ABSTRACT

As a result of rapid growth in semi conductor technology, there is a continuous increase of the system power but shrinkage of the size. High heat flux of electronic devices, e.g. projector, LED, high power chip, etc., require efficient cooling methods for heat dissipation in a limited region. It means maintaining a small heat source at an acceptable temperature. This resulted in inevitable challenges in the field of thermal management of electronics to maintain the desirable operating temperature under natural and forced convection. This study present the determination of the optimum values of the design parameters for the radial heat sink under natural and forced convection by using the Taguchi method. The experimental investigation for the radial heat sink consists of the circular base with rectangular fins arranged in radial direction. The effect of design parameters of the heat sink such as number of fins, length of the fins, height of the fins and the heat flux on the Nusselt number and thermal resistance under natural convection and for number of fins, length of the fins, height of the fins, Reynolds number and the heat input on the Nusselt number under forced convection are investigated. Taguchi method is used for design of experiment for natural and forced convection. An L_9 and L_{27} orthogonal arrays are chosen for experimental plan. The heat input range for natural convection is quit lower as compared to forced convection. The experiments are performed and the data collected is analyzed using analysis of variance (ANNOVA) to observe the effect of various parameters on the performance of the radial heat sink. The present work provides the detailed discussion on the effect of various parameters on the thermal performance of radial heat sink. The uncertainties of different variables are also carried out. The performance of the radial heat sink is strongly depends on the flow pattern and the thermal boundary layer formed at the surface of the fins of the heat sink. For natural convection the general flow pattern is that of a chimney i.e., cooler air entering from outside is heated as it passes between the fins, and then rises from the inner region of the heat sink. For natural convection the experimental results are also compared with the numerical analysis results using FLUENT CFD software. The numerical results are very much comparable with the experimental result, so the validity of numerical results is done and at the same time the bench marking of both the experimental and numerical procedure is carried out for natural convection. A new correlation was proposed on the determination of average Nusselt numbers for the range $7000 \leq Ra \leq 13000$, $1.5 \leq H/L \leq 3.35$, $24 \leq n \leq 32$ for air under natural convection.