

Extra Lightweight Thermal Design for PV Converter

Team 13

Electrical Engineering

Melanie Gonzalez

Tianna Lentino

Mechanical Engineering

Leslie Dunn

James Hutchinson

Colleen Kidder

Outline

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Background

Power Converter

- Convert power
- Power losses
 - Switching
 - Conduction
- Heat by-product
- Heavy heatsinks
 - 25% to 50% total weight

Practical Significance

Cutting-edge research

- 2.5 kW/kg
- 97% efficiency
- SiC MOSFET

Electronic device size

Heatsink size

Current Design



Figure 1: Current PV Converter

Project Scope

Team 13 Design Task

- Thermal conscious design
 - Appropriate heat dissipation
- Lightweight
 - Reduce overall weight
 - Double power density

Project Overview

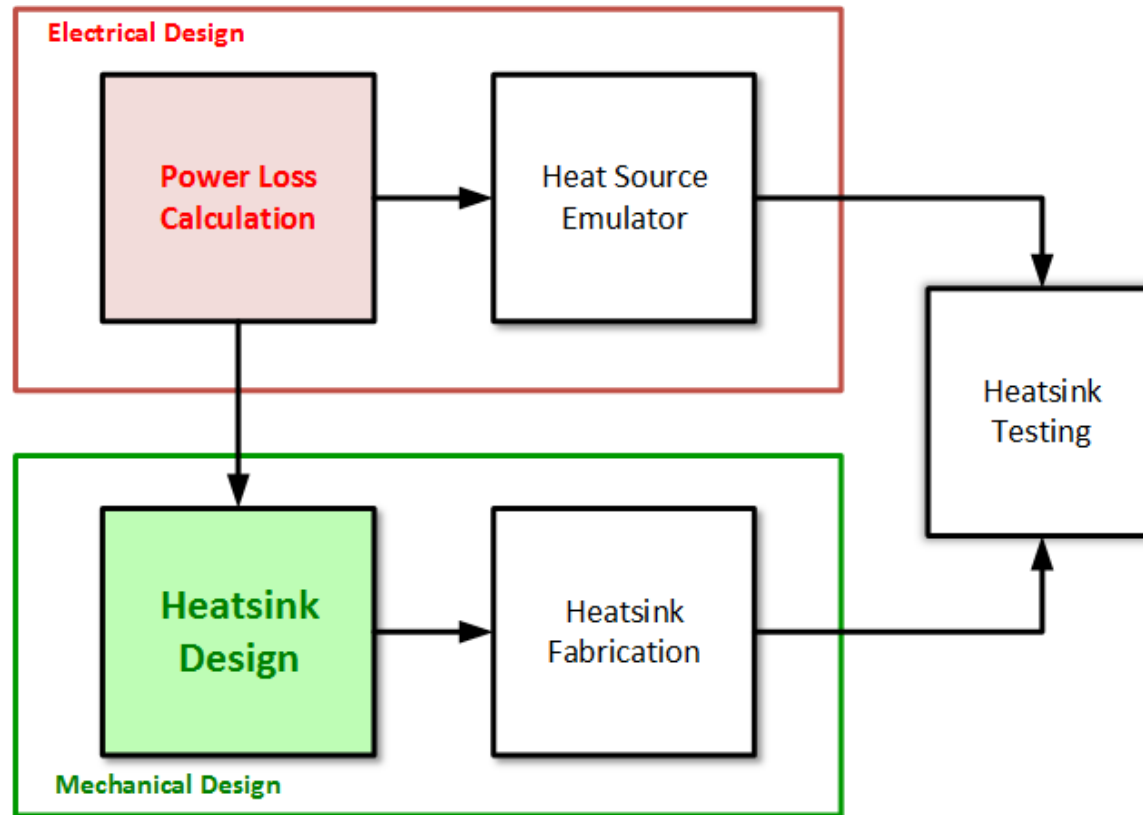


Figure 2: Project Responsibilities

Approach

- Work Breakdown Structure
- Gantt Chart
- Critical Path Method

- Background Research
- Communication
- House of Quality
- Decision Matrix

House of Quality

Top Customer Requirements

- Time Sensitivity
- Power Density
- Lightweight

Top Engineering Parameters

- Fin Specifications
- Power Loss
- Pressure Drop
- Thermal Resistance

Work Breakdown Structure

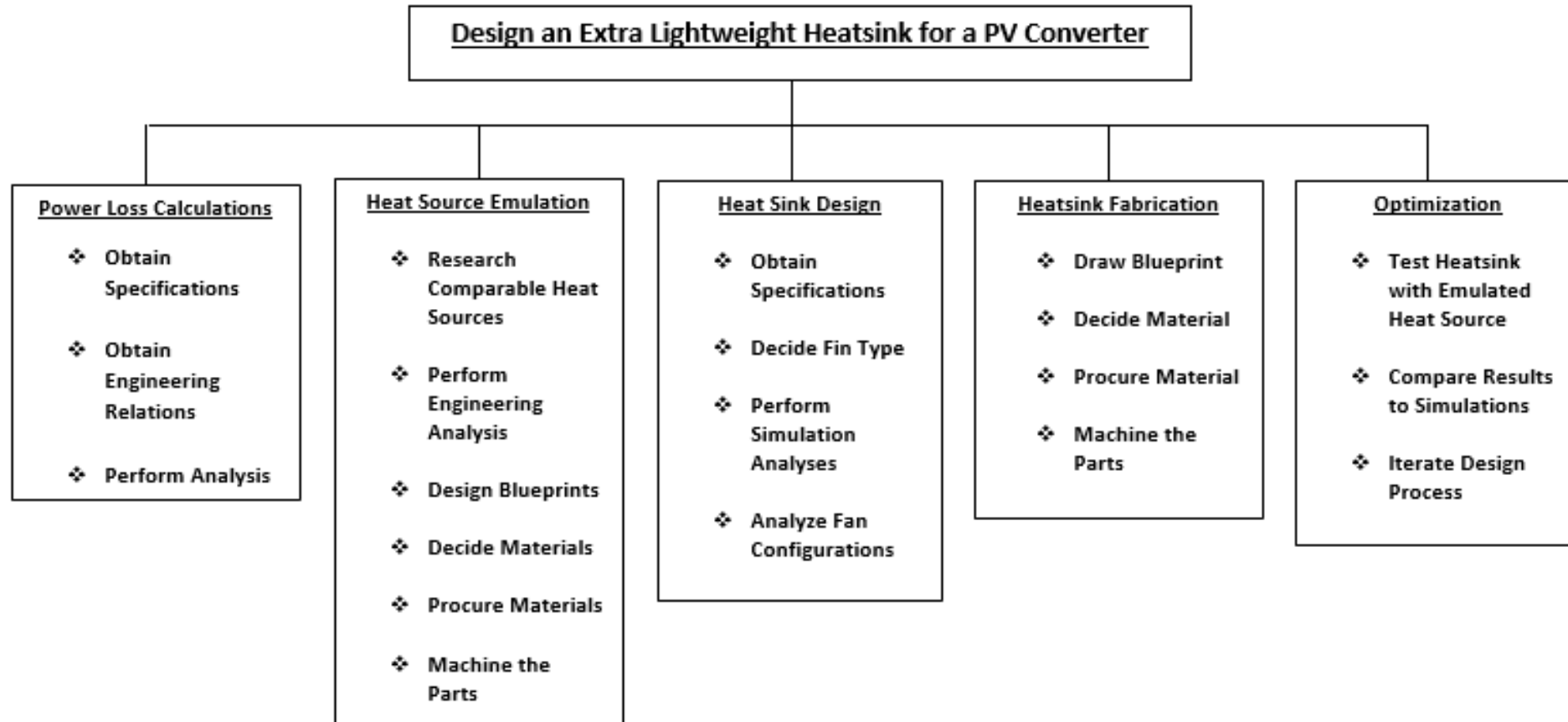
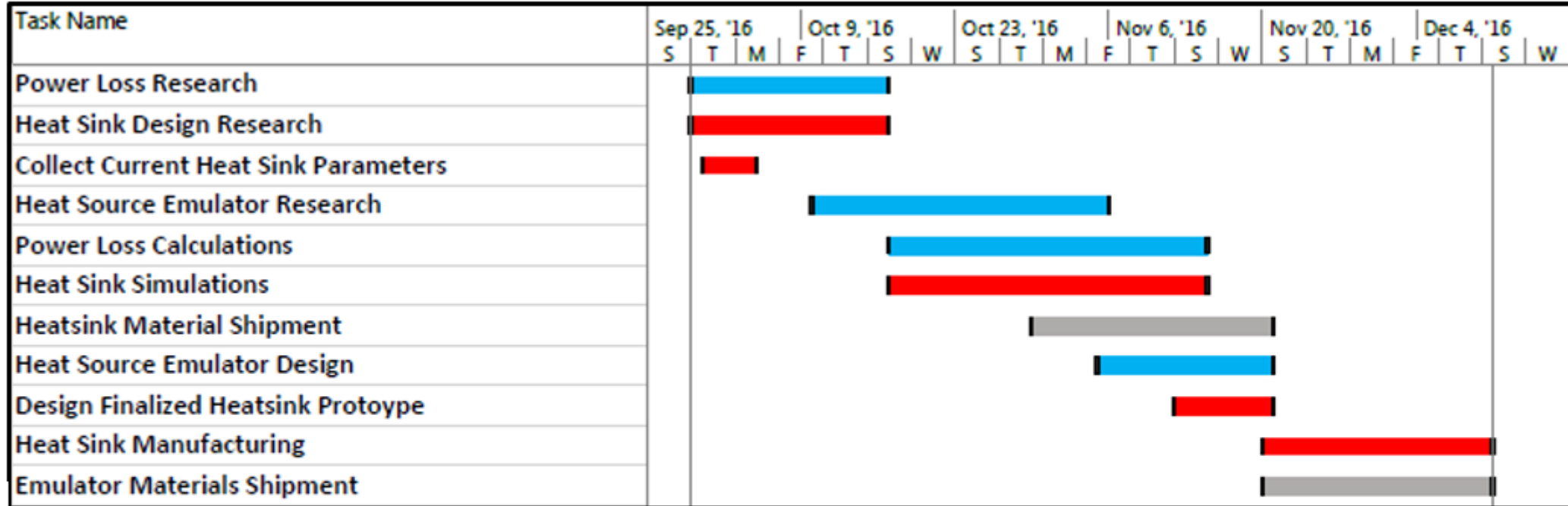


