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Study on Thermal Dissipation of CPU

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Roles And Responsibilities

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2. **Source Accumulator : Shahid Rza**
3. **Associate Columnist : Ananya Kashyap**
4. **Statistician : Sourabh Biswas**

Abstract:
This paper aims to investigate the thermal dissipation properties of a CPU using a heatsink made of aluminium alloy 6063T1. The study employs a detailed analysis of the thermal characteristics and heat dissipation efficiency of this specific heatsink material, considering its composition and design. The findings provide valuable insights into the effectiveness of using aluminium alloy 6063T1 heatsinks in managing CPU temperatures. By conducting experiments and analyzing data, We have found that the aluminum alloy 6063T1 heatsink efficiently absorbs and disperses heat away from the CPU, preventing it from overheating and ensuring optimal performance. This study sheds light on the importance of using high-quality materials like aluminum alloy 6063T1 in the design and manufacturing of heatsinks to enhance the overall thermal management of electronic devices. Additionally, the research provides valuable insights into the potential applications of this technology in various industries where thermal dissipation is crucial for the functionality and longevity of electronic components.

Introduction

The purpose of this study is to evaluate the thermal dissipation capabilities of a CPU heatsink made of aluminium alloy 6063T1 and its potential benefits in managing heat generated by the CPU during operation. Given the increasing demand for high-performance computing systems, efficient thermal management is crucial to ensure optimal performance and longevity of electronic components.

As electronic devices continue to evolve, the demand for efficient thermal management solutions becomes increasingly critical. Among these devices, central processing units (CPUs) play a pivotal role in modern computing systems. The performance of CPUs is directly influenced by their operating temperature, and excessive heat can lead to reduced efficiency, instability, and even permanent damage.

One of the most common methods to dissipate heat from CPUs is through the use of heatsinks. These passive cooling devices are designed to transfer heat away from the CPU to the surrounding environment. In recent years, aluminum-based heatsinks have gained popularity due to their favorable properties, cost-effectiveness, and ease of manufacturing.

Literature review

The effective dissipation of heat in central processing units (CPUs) is crucial to ensure their optimal performance and longevity. Heatsinks are among the most common solutions employed to manage thermal loads in electronic devices. This literature review delves into the existing body of research on the thermal dissipation characteristics of heatsinks, with a particular focus on aluminum alloys, especially 6063-T1. The review will cover the thermal properties of aluminum alloys, heatsink design considerations, surface treatments, and the impact of computational and experimental methods in optimizing heatsink performance.

Aluminium alloy 6063T1 is known for its excellent thermal conductivity, which is crucial for effective heat dissipation. It also offers good corrosion resistance and mechanical strength, making it suitable for heatsink applications. The alloy's properties are influenced by its chemical composition and heat treatment processes, which can be optimized to enhance thermal performance.

Previous research has explored the thermal performance of various aluminium alloys in heatsink applications. Studies have demonstrated that aluminium alloys can effectively dissipate heat and improve CPU cooling efficiency. However, there is limited research specifically focusing on the 6063T1 alloy, highlighting the need for further investigation into its suitability for heatsink design.

Methodology

The study involves conducting thermal analysis experiments using CPU heatsinks made of aluminium alloy 6063T1. The heatsink's design, material composition, and heat dissipation efficiency are carefully evaluated under varying thermal loads to determine its effectiveness in cooling the CPU.

To select the best solution, a thorough analysis of the Thermal Conductivity and convection was conducted, comparing various options available. The initial step in thermal dissipation involved creating a cad version of it and using industrial standard softwares to solve the problems and simulate using physics for thermal analysis.

