The Electromagnetic Effect of Different Sources on Pin-fin Heatsinks

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Due to the geometric features of heatsinks, the heatsinks may have adverse effects on electromagnetic radiation as the operating frequency of electronic devices increases to the gigahertz range. Different electromagnetic sources are often used in various practical applications. Thus the influence of electromagnetic interference (EMI) from different sources on heatsinks needs to be considered.

A finite difference time domain (FDTD) technique is used to investigate to the EM effect of different sources on pin-fin heatsinks. Seven fin configurations are investigated; namely, one without any fin, a metal block fin, and five pin fins with pin numbers of 2×2, 3×3, 4×4, 5×5, 6×6 respectively. Two types of excitation sources are studied, including a smooth compact pulse and a modulated Gaussian pulse with frequencies ranging from 0.8 GHz to 10 GHz.

The computational results show that at the low frequency of 0.8 GHz, for both types of excitation sources, only the heatsink with 6×6 pins exhibits obvious resonant phenomenon in electric fields. The difference lies in the extent of resonant levels. The resonant effect is larger for the case with modulated pulse source. At 4 GHz, the resonant behavior occurs at all fin configurations except the 3×3 pin-fin heatsink, irrespective of the difference in excitation sources. At this operating frequency, the resonant points and radiated magnitudes caused by the heatsinks for two sources are similar. At 10 GHz, multiple resonant points are observed. Furthermore, the resonant points move toward a distribution of high frequencies for the case of the smooth compact pulse excitation source. In contrast, the spectrum distribution resulted from the modulated Gaussian pulse source is concentrated mostly at discrete frequencies. In other words, the response due to different excitation source is insignificant at lower operation frequencies. But at higher operation frequencies, the difference in excitation sources can be significant and should be careful interpreted.