IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X
PP. 17-21
www.iosrjournals.org

Thermal analysis and optimization of heat sink

Shashidhar N S[1], Balaji D Tandle[2]
[1](*Department of Mechanical, Sr. Application Engineer , Orbit 9 Electronics, Hyderabad, Telangana)*
[2](*Department of Mechanical Engineering, St. Martin's Engineering College,Hyderabad, Telangana)*

Abstract: *To reduce the temperature of the components, various cooling techniques such as providing thermal vias under the device, using a fan to facilitate forced convection or using a heat sink (Fig. 1 and Fig. 2) are explored to dissipate heat from the devices to the external ambient. This paper shows how an optimized heat sink design can be deployed effectively to bring down the temperature of devices within the system. The heat sink must be designed to meet space constraints and yet offer adequate surface area for heat transfer to minimize the temperature rise of the devices. Heat sinks with different parameters like fin configuration, fin width, fin height and number of fins (Table I) are analyzed. Fig. 1 and Fig. 3 show the types of heat sinks evaluated in the study*

Keywords: *Aluminum 6061, Air Serrated Fin*

I. Introduction

This Study is carried out To overcome on complex design of Heat sink with serrated fin Structure. basically manufactureing of serrated Fin is Very complex and costlier.

FloEFD is used to perform the conjugate heat transfer study with forced cooing to Verify that in the given flow situations serrations on the fins have negligible advantage in performance over extruded fins. Establish that reducing the fin count from 21 fins to 18 fins does not affect the thermal performance of the heat sink. To recommend other design implementation to enhance the heat transfer in the given set up

II. Thermal Modle Set Up:

The unit contains 2 heat sinks to dissipate heat from electronic enclosure. Total heat load is 90 watts on each heat sink. Inlet Volume flow rate is 220 m3/hr. Case is tested for two types of heat sink fins.

1. Serrated fins (21)
2. Serrated fins (19)
3. Extruded fins (18)
4. Serrated fins (21) With Flow separator

Boundary Conditions: Ambient temperature 65 °C, Sea level calculation Forced convection, Radiation negligible

Material: Aluminum 6061, Air Serrated Fin:

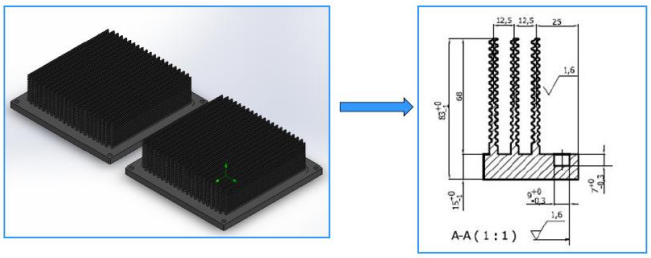

Fig 1: Serrated shape – number of fins -21 [1]

Extruded Fin:

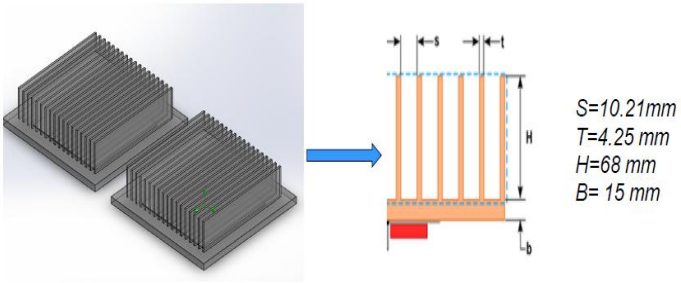

Fig 2: Extruded Fin – number of fins -18

The Surface Temperature Plots For Serrated Fin (21 Number)

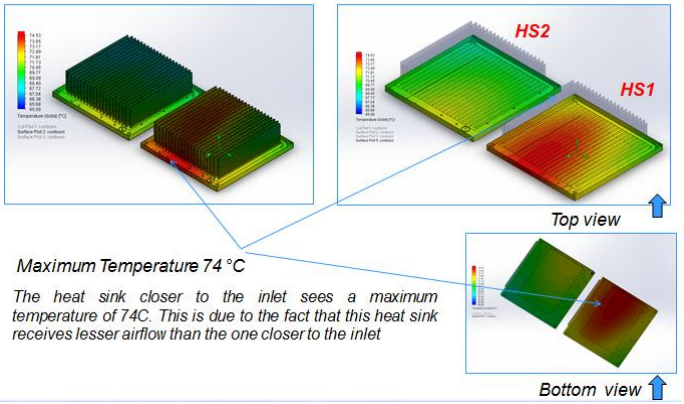

Fig 3: The surface temperature plots for Serrated Fin(21 number)