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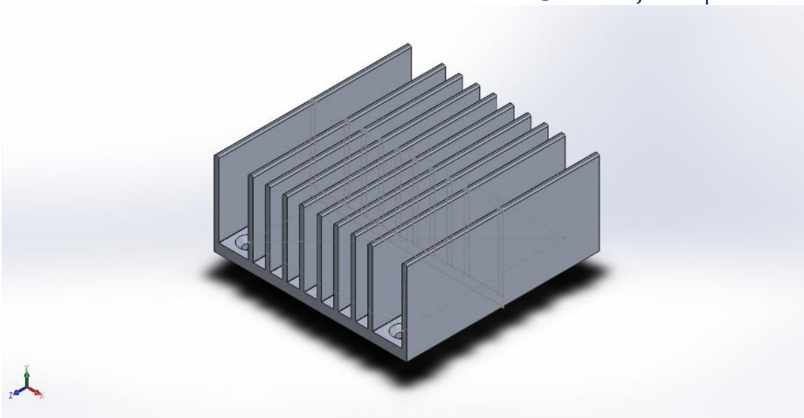


Thermal Dissipation For CPU

Principle Investigator: Saorabh Tiwari
Source Accumulator : Shahid Rza
Columnist : Ananya Kashyap
Statistician : Sourabh Biswas
Study name: Thermal analysis 6063T1
Analysis type: Thermal(Steady state)

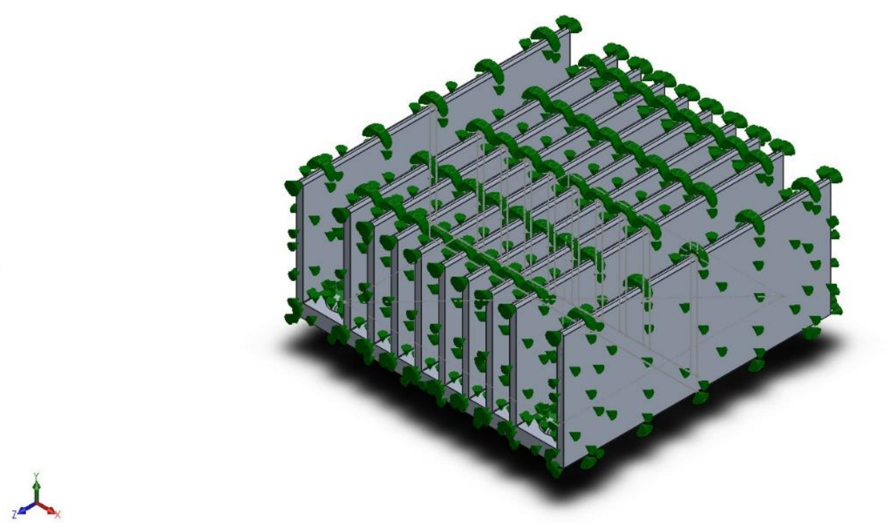
Description

When conducting research on the thermal dissipation of a CPU, the choice of heatsink material plays a crucial role in determining the overall of heat transfer. In this study, we focus on comparing the thermal performance of heatsinks made of aluminum alloy 6063T1 with those made of similar alloys like 6063T4 6063T5, and 6063T6. Aluminum alloy 6063T1 is known for its high thermal conductivity and excellent heat dissipation properties, making it a popular choice for heatsink applications. Through comparative analysis, we aim to identify the most effective aluminum alloy for CPU heatsinks in terms of thermal dissipation capabilities. This research will provide valuable insights for improving the design and performance of cooling systems for electronic devices.

Assumptions

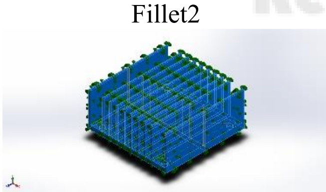
When conducting research on the thermal analysis of CPU, it is essential to consider various assumptions to ensure results. Firstly, it is important to assume that the CPU operates under steady-state conditions to simplify the analysis. Additionally, assumptions about the material properties of the CPU, such as thermal conductivity and specific heat capacity, need to be made to model the heat transfer accurately. Furthermore, assumptions regarding the heat dissipation mechanisms, such as conduction, convection, and radiation, play a crucial role in understanding the thermal behavior of the CPU. By carefully considering these assumptions, researchers can effectively analyze and optimize the thermal management of CPUs for improved performance and reliability.

