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THOMSON REUTERS
[Avishek et al., 5(10), Oct 2020]

ISSN : 2455-9679
Impact Factor : 3.340

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IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"A REVIEW ON CPU HEAT SINK THERMAL ANALYSIS"

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ABSTRACT

In today's high-tech world, chips inside electronic gadgets are getting thinner with more processing power, and hence generating higher amounts of heat energy in a smaller volume. The maximum allowable operating temperature of CPU chip is around 70°C (343K) and its reliability decreases by 10% for every 2°C increase in temperature. The challenges faced by engineers are to effectively cool the electronics system without compromising on power consumption, space, weight, noise level and cost efficiency. Bearing in mind the A performance analysis has presented on heat sinks of the same model in this project , namely a graphite metal heat sink and aluminum heat sink. In the same conditions, the temperature distribution, pressure and velocity fields of the aluminum heat sink were analyzed. Besides, the temperature distribution and thermal resistance of these heat sinks were compared and analyzed with the graphite metal heat sink.

Key Words: *CPU, heat sink, aluminum, pressure, velocity.*

I. Introduction

The warmth move through the warmth sinks present in stream channel can be expanded by utilizing change in uninvolved surfaces, for example, broadened surfaces with geometrical alterations. These procedures are having wide application, for example, cooling turbine aerofoil, electronic cooling frameworks, biomedical instruments, and warmth exchangers. The pin balance innovation is broadly utilized in numerous applications, for example, PC mother board heat sink over chip.The setup of gainful cooling frameworks is crucial for strong execution of high force thickness devices. Different frustration frameworks in electronic contraptions, for instance, between metallic advancement, metal development, and void course of action, are related to warm effects. Truth is delineated for, the pace of such disappointments about sets with each 10°C augmentation over the working . temperature (80°C) of high force equipment [1]. Other than the damage that excess thermally can achieve, it constructs the advancement of free electrons within semiconductors, making a development in sign disturbance [2]. In this manner, devices warm organization is of basic hugeness as is reflected in the business area. Warm organization things show an improvement from about $7.5 billion out of 2010 to $8 billion out of 2011, and it is required to create to $10.9 billion out of 2016, a compound yearly advancement rate augmentation of 6.4%. Warm organization hardware, for example fans and thermally sinks, speaks to around 84% of the total business division. Other essential cooling thing segments, for example programming, interface materials, and substrates, each record for some place around 4% and 6% of the business area, independently. This power dissipating makes heat, which is a by-thing in various planning applications. This unfortunate by-thing can reduce the execution of the structures since skirting on each building system is proposed to work within a particular temperature limits. Overheating in order to outperform these limits, could provoke a system dissatisfaction.

ISSN : 2455-9679
Impact Factor : 3.340

Figure 1.1: Heat sink CPU arrangements

II. Literature Review

R. Mohan et al [2010] This paper depicts about pin balance and space equal plate heat sinks with copper and carbon composite(CCC) base plate material mounted on CPU's. The boundaries, for example, balance calculation, base plate material, base plate thickness, number of blades, balance thickness are thought of and fundamentally in this paper balance math, base platethicknesses, base plate materials are enhanced for improving the warm exhibition of a warmth sink in the people to come. In this examination work, the warm model of the PC framework with different blade math heat sink configuration has been chosen and the liquid stream, warm stream attributes of warmth sinks have been considered. The plate, pin and Elliptical balance math heat sinks have been utilized with base plate to improve the warmth dispersal. In this examination a total PC undercarriage with various warmth sinks are explored and the exhibitions of the warmth sinks are compared.[**1**]

U. S. Gawai, Mathew V. K. et.al. [2013] They carried out an exploratory evaluation of heat trade by pin balance. The findings for single cutting edges of aluminium and copper is based on heat trading. The findings revealed that the brightness of the exchange coefficient and the capacity of the aluminium balance are more visible than the metal cutting edge.[2]

