently some of them start to deliver it in syringes ready to use on conformal coating machines.

Figure 12. Modular 5 axis, 4 valve, 4 materials selective conformal coating machine

Equipment

Today's complex boards need advanced equipment to apply conformal coating materials. The machines from the past with only one or two heads and limited rotation will not be grown up against the tough coating jobs of today. Today's market is asking for machines with at least 3 heads (spray valve, needle valve with low viscosity and needle valve with gel). Some even want a 4th valve for a wide beam valve or a component stabilising material.

Of course options like teach camera's flow control, fiducial alignment, empty detection, and remote diagnostics improve the final quality of the overall coating process but if you can do only a part of your board automated due to lack of enough valves in your machine all these fine options do not lead to a perfect board. There are machines on that market that offer them all.

ACKNOWLEDGEMENTS

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