Model Information



Model name: Assem1
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude3 	Solid Body	**Mass:0.108135 kg** **Volume:1.215e-05 m^3** **Density:8,900 kg/m^3** **Weight:1.05972 N**	**C:\Users\Saorabh Tiwari\Documents\cpu 1.SLDPRT** May 6 09:47:54 2024
Fillet2 	Solid Body	**Mass:0.0921249 kg** **Volume:3.41204e-05 m^3** **Density:2,700 kg/m^3** **Weight:0.902824 N**	**C:\Users\Saorabh Tiwari\Documents\test 1.SLDPRT** May 5 00:16:17 2024

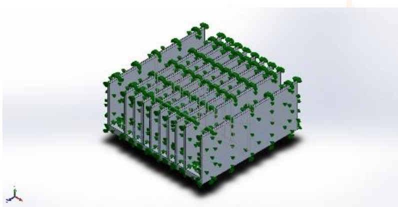
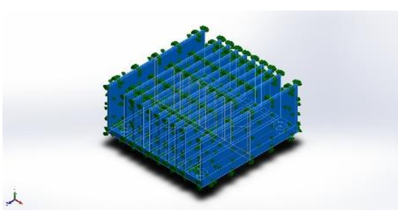
Study Properties

Study name	Thermal analysis 6063T1
Analysis type	Thermal(Steady state)
Mesh type	Solid Mesh
Solver type	FFEPlus
Solution type	Steady state
Contact resistance defined?	No

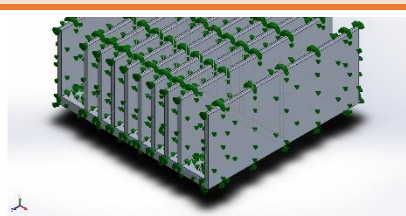
Units

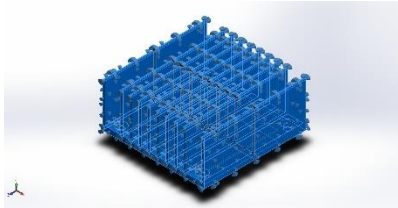
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Material Properties

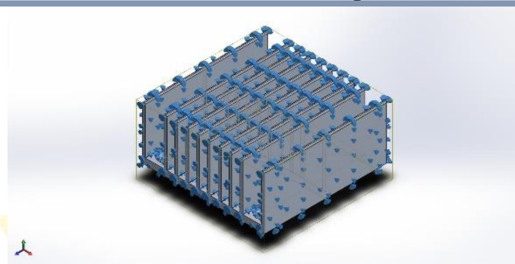
Model Reference	Properties	Components
	**Name:** Copper **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Thermal conductivity:** 390 W/(m.K) **Specific heat:** 390 J/(kg.K) **Mass density:** 8,900 kg/m^3	SolidBody 1(Boss-Extrude3)(cpu 1-1)
Curve Data:N/A		
	**Name:** 6063-T1 **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Thermal conductivity:** 193 W/(m.K) **Specific heat:** 900 J/(kg.K) **Mass density:** 2,700 kg/m^3	SolidBody 1(Fillet2)(test 1-1)
Curve Data:N/A		

Thermal Loads

Load name	Load Image	Load Details
Heat Power-1		**Entities:** 1 face(s) **Heat Power Value:** 40 W

Convection-1		**Entities:** 94 face(s) **Convection Coefficient:** 200 W/(m^2.K) **Time variation:** Off **Temperature variation:** Off **Bulk Ambient Temperature:** 301.15 Kelvin **Time variation:** Off

