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Optimizing the Performance of Thermoelectric for Cooling Computer Chips Using Different Types of Electrical Pulses

Authors : Saleh Alshehri

Abstract : Thermoelectric technology is currently being used in many industrial applications for cooling, heating and generating electricity. This research mainly focuses on using thermoelectric to cool down high-speed computer chips at different operating conditions. A previously developed and validated three-dimensional model for optimizing and assessing the performance of cascaded thermoelectric and non-cascaded thermoelectric is used in this study to investigate the possibility of decreasing the hotspot temperature of computer chip. Additionally, a test assembly is built and tested at steady-state and transient conditions. The obtained optimum thermoelectric current at steady-state condition is used to conduct a number of pulsed tests (i.e. transient tests) with different shapes to cool the computer chips hotspots. The results of the steady-state tests showed that at hotspot heat rate of 15.58 W (5.97 W/cm²), using thermoelectric current of 4.5 A has resulted in decreasing the hotspot temperature at open circuit condition (89.3 °C) by 50.1 °C. Maximum and minimum hotspot temperatures have been affected by ON and OFF duration of the electrical current pulse. Maximum hotspot temperature was resulted by longer OFF pulse period. In addition, longer ON pulse period has generated the minimum hotspot temperature.

Keywords : thermoelectric generator, TEG, thermoelectric cooler, TEC, chip hotspots, electronic cooling
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