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"A REVIEW ON DESIGN AND ANALYSIS OF HEAT SINK IN CPU"

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ABSTRACT

Heat sinks are an extremely useful component that helps to lower maximum temperature of electronic devices resulting in an improvement in overall thermal efficiency and performance. Fins form an integral part of sinks. Geometry of fins plays a vital role in heat transfer from sinks. Researchers have studied effects of thermodynamic properties like heat input and base to ambient temperature difference. After experiments some investigators have also developed correlations .While optimising heat sink geometry aspect ratio needs to be also considered which has an important effect on heat transfer. Effect of very low aspect ratio needs to be determined.

Key Words: *Aspect ratio, Fins, Heat sinks*

I. INTRODUCTION

All electronic equipment relies on the flow of and control of electrical current to perform a variety of functions. Whenever electrical current flows through a resistive element, the heat is generated. Regarding the appropriate operation of the electronics, heat dissipation is one of the most critical aspects to be considered when designing an electronic box. Heat generation is an irreversible process and heat must be removed in order to maintain the continuous operation. With various degrees of sensitivity, the reliability and the performance of all electronic devices are temperature dependent. Generally the lower the temperature and the change of temperature with respect to time, the better they are. Pure conduction, natural convection or radiation cool the components to some extend whereas today's electronic devices need more powerful and complicated systems to cope with heat. Therefore new heat sinks with larger extended surfaces highly conductive materials and more coolant flow are keys to reduce the hot spots.

The performance criterion of heat sinks is the thermal resistance, which is expressed as the temperature difference between the electronic components and ambient per watts of heat load. It is expressed with units K/W.

Today's electronic chips dissipate approximately 70 W maximum whereas this number will be multiples in the nearfuture. The temperature differences from the heat sink surface to the ambient range from 10 ºC to 35 ºC according to the heat removal capability of the installed heat sink.

II. LITERATURE REVIEW

C.J. Kobus, T. Oshio [1] investigate the effect of thermal radiation on the thermal performance of heat sink having pin fin array by theoretical and experimental approach. In order to investigate the ability of influence of thermal radiation

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on the thermal performance a new coefficient effective radiation heat transfer is collaborated. For validation of theoretical model it is matched with experimental data.

Hung-Yi Li and Chen [2] have done their investigation to find the thermal performance of plate-fin heat sinks. The plate pin heat sinks are kept under the confined impinging jet conditions. The altered parameters and there ranges are taken as for the study Reynolds number (Re) 5000–25000. The width (W/L) 0.08125–0.15625, the impingement distance (Y/D) 4–28and the height (H/L) 0.375–0.625 was taken and the optimum result was presented.

Li et al. [3] done there investigation on plate-fin heat sinks by numerically and experimental. Impingement cooling is used by amending, the Reynolds number (Re), the impingement distance(Y/D), and the fin dimensions. The results appearance that heat transfer is enhance by the heat sink with increasing the impinging Reynolds number.

S.S. Sane et al. [4] made there comparison and establish a match between experimental result and CFD software result for Notched fin array. They used notched fin array for single chimney flow pattern. Notched fin array shows the enhancement of more than 20 %. And the heat transfer coefficient is found in the range of 5%.

G. Hetsroni et al. [5] investigate experimentally, Natural convection heat transfer in metal foam strips with two porosities. Image processing of the thermal maps was used to evaluation of non-equilibrium temperature distribution for surface along with inner area of the metal foam. Augmentation in heat transfer at natural convection was found 18–20 times with respect to the flat plate.

H. R Goshayeshi, F. Ampofo[6] conduct numerical studies on vertical fins, attached with the surface. Natural convective heat transfer find out from heated plane which is kept into air with horizontal and vertical surface. Results show that vertical plate with dimensionless form delivers best performance for the natural cooling.

Yang and Peng [7] studied the thermal performances of the heat sink with non-uniform fin width. The investigation is carried out to know the effects of the fin shape of the heat sink on the thermal performance. The range for different parameters reported as Re. number (Re) with 5000–25000 and fin height (H) was taken as 35, 40 and 45 mm.