Interaction Information

Interaction	Interaction Image	Interaction Properties
Global Interaction		**Type:** Bonded **Components:** 1 component(s) **Options:** Independent mesh

Mesh information

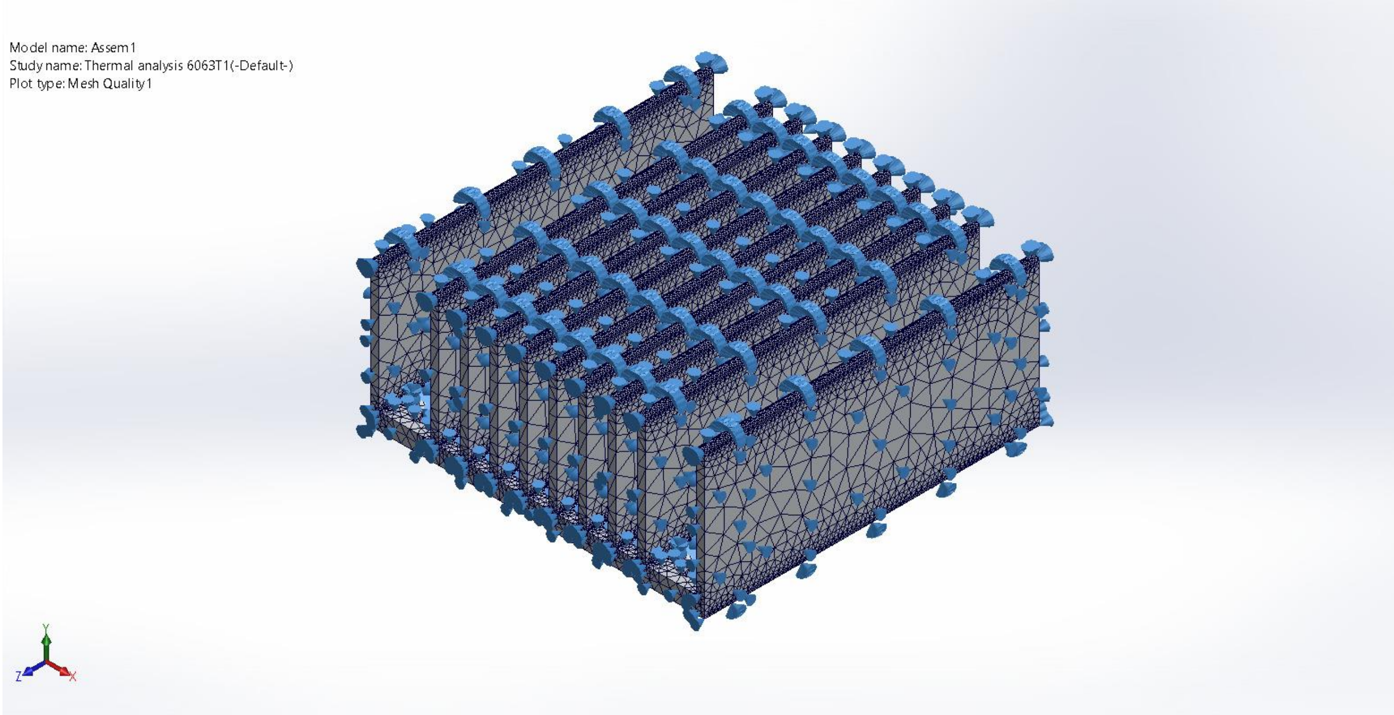
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	0.32954 in
Minimum element size	0.016477 in
Mesh Quality	High
Remesh failed parts independently	Off
Reuse mesh for identical parts in an assembly (Blended curvature-based mesher only)	Off

Mesh information - Details

Total Nodes	422300
Total Elements	258435
Maximum Aspect Ratio	98.179
% of elements with Aspect Ratio < 3	92.6
Percentage of elements with Aspect Ratio > 10	0.00464
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:31
Computer name:	