The Cut Plot For Velocity

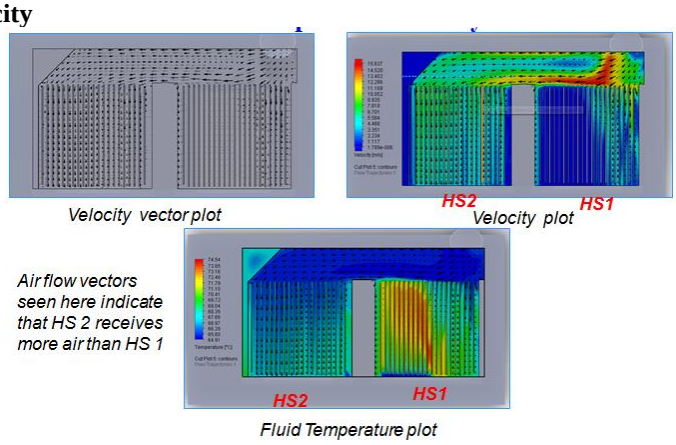

Fig 4: The cut plot for Velocity

The Surface Temperature Plots For Serrated Fin (19 Number)

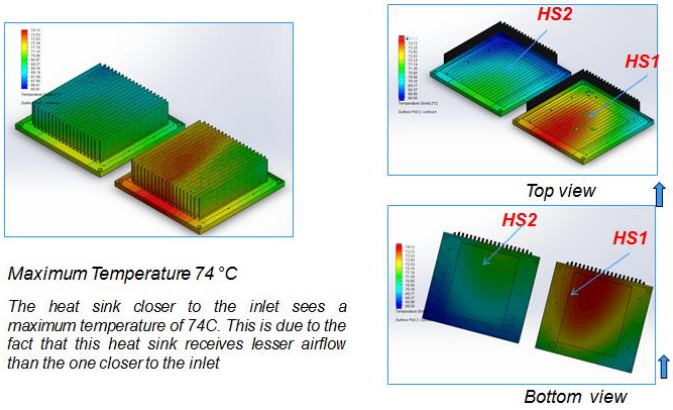

Fig 5: The surface temperature plots for Serrated Fin(19number)

The Surface Temperature Plots For Extruded Fin(18 Number)

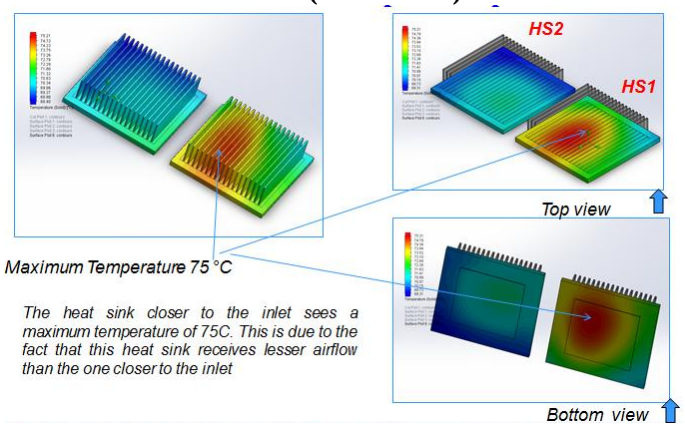

Fig 6: The surface temperature plots for Extruded Fin(18number)

Observation: by referring to Velocity cut Plot, most of the flow is going towards HS2 heat sink. To overcome on this flow separator is added to divert the air flow equally.

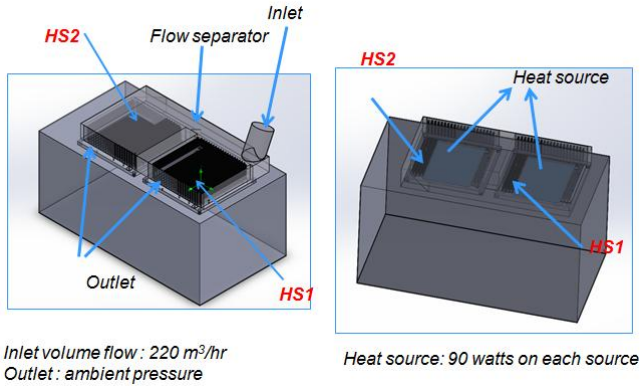

Fig 7: position of Flow separator and inlet out let position

The Surface Temperature Plots For Serrated Fin (21 Number) With Flow Separator

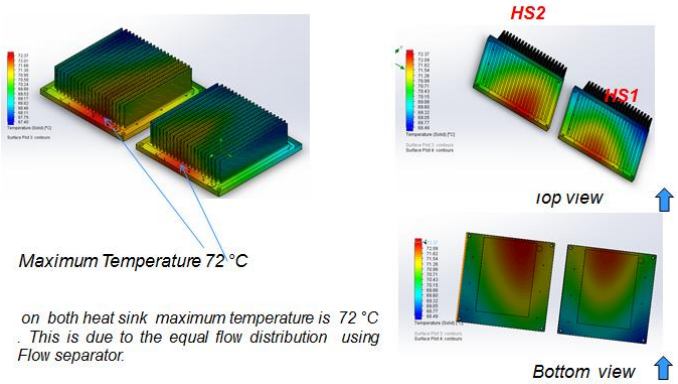

Fig 8: The surface temperature plots for Serrated Fin(21 number) With flow separator

