Thermal analysis of a high power LED multi-chip package module

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Abstract

Abstract— Some difficulties occur by using multiple high-power LEDs in products to predict the temperature distribution because of the interaction of heat generated by each single-chip LED in the same module. To determine the heat dissipation of a multi-chip LED module, solid physical models for both single-chip and multi-chip LEDs with cooling fins were constructed. Simulation of the temperature distribution under natural convection was conducted using numerical analysis and by introducing formulas to estimate change in heat resistance. In addition to elucidating the heat dissipation of multi-chip LED modules, this study attempts to identify the major factors affecting the temperature distributions of LEDs.

Simulation results from the finite element program indicate that expressing the temperature distribution of a single LED chip using a spherical coordinate system is appropriate. The temperature curve of a copper plate away from the chip is nonlinear since the distribution curve declines dramatically and is no longer linear. The temperature of a multi-chip LED module is slightly less than that of linear superposition. A comparison of the estimated value for a multi-chip LED with the simulation result confirms the practicability and accuracy of the proposed thermal resistance formula in this work. This study provides reference data for estimating of thermal resistance in a multi-chip module.