Mesh Quality Plots

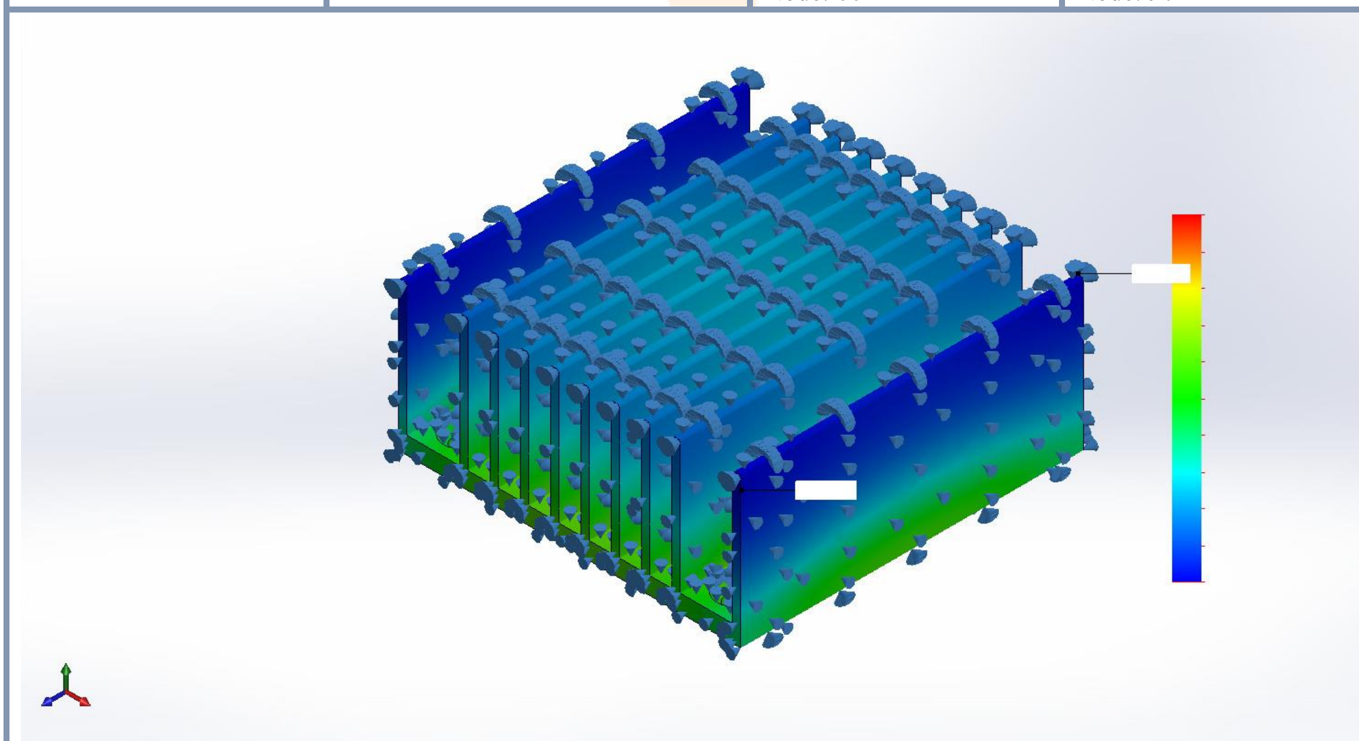
Name	Type	Min	Max
Quality1	Mesh	-	-