The Cut Plot For Velocity With Flow Separator

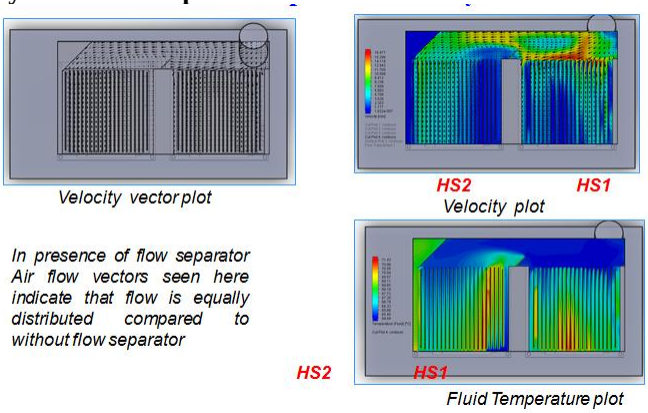

Fig 9: The cut plot for Velocity with flow separator

III. The Results And Discussions

1. Maximum temperature observed is 74.53 °C with Serrated fin heat sink.(21)
2. Maximum temperature observed is 75.25°C with Extruded Plate fins.(18)
3. Maximum temperature observed is 74.12 °C with Serrated fin heat sink.(19)

Nomenclature:

HS 1: Heat sink 1
HS 2: Heat sink 2
Temperatures are in Deg C
Volume flow rate is in m3/hr

Software Tool:
Mentor Graphics FloEFD software. https://www.mentor.com/products/mechanical/floefd/

About Orbit 9 Electronics:
http://www.orbit9electronics.com/

We would like to introduce ourselves as authorized distributor for Mentor Graphics. Orbit9 Electronics (O9E) is incorporated Company by First Generation Technocrat Entrepreneurs, having its Head Office at Hyderabad and branches at Bangalore. The Mechanical Analysis Division of Mentor Graphics (formerly Flomerics) provides the world's most advanced computational fluid dynamics (CFD) products such as FloTHERM, FloTHERM IC, FloVENT and FloEFD software in addition to this we have one more 1D analysis software called FloMASTER recently acquired by Mentor Graphics and also we have one more testing hardware equipment called T3Ster.

Temperature Comparison Table

S.no	Fin Type	Temperature
1	Serrated fins (21)	74.53 °C
2	Serrated fins (19)	74.12°C
3	Extruded fins (18)	75.25 °C
4	Serrated fins (21) with Flow separator	72.37 °C

Table 1: Temperature comparison

IV. Conclusion

1. Extruded Plate fin Heat sink performance is equally found good with serrated fin heat sink.
2. The error in simulations and tests with thermocouples is generally found to be 3-5C. Since this is within the error range it is safe to assume that moving from a serrated fin design to extruded fin does not affect the heat sink performance in anyway
3. Inlet air flow is fully diverting one side i.e on HS2 . Temperature found higher on HS1 even HS 1 is near to inlet for both the cases. on configurations without flow separator .
4. Study has been carried out to check the performance of Serrated fin heat sink(21) with flow separator.
5. In presence of flow separator performance is improved and maximum temperature is 72.37 °C. Which is 2-3 °C compared to other configurations.

Acknowledgements

I express my sincere thanks to Orbit 9 Electronics, Hyderabad , which provided me an opportunity to present this paper. I would like to express my sincere thanks to Mr. Movva Shrinivas , Director , Orbit 9 Electronics for providing the facilities.

References

[1]. Thermal Design: Heat Sinks, Thermoelectrics, Heat Pipes, Compact Heat Exchangers, and Solar Cells
[2]. Wirtz, R. A., Sohal, R., and Wang, H., "Thermal Performance of Pin-Fin Fan-Sink Assemblies," Journal of Electronic Packaging, Vol. 119, March 1997, pp. 26–31.
[3]. Jonsson, H., and Bjorn, P., "Experimental Comparison of Different Heat Sink Designs for Cooling of Electronics," American Society of Mechanical Engineers, Heat Transfer Division, HTD, Vol. 329, No. 7, Association of Mechanical Engineers, New York, 1996, pp. 27–34.
[4]. Tahat, M. A., Babus'Haq, R. F., and Probert, S. D., "Forced Steady-State Convections from Pin Fin Arrays," Applied Energy, Vol. 48, No. 4, 1994, pp. 335–351.
[5]. Jung, H. H., and Maveety, J. G., "Pin Fin Heat Sink Modeling and Characterization," Sixteenth IEEE Semi-Therm Symposium, IEEE Publications, Piscataway, NJ, March 2000, pp. 260–265.
[6]. Behnia, M., Copeland, D., and Soodphadakee, D., 1998, "A Comparison of Heat Sink Geometries for Laminar Forced Convection," Proceedings of The Sixth Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems, Seattle, Washington, USA, May 27–30, pp. 310–315
[7]. Kodandaraman, C.P., Heat and Mass Transfer Data Book.