Burak and Hafit [8] developed expression for prediction of the optimal fin spacing for vertical rectangular fins with rectangular base. The different parameters and there range was taken as fin spacing 2.85- 85.5 mm, fin length 100- 500 mm . Base-to-ambient temperature difference 14- 162°C and Fin height as 5- 90 mm. Fin thickness 1 - 19 mm, and width of rectangular base plate 180 - 250 mm. The correlation for predicted on the basis of experimental data.

Li and Chao [9] investigate the performance of plate-fin heat sinks with cross flow. The effect of different parameters like the fin width, fin height, Re. number of cooling air on the thermal resistance and the pressure drop of heat sinks were analyzed.

Ganguli et al. [10] studied the variation in the heat transfer coefficient through natural convection for tall slender vertical geometries. The various parameters are like height with ranging 100-1000 mm, gap widths 5- 84.7 mm, temperature differences 5 - 90 K, and a correlation for appraisal of Nu has been proposed by the authors.

Naidu et al.[11] investigates by both experimentally and theoretically to find the outcome of inclination of the base of the fin array on heat transfer rate. Five different inclinations like 00, 300, 450, 600, and 900was taken. A numerical model is also developed by authors taking an enclosure by two adjacent vertical fins and with a horizontal base.

Sableet al. 2010 investigate the natural convection of a vertical heated plate with a multiple v- type fins having ambient air surrounding. The mica gladded Nichrome element is inserted between two base plates. V-type fin array design performs better than rectangular vertical fin array and V-fin array that between the three different fin array configurations on vertical heated plate with bottom spacing design.

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Mahdi Fahiminia et al. [13] conduct an experiment to investigate the effects of micro fin height and spacing on heat transfer coefficient for a horizontally mounted heat sink under steady state natural convection conditions, fin height ranging from 0.25-1.0 mm and fin spacing from 0.5 to 1.0 mm was taken. Computational Fluid Dynamic (CFD) modelling of laminar natural convection heat transfer was also conceded out for a horizontal flat plate.

Cheng-Hung al. [14] develops a three-dimensional heat sink design to estimate the optimum design variables. Levenberg–Marquardt Method (LMM) was used and commercial code CFD-ACE+ was developed. Temperature distributions are dignified by using thermal camera for the optimal heat sink modules and results are compared with the numerical solutions to validate the design.

Cheng-Hung et al. [15] examine a three-dimensional heat sink module design to find out the optimum design variables. Levenberg–Marquardt Method (LMM) was employed and commercial code CFD-ACE+ was developed. Finally, temperature distributions for the optimal heat sink modules are measured using thermal camera and compared with the numerical solutions to justify the validity of the present design.

Ayla DOGA Net al. [16] perform numerical investigation to find out the natural convection heat transfer from an annular fin on a horizontal cylinder. Effects of geometric parameters like: fin diameter, fin spacing and base-to-ambient temperature difference are studied. Finally, a correlation for the optimum fin spacing depending on Rayleigh number and fin diameter was presented.

Cheng and Jon [17] investigationfor dynamic heat dispersion the pin-fin heat sinks. 3-D model that contains the heat transfer from the heat source to fins and the forced convective heat transfer by a horizontal air-cooling fan is presented. The studied was performed to minimize entropy generation rate.

Farhad et al. [18] solve .Navier–Stokes equations and RNG based k- turbulent model for array of solid and perforated fins mounted in vertical flat plates used to predict turbulent flow parameters. Flow and heat transfer features are presented for Re. no. from 2×104 - 3.9 × 104.Prandtl numbers was taken as 0.71. Numerical simulation is validated by compare with experimental results.

Saedodin and Sadeghi [19]conducted their investigation to know the performance of porous and solid fins for natural convection kept in natural environment. Energy balance along with Darcy’s model was employed to convey the equation. This study is based on long fin tip. It is found that the heat transfer rate from porous fin could exceed that of a solid fin.

S.G. Taji et al. [20] heated horizontal rectangular fin array (HRFA) under natural and assisting mode of mixed convection is presented. The average heat transfer coefficient has increased up to 69.46% at cost of very small energy input (0.3–0.65 W).. An empirical equation has been developed to correlate the average Nusselt number(Nu) as a function of Re, Gr and S/H within uncertainty.