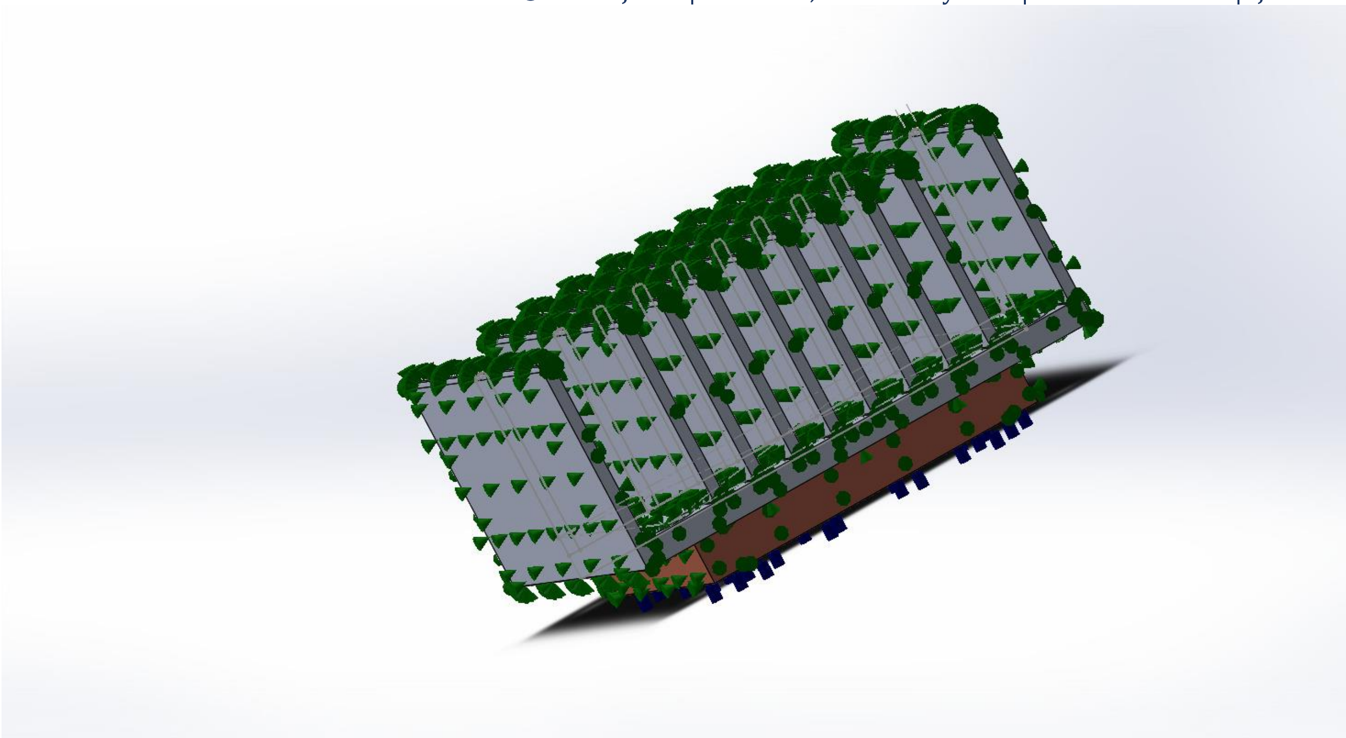
Assem1-Thermal analysis 6063T1-Quality-Quality1