K. Kumar, Vinay et.al. [2013] They conducted a warm and supportive review of the tree-shaped cutting edge presentation. They brought a sharp edge shaped tree with openings and a tree developed equalisation without room for their inspection. In addition, they focused on the effect of the material on the effects of similar geometries by taking the aluminium composite, the helper steel and the copper mixture as equivalents. The results showed that the capability of the opened tree is better adjusted than without the opening of the tree cutting edges. As shown by the copper cutting content. The aluminium opening cutting edge was better described as providing an efficient heat exchange without contortion between all the equalizations used for the examination.[3]

V. Kumar and Bartaria et al. [2013], They carried out an exploratory and CFD evaluation of the round pin balance heat sink using ANSYS ver.12.1. They did the test by adjusting the estimate of the bent pin cutting edge, e.g. by shifting the cross-section and the area. Results showed that for all of the 2 mm low turn roundabout pin parity speeds, warm opposition and weight drop would be perspicuous. [4]

H. Dange and Patil et al. [2013], Preliminary and CFD examinations for heat trading on a round sharp edge were carried out by the appropriate convection. They did the test by adjusting the pace. The results showed that the glow coefficient of trade increased with the growth of fluid speed. [5]

ISSN : 2455-9679
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Dhumne and Farkade et al. [2013], They made a warm trade evaluation of the cylinder moulded, punctured cutting edges in a stunned game-plan. For the measurement, punctured adjustments of various sizes were used. The findings showed that there were no further additions with a reduction in breathing space and bury balance insulation. Variable decay additions with decrease in the cover balance dispersion.[6]

M. Reddy and G. Shivashankaran et al. [2014], They performed numerical entertainment of the necessary convection heat trade by porous pin fins balancing on a rectangular tube. They figured out about a round, long roundabout and short bent pin sharp edge heat sink by adjusting inlet speeds such as 0.5 m/s, 1 m/s, 1.5 m/s and 2 m/s using ANSYS CFD natural programming. The result showed that the glow moving efficiency in the porous pin balance is about half higher than the solid pin balance,[7]

D.D Palande and Walunj et. al. [2014], they also carried out an exploratory evaluation of the evaluation of the thin plate edges of the heat sink under simple convection. They investigated the cutting edges concerning the degree of the point of view and the specific details on the radiator wattage. The result showed that ordinary heat exchange increases with the heat data. Convective exchange in warmth increases with the field of perspective.[8]

M. Ali, Tabassum et.al. [2014], conducted a warm and water-driven evaluation of rectangular offset displays with individual gap size and number. They changed the puncture from 0 to 2 and contrasted the opening width structure from 0 mm to 3 mm. The results showed that the glow trade and weight drop extended with the extension in the Reynolds number for all adjustments. [9]

K. Chaitanya and G. Rao et al.[2014], they carried out a temporary warm assessment of the drop shaped pin sharp edge community using CFD. They did the close thing to focus between a round shape pin sharp edge and a drop shaped pin balance. The results showed that the glow trade was extended due to the creation of the fluid surface contact zone and equalisation. Extension in weight drop for drop shaped pin offsets appeared differently in relation to indirect pin change.[10]

K. Dhanawade and Sunnapwar et.al. [2014], They made a warm assessment of the square and indirect sharp edge bundle punctured by forced convection. For eg. the range of gaps for the assessment was changed to 10 mm square, 8 mm square and 6 mm square and for indirect punctures to 10 mm, 8 mm, and 6 mm square. The result showed that the, Nusselt numbers extended with the extension in the Reynolds number, the warm touch extended with the development in puncture and the use of punctured equalisation assemble the glow trade besides there is a decrease in weight, saving of the material that finally decays the utilisation on the balance material. [11]

Junaidi, Ansari et.al. [2014], They did a warm inspection of the spread pin cutting edge of the heat sink. They conducted a CFD assessment using ANSYS Fluent 12.1 with various focal points (e.g. 4°, 5° , 6° and 7°) of inclination of the pin sharp edge with respect to the base plate. Glow trade in the midst of normal convection is more in the spread structure of the pin balance. The distribution of the pin balance gives better air disturbance.[12]

Hagote and Dahake et. al [2015], they have improved the ordinary convection heat trade coefficient by using V-balance group. They analyzed the V-balance using ANSYS CFX and probably. They used plate sharp edges where the parities were composed at an inclination of 60o. The best convective warmth trade got was 600°.[13]