SUBHAS. L. [21] The present work investigates the numerical simulation of thermal analysis of mixed convection air flow in a CPU Cabinet. The simulation is focused on the non-uniformly heated mother board temperature distribution. In the present work three cases have been studied, 1) Placing the CPU in vertical position, 2) Placing the CPU in horizontal position and 3) Providing exhaust fan on top. The work also includes studies of effectiveness of different inlets provided. The temperature distribution of the components and streamlines were investigated in order to get a clear picture of which case is more effective for cooling of the mother board. The simulation was carried out using a standard commercial CFD code-ANSYS-Fluent. It is found that horizontal position results in reduction of motherboard average temperature of 0.1 ^{0}C as compared to vertical position. It is also observed that bottom opening has very less effect on motherboard temperature.

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Younghwan and Kim [22] investigate analytically thermal performance of optimized plate-fin and pin-fin heat sinks with a vertically oriented base plate. A new correlation of the heat transfer coefficient is proposed and validated experimentally to optimize pin-fin heat sinks.

Prakash.T [23] This paper uses CFD to identify a cooling solution for a desktop computer. In this modern world speed determines everything especially desktop PC, CPU have been popular. The computer revolution is growing rapidly in almost every field. CPU is the electronic components, which produces a lot of heat that reduces the performance. In this study the forced convection cooling of heat sinks mounted on CPU are investigated. The design is based on total chassis power dissipation. This represents significant power dissipation for the chassis components (Main processor chip, other chipsets North bridge heat sink and South bridge heat sink) the main processing chip has fin attachments (heat sink) over it for heat dissipation.

Nilesh Khamkar el.al [24] ,The ever rising transistor densities and switching speeds in microprocessors have been accompanied a dramatic increase in the system heat flux and power dissipation. In this context the rising IC ensities combined with even more stringent performance and reliability requirement have made thermal management issues ever more prominent in the design of sophisticated microelectronic systems. So in order to achieve a high degree power dissipation extruded heat sinks, a number of research works have been done in last two decades.
It is observed that components of modern portable electronic devices with increasing heat loads with decrease in the space available for heat dissipation. The increasing heat load of the device needs to be removed for maintaining the efficient performance of the device. The exponential increase in thermal load in air cooling devices requires the thermal management system to be optimized to attain the highest performance in the given space. In the present paper a review report on comprehensive description for thermal conditions for cooling purpose within the heat sink for electronic devices has been summarized.

Ibrahim Mjallal [25] As the temperature of electronic devices increases, their failure rate increases. That is why electrical devices should be cooled. One of the promising cooling techniques is using Phase Change Materials (PCMs). A new passive temperature management technique, that involves the direct placement of PCMs on the chip, has been explored and developed. PCMs are potential temperature regulators that can store thermal energy and release it during melting and freezing respectively. PCM-based heat sinks can efficiently store the heat dissipated from the electronic components to delay the peak temperature of the electronic devices as much as possible and then release the stored energy during the off period. This paper compares the temperature distribution on a heat sink with and without PCM with different magnitudes of heat flux.

III. SUMMARY

Researchers have found that rectangular plate fin heat sinks are easy to manufacture. Heat transfer rate from rectangular plate heat sinks in vertical orientation is more as compared to horizontal one. Heat transfer rate from plate heat sinks depends on base-to-ambient temperature difference as well as fin geometry. Geometric parameters like fin length, fin height, thickness play a significant role on convective heat transfer. It is observed that with an increase in fin height, fin length and base-to-ambient temperature difference heat transfer rate increases proportionately. It is also found that optimum fin spacing depends on above mentioned parameters. Investigators have come to conclusion that optimum fin thickness depends on height, solid conductivity and conductivity of the surrounding fluid but is independent of Rayleigh number, fluid viscosity and length. Optimum fin spacing though differs for a difference in fin length and fin height this difference is not significant. It is proposed to investigate combined effect of low aspect ratio, variation in height and length as well as heat input on convective heat transfer and ultimately optimum fin spacing is to be achieved. Simultaneusly flow pattern of air on plate surfaces in various positions is to be studied.

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