Study Results

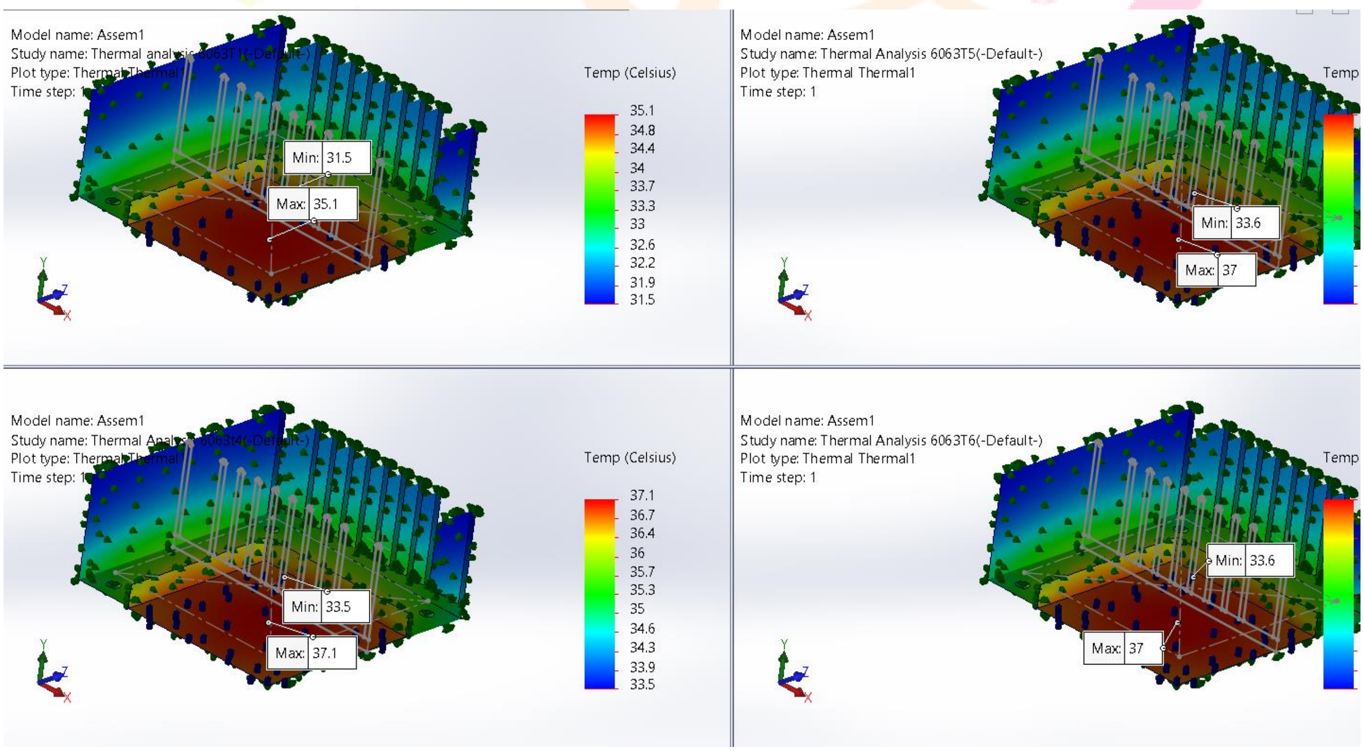
Name	Type	Min	Max
Thermal1	TEMP: Temperature	31.5Celsius Node: 664	35.1Celsius Node: 90



Assem1-Thermal analysis 6063T1-Thermal-Thermal1



Mesh of heat convection and Material properties



Comparision of Materials used for heatsink

Conclusion

In conclusion, the research paper on the thermal analysis of CPU using heatsinks made of aluminum alloy 6063T1 to other alloys like 6063T4, 6063T5, and 6063T6 has provided valuable insights into the effectiveness of different materials in heat dissipation. Through the study, it was observed that the 6063T1 alloy demonstrated superior thermal conductivity and efficiency in dissipating heat from the CPU compared to the other alloys tested. This finding highlights the importance of selecting the right material for heatsink construction to ensure optimal performance and cooling of electronic devices. Further research in this area could lead to advancements in heatsink design and technology, ultimately benefiting the efficiency and longevity of electronic devices.

Appendix

This research paper focuses on conducting a thermal analysis of a CPU using a heatsink made of aluminum alloy 6063T1, comparing it to similar alloys like 6063T4, 6063T5, and 6063T6. The aim is to evaluate the effectiveness of the heatsink in dissipating heat generated by the CPU during operation. By studying the thermal properties of these alloys, researchers can determine which one provides the most efficient cooling solution for the CPU. This analysis is crucial for improving the performance and longevity of CPUs in various electronic devices. The results of this research will contribute valuable insights to the field of thermal management in electronics.

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