Next Generation Air Cooled Heat Sink

Project Description

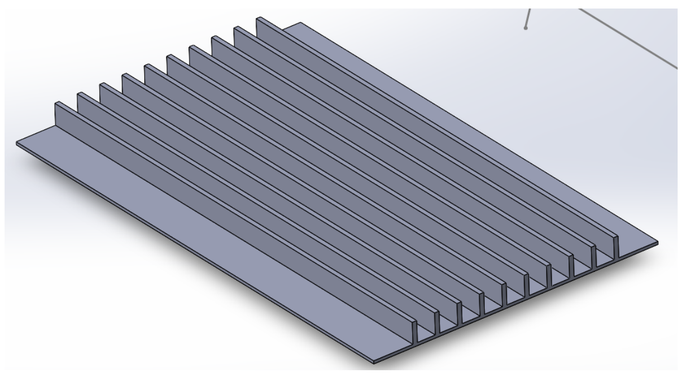
The team investigates and tests next-generation air-cooled heat sinks for high-heat-density electronics, guided by Lockheed Martin's design constraints. The team will evaluate traditional machined and additively manufactured designs, exploring methods to improve heat rejection using advanced technologies such as graphite spreaders and oscillating heat pipes (OHPs). The team will analyze, test, and produce a working prototype.

Existing Process

Calculations for non-predetermined dimensions are done in MATLAB, modeling in SOLIDWORKS, and fluid simulation in ANSYS. The final design will incorporate a heat spreader, to distribute heat evenly to the heatsink, so research has begun to find a suitable option. Throughout the project, The SU team stays in contact with the Lockheed Martin team to discuss prototyping/production costs and manufacturability

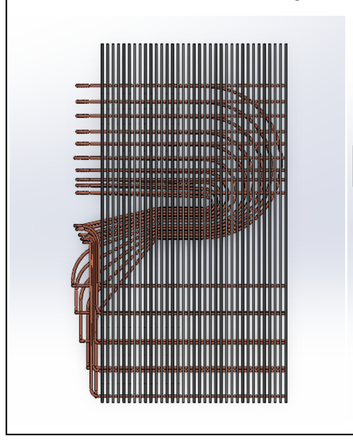
Current Designs

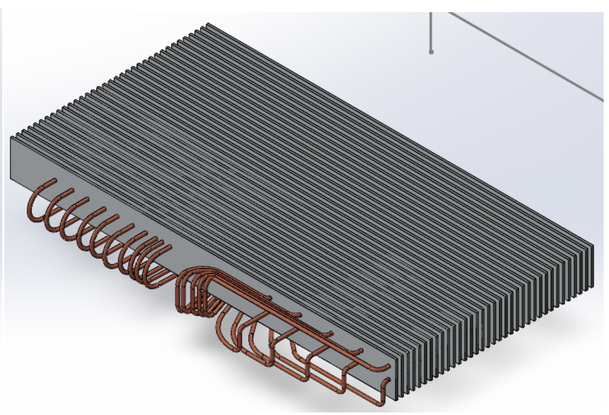
Standard Model



This standard model was designed within the specified volume requirements to create an initial CFD model to use for future designs. Geometry was created according to heat sink theory using MATLAB calculations.

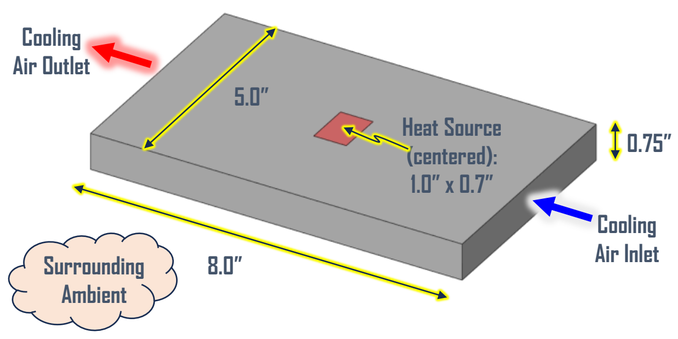
Implementation of Heat pipes





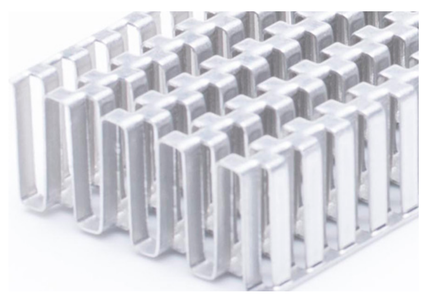
Problem definition

Parameter	Value
Air Inlet Temperature	+20°C to +55°C
Pressure Drop	≤ 2.0 in H2O
Airflow Rate	≤ 30 cfm
Heat Source	150W
Heat Sink Temperature	≤ 75°C
Surrounding Ambient Temperature	-54°C to +71°C