Yogesh G. Joshi et. al. [2015] The expansion in dispersed force per unit zone of electronic segments sets greater levels of popularity on the presentation of the warmth sink. Likewise in the event that we proceed at our present pace of scaling down, PCs and other electronic gadgets can get warmed up immensely. Henceforth we require a superior warmth scattering heat sink framework to conquer the overabundance heat creating issue. To deal with the over the top and frequently erratic warming up of superior electronic segments like chip, we have to foresee the profile dependent on temperature of the warmth sink utilized. Remembering the A presentation examination has introduced on heat sinks of a similar model in this venture , to be specific a graphite metal warmth sink and aluminum heat sink. In similar conditions, the temperature conveyance, weight and speed fields of the aluminum heat sink were dissected. Furthermore, the temperature conveyance and warm opposition of these warmth sinks were contrasted and investigated

ISSN : 2455-9679
Impact Factor : 3.340

and the graphite metal warmth sink. The graphite-metal warmth sink has incredible points of interest in CPU heat dispersal for the great warm conductivity. Consequently after execution investigation it will discover the benefit of graphite metal warmth sink over aluminum heat sink. What's more, consequently will characterize and create a graphite metal warmth sink which can supplant the aluminum heat sink.[14]

Prakash.T et.al. [2016] Circular heat sink model made up of the rectangular fins. But in this model a copper base plate is introduced at the bottom of the heat sink. Since the copper is having the maximum thermal conductivity, the heat dissipation will surely increase. The copper base plate is of 5MM thick and 80MM in diameter. Maximum temperature results find out 343 K and heat flow 96.6 W.[15]

M. Zaretabar &H. Asadian et.al. [2017] In this study, the heat transfer investigation of a main board chip heat sink with air flow cooling is considered.Heat sinks are made from aluminum or copper which have temperature dependent thermal conductivity. There is internal heat generation in heat sink and Aluminum heat sink with 13 fins and 50 mm height. heat transfer from heat sink surface can be considered temperature results 373K. [16]

Krishnendu Mukherjee, Abhinay Todmal, Junling Hu et.al. [2017] The thermal behavior of the heat sink and the air flow around is simulated by 2016 Solid Works Flow Simulation. A 3D computational domain of dimensions of 190 mm × 190 mm × 113 mm is constructed around the heat sink assembly with the bottom flush with the top surface of the PCB board. The designed aluminum heat sink has 40 fins of 2 mm thick, combined with a copper core of a height of 35 mm and a Ø65 mm thermal spreader of a 2 mm thickness. We took the thermal boundary condition 38degree Celsius atmospheric temperature , heat flow 80 W. Find the maximum temperature 341.09 K and velocity 10 m/sec [17]

Abhinay Todmal and Junling Hu et. al [2017] Active CPU coolers are one of the effective technologies to remove heat from the highly integrated CPUs. In this paper, an active heat sink is designed to cool a silicon CPU that dissipates 70 W of heat. The active CPU cooler is composed of an axial fan sitting above the heat sink, an aluminum radial heat sink, a copper heat spreader at the base of the heat sink and a copper core inside the heat sink. The air flow and thermal behavior of the heat sink assembly are simulated with 2016 Solid Works Flow Simulation. CFD simulations have been used to explore various design parameters, such as fin thickness, fin numbers, thermal spreader thickness and diameter, and copper core height. Parametric study was also conducted to determine the maximum heat the design can dissipate and the required fan speed for effectively cooling the CPU at a low noise level. [18]

S.Ravikumar et. al. [2017] The progression of the advanced PC and its use step by step is quickly expanding. In any case, the dependability of electronic segments is basically influenced by the temperature at which the intersection works. The creators are compelled to abbreviate the general framework measurements, in extricating the warmth and controlling the temperature which center the investigations of electronic cooling. In this venture Thermal examination is done with a business bundle gave by ANSYS. The mathematical factors and plan of warmth sink for improving the warm presentation is tested. This undertaking uses warm examination to recognize a cooling answer for a work station, which utilizes a 5 W CPU. The plan can cool the body with heat sink joined to the CPU is satisfactory to cool the entire framework. This work considers the roundabout barrel shaped pin balances and rectangular plate heat sink balances plan with aluminum base plate and the control of CPU heat sink processes.[19]

