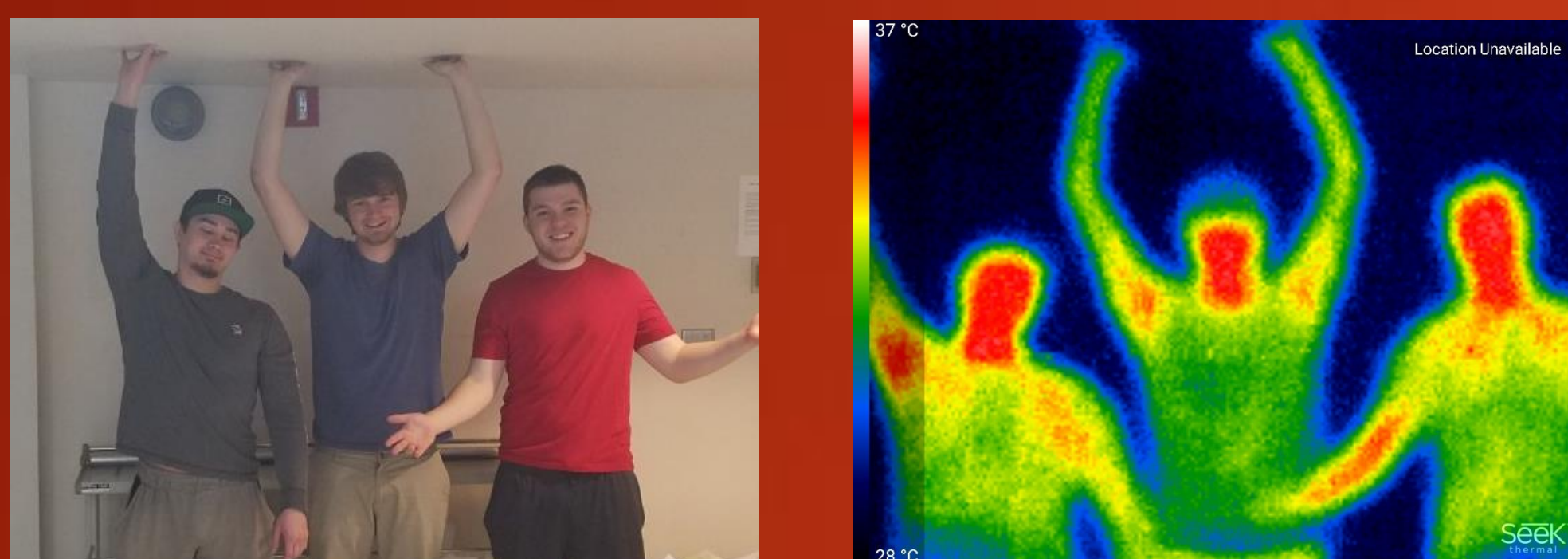