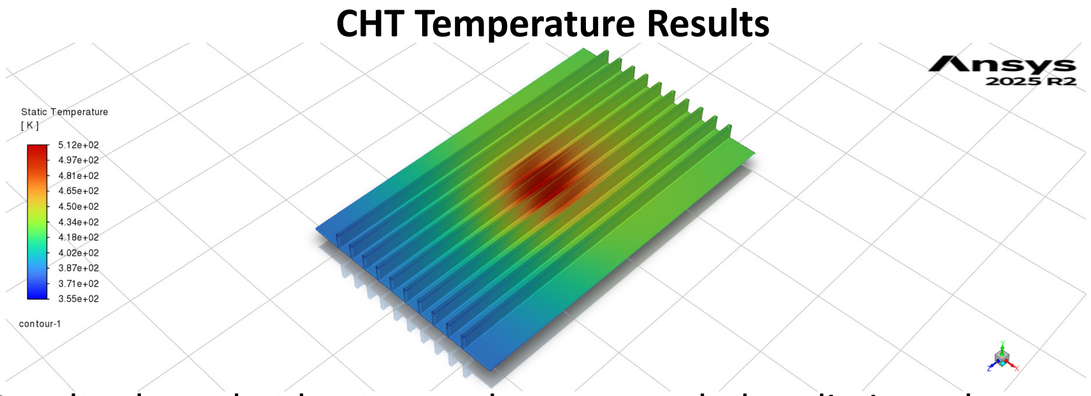
Future Designs

Lanced Offset Fins



Pin Fins

CHT Temperature Results



Results show that heat spreaders are needed to dissipate heat throughout the entire heat sink.

CHT Pressure Results

- **Pressure Drop:**

0.1642 in H2O

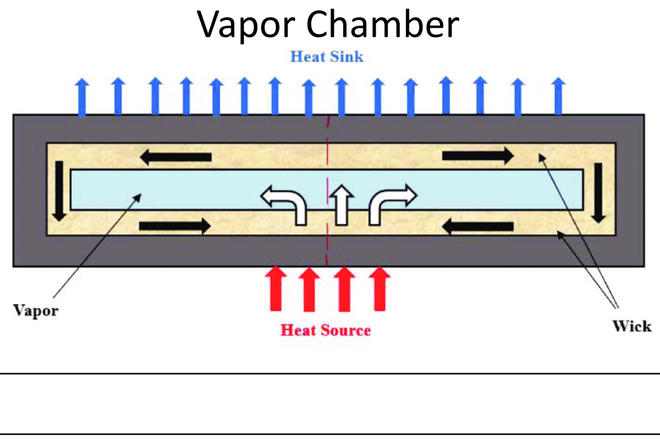
Pressure drop is currently within the allowable range. The design has to be optimized and heat spreaders must be implemented to improve thermal performance.

Total Heat Transfer Rate	[W]
report-def-0	-149.99924
User Energy Source	150
Net	0.00076086819
Area-Weighted Average	[K]
inlet	328
Area-Weighted Average	[K]
outlet	345.13763
Area-Weighted Average	[Pa]
inlet	40.882854
Mass Flow Rate	[kg/s]
inlet	0.0092499179

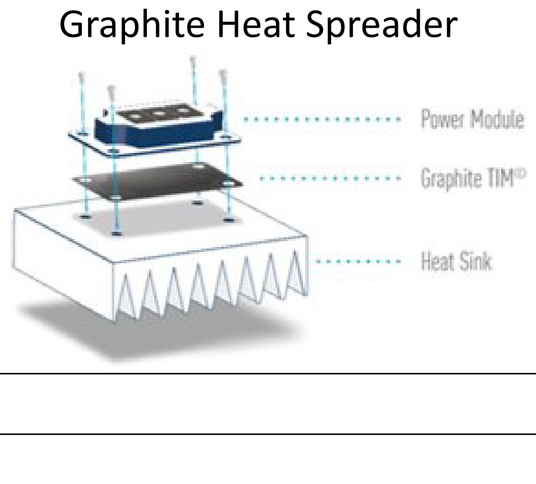
Heat Spreaders

(The following heat spreading technologies are currently being researched as potential solutions to dissipate heat across a larger area of the heat-sink base.)

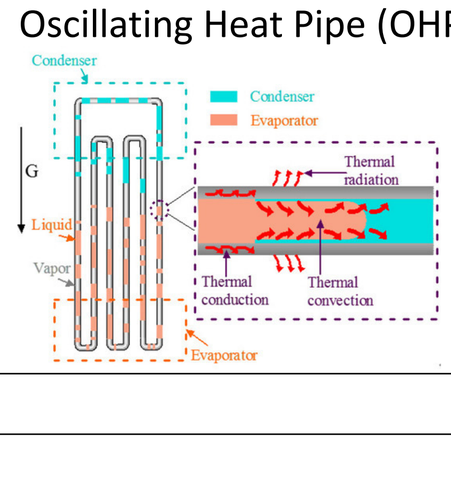
Vapor Chamber



Graphite Heat Spreader

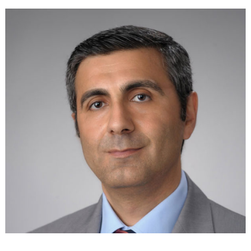


Oscillating Heat Pipe (OHP)



Semester Deliverables:

1. Optimized additively manufactured design that implements a heat spreader to dissipate heat throughout the heat sink
2. Complete CAD drawings for the heat sink design
3. Complete CFD analysis for the heat sink design
4. PDR package to be presented to Lockheed Martin according to heat sink design



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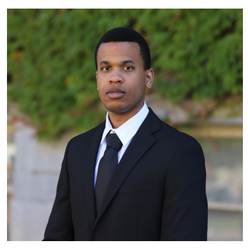

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