Nilesh Khamkar el.al [2018], Reliably increasing transistor densities and trading speeds in microchips have resulted in a surprising increase in the structure of heat movement and dispersal of force. Right now, rising IC organisations, along with a lot of increasingly rigorous execution and consistent consistency, have made warm organisation problems ever more apparent in the framework of today's microelectronic systems.[20]

Ibrahim Mjallal el.al [2018], If the temperature of the electronic gadgets builds, their disappointment rate increases. That's why electronic devices need to be cooled down. One of the promising cooling techniques is the use of Phase Change Materials (PCMs). Another detached temperature strategy of the executives, including the immediate situation of the PCMs on the chip, has been investigated and established. PCMs are possible temperature regulators that will store and discharge warm vitality when dissolved and frozen separately. This paper analyses the diffusion of temperature on a heat sink with and without a PCM with different degrees of heat motion. In addition two different PCMs with different

 ISSN : 2455-9679
Impact Factor : 3.340

densities, primarily salt-hydrate and wax, were investigated in the cooling of electronic gadgets. [21]

M. Neyestani et. al [2019] In this paper, diverse warmth sinks are examined to improve CPU cooling tentatively. Various sorts of copper heat sinks including a novel "permeable warmth sink" are proposed and contrasted with get the ideal warmth move rate. Water and Al_2O_3/water nanofluids (40 nm) in two diverse volume divisions (0.1 and 0.2 vol.% from 40-nm nanoparticles) are utilized as warmth move liquid to cool the CPU. Diverse stream rates are additionally analyzed in the trial study. The Nusselt number, divider temperature, warm obstruction and LMTD temperature have been investigated for a wide scope of boundaries of the warmth sinks. Likewise, the impact of math, heat move liquid, input force and stream rate on the warmth move rate is accounted for. The outcome shows that the math of the warmth sink importantly affects the warm exhibition of the framework. The pace of warmth move in the proposed novel permeable warmth sink is bigger than different cases. The Nusselt number in the permeable warmth sink by utilizing nanofluids is 2.2 occasions bigger than the warmth sink with an inline pattern. [22]

III. CONCLUSION

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. Simultaneously flow pattern of air on plate surfaces in various positions is to be studied.
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REFERENCES

1. R. Mohan and Dr.P.Govindarajan "THERMAL ANALYSIS OF CPU WITH COMPOSITE PIN FIN HEAT SINKS" International Journal of Engineering Science and Technology Vol. 2(9), 2010, 4051-4062.

2. P. Singh, H. Lal, B. S. Ubhi, "Structure and Analysis for Heat Transfer Through Fin with Extensions", International Journal of Innovative Research in Science, Engineering and Technology, Vol.3, Issue 5, May 2014.

3. Sachin R. Pawar, R. Yadav, "Computational Analysis of Heat Transfer by Natural Convection from Triangular Notched Fin Array", IJST-International Journal of Science Technology and Engineering, Vol-1, Issue 10, April 2015.

4. U. S. Gawai, Mathew V. K., Murtuza S. D., "Test Investigation Of Heat Transfer By Pin Fin", International Journal Of Engineering And Innovative Technology (IJEIT), Vol-2, Issue 7, January 2013.

5. K. Kumar, P. Vinay, R. Siddhardha, "Warm and Structural Analysis of Tree Shaped Fin Array", Int. Diary of Engineering Research and Applications", Vol-3, Issue-6, Dec 2013.

6. V. Kumar, Dr. V. N. Bartaria, "CFD Analysis of an Elliptical Pin Fin Heat Sink Using Ansys Fluent V12.1", International Journal of Modern Engineering Research (IJMER), Vol-3, Issue 2, April 2013.

7. R. Patil, H. M. Dange, "Exploratory and Computational Fluid Dynamics Heat Transfer Analysis on Elliptical Fin by Forced Convection", International Journal of Engineering Research and Technology (IJERT), Vol-2, Issue-8, August 2013.

