

Optimization of reflow soldering process for BGA packages by artificial neural network

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Abstract

Purpose - This investigation applied a hybrid method combining a trained artificial neural network (ANN) and the Sequential Quadratic Programming (SQP) method to determine an optimal parameter setting for a reflow soldering process of ball grid array (BGA) packages in printed circuit boards (PCBs).

Design/methodology/approach - Nine experiments based on an orthogonal array table with three controlled inputs and average shear forces of solder spheres as a quality target were utilized to train the ANN and then the SQP method was implemented to search for an optimal setting of parameters.

Findings - The ANN can be utilized successfully to predict the shear force under different reflow soldering conditions after being properly trained and the identified optimal parameter setting are capable of striking the balance between the average shear forces and the manufacturing cycle time.

Practical implications - The reflow time and the peak temperature were found to be the most significant factors for the reflow process via analysis of variance (ANOVA).

Originality/value - This study provided an algorithm integrating a black-box modeling approach (i.e., the ANN predictive model) with the SQP method to resolve an optimization problem. This algorithm offered an effective and systematic way to identify an optimal setting of the reflow soldering process. Hence, the efficiency of designing the optimal parameters was greatly improved.

Keyword : BGA, Reflow profiling, Artificial neural network, Optimization, ANOVA