Development of an Automation Process for a New Conformal Coating

Degree programme: BSc in Industrial Engineering and Management Science | Specialisation: Industrial Engineering
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Conformal coating is applied to printed circuit boards (PCBs) for protection against harsh environments. E+H Flowtec AG is currently developing a new solvent-free coating for improved quality while it poses less risks for health and environment. Hence, a new coating process is being evaluated for fully automated production lines; with the new UV-light curable material.

Introduction and Objective of the Thesis

The new conformal coating is solvent-free, resulting in a viscosity ten times higher than its predecessor. Due to this change in material processability, a new process must be evaluated to ensure homogeneous application of the coating on different PCB structures. This evaluation includes the use of a new spraying nozzle for which there is limited empirical information available in the field of conformal coatings. In this thesis, the coating parameters are thoroughly studied to achieve enhanced coating quality compared to the previous coating process. This is one of the main drivers of the project, along with the evaluation of the more ecological coating material.

Methods

An iterative “build-measure-learn” approach was employed to test the coating machine, spraying system, and coating material. Design of experiments supported this iterative process by utilizing a statistical and analytical approach to evaluate the most important process parameters that influence the coating quality. With the optimized parameters a versatile PCB suitable for process and material validation was used to test the coating quality on various electronic components. All tests were conducted using an experimental setup consisting of a coating machine and a UV curing unit at Endress+Hauser Flowtec AG in Reinach.

Results

The experiments proved that it is indeed possible to coat a PCB with a minimal thickness of 30 µm (refer to Figure 2), providing two-dimensional protection to the PCB in all required areas. Moreover, the coverage in three dimensions was improved compared to the current coating quality. Out of the nine process parameters, five were found to significantly influence the coating outcome: Dispensing speed, movement speed, distance of application, line spacing and atomizing pressure. However, not all parameters have the same level of significance with regards to the outcome. Additionally, apart from the parameters, the coating quality is also influenced by the specific coating and routing program, which must be carefully implemented for each type of PCB.

Recommendations

It is suggested to use the process parameters in their respective process windows as they were evaluated in this study. These parameters yield a stable layer thickness with good contour sharpness and coverage for all electronic components used. Even though the coating machine of the experimental setup was able to enhance the coverage in three dimensions, it is thought that a more sophisticated machine could improve the coating quality even further.

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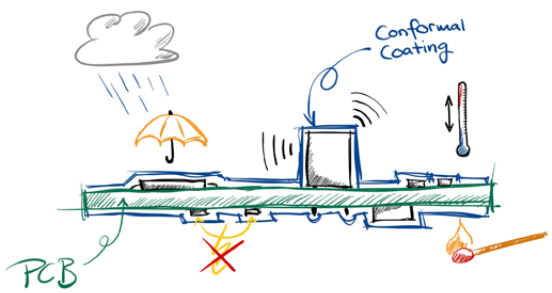

Figure 1: Conceptual drawing of conformal coating illustrating PCB’s resilience under different harsh conditions.

Figure 2: The PCB used for evaluating the process is conformal coated with the new material according to the coverage plan.