Figure 3: Work Breakdown

Resource Allocation



Electrical Engineers	█
Mechanical Engineers	█
Other	█

Figure 4: Gantt Chart

Product Specifications

Electrical

Temperature

- 150°C - Max
- 120°C - Operating

Mechanical

Power density

- 5 kW/kg

Weight

- <6.5kg

Material

- Aluminum T5-6063

Initial Design I

Modular circular pin fin heatsink

Pros

- Greater heat transfer
- Smaller dimensions
- Customizable arrangement

Cons

- Larger dimension fan
- Analytical model highly difficult
- Mounting fan axially

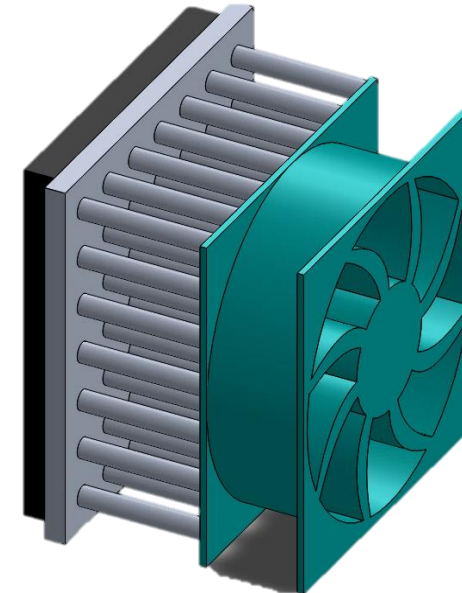


Figure 5: Circular Pin Fin Heatsink

Initial Design II

Modular straight fin heatsink

Pros

- Design similarity
- Smaller dimensions
- Customizable arrangement
- Low cost

Cons

- Decreased heat transfer

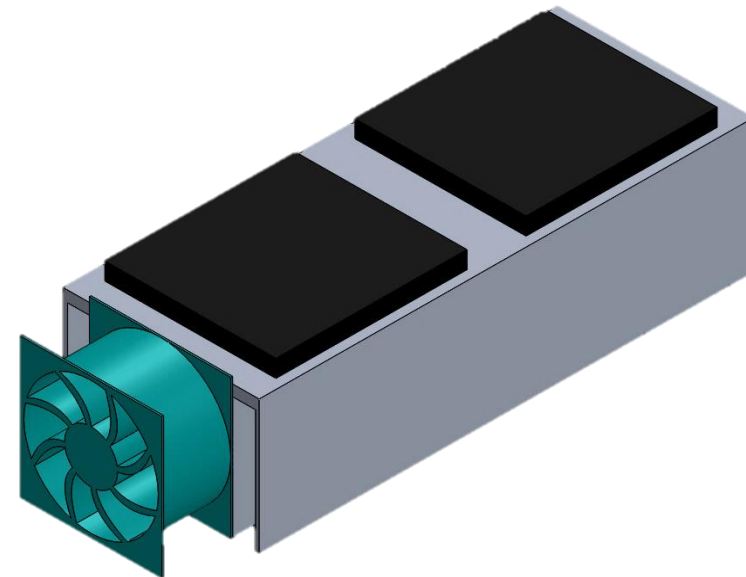


Figure 6: Straight Fin Heatsink

Testing

Analytical model

- Overall thermal resistance
- Programs
 - MATLAB
 - MathCad

Simulated model

- COMSOL

Conclusion

Completed Objectives

- Identified needs and scope of project
- Identified the constraints and specifications

Future Plans

- Continue weekly meetings
- Design selection
- Emulated heat source design
- Finalize heatsink design
- Develop bill of materials

Questions?