ISSN : 2455-9679
Impact Factor : 3.340

8. Amol Dhummne, H. Farkade, Heat Transfer Analysis Of Cylindrical Perforated Fins In Staggered Arrangement, International Journal Of Innovative Technology And Exploring Engineering (IJITEE), Vol-2, Issue-5, April 2013.

9. M. Reddy, G. S. Shivanshankar, "Numerical Simulation of Forced Convection Heat Transfer Enhancement by Porous Pin Fins In Rectangular Channels", International Journal of Mechanical Engineering and Technology (IJMET), Vol-5, Issue-7, July 2014.

10. A. A. Walunj, D. D. Palande, "Test Analysis Of Inclined Narrow Plate-Fins Heat Sink Under Natural Convection", IPASJ International Journal Of Mechanical Engineering(IIJME), Vol. 2, Issue-6, June 2014.

11. M. Ehteshum, M. Ali, M. Tabassum, "Warm and Hydraulic Performance Analysis of Rectangular Fin Arrays With Perforation Size and Number". sixth BSE International Conference On Thermal Engineering (ICTE 2014), Procedia Engineering.

12. K. Chaitanya, G. V. Rao, "Transient Thermal Analysis Of Drop Shaped Pin Fin Array By Using CFD", International Journal Of Mechanical Engineering And Computer Applications, Vol-2, Issue 6, Dec 2014.

13. K. Dhanawade, V. Sunnapwar, "Warm Analysis of Square and Circular Perforated Fin Arrays by Forced Convection", International Journal of Current Engineering and Technology, Special Issue-2, February 2014.

14. Md. Abdul Reheem Junaidi, R. Rao, S. Sadaq, M. Ansari, Thermal Analysis Of Splayed Pin Fin Heat Sink, International Journal Of Modern Communication Technology and Research (IJMCTR), Vol-4, Issue-4, April 2014

15. R. Hagote, S. K. Dahake, "Upgrade Of Natural Convection Heat Transfer Coefficient By Using V-Fin Array", International Journal Of Engineering Research And General Science, Vol-3, Issue-2, April 2015.

16. Yogesh G. Joshi,Dhananjay R. Ikhar “A Literature Review on Design and Performance analysis of Graphite metal as Heat sink for Microprocessor in CPU “ISSN (Print) : 2321-5747, Volume-3, Issue 4,2015

17. Prakash.T , Sabarinathan.R "Plan And Analysis Of Heat Sink In CPU By Using CFD" IJARIIE, Vol-2 Issue-6 2016 - ISSN (O)- 2395-4396

18. S.Ravikumar* , Parisaboina Subash Chandra , Remella Harish ,Tallapaneni Sivaji“Experimental and Transient Thermal Analysis of Heat Sink Fin for CPU processor for better performance “IOP Conf. Series: Materials Science and Engineering 197 012085 doi:10.1088/1757-899X/197/1/012085, 2017

19. Nilesh Khamkar, avinash Waghmode, Atul Joshi, pramod Supekar, dr. Ashwini Kumar, Prof. Kiran Londhe, Prof. Vipul R. Kaushik "Warmth Sink Design For Optimal Performance Of Compact Electronic Appliances-A Review" IAETSD Journal For Advanced Research In Applied Sciences, Volume 4, Issue 5, Oct/2017

20. Abhinay Todmal and Junling Hu “Design of an Active CPU Cooler Incorporating a Heat Spreader “research publication . Conference Paper researchgate.net April 2017

21. Ibrahim Mjallal , Hussien Farhat, Mohammad Hammoud , Samer Ali and Ibrahim Assi "Improving the Cooling Efficiency of Heat Sinks using Different Types of Phase Change Materials" International Journal of Molecular Sciences, 2018

ISSN : 2455-9679
Impact Factor : 3.340

22. M. Neyestani• M. Nazari • M. M. Shahmardan • M. Sharifpur • M. Ashouri , J. P. Meyer"Thermal characteristics of CPU cooling by using a novel porous heat sink and nanofluids Comparative experimental study "Journal of Thermal Analysis and Calorimetry Hungary Accepted: 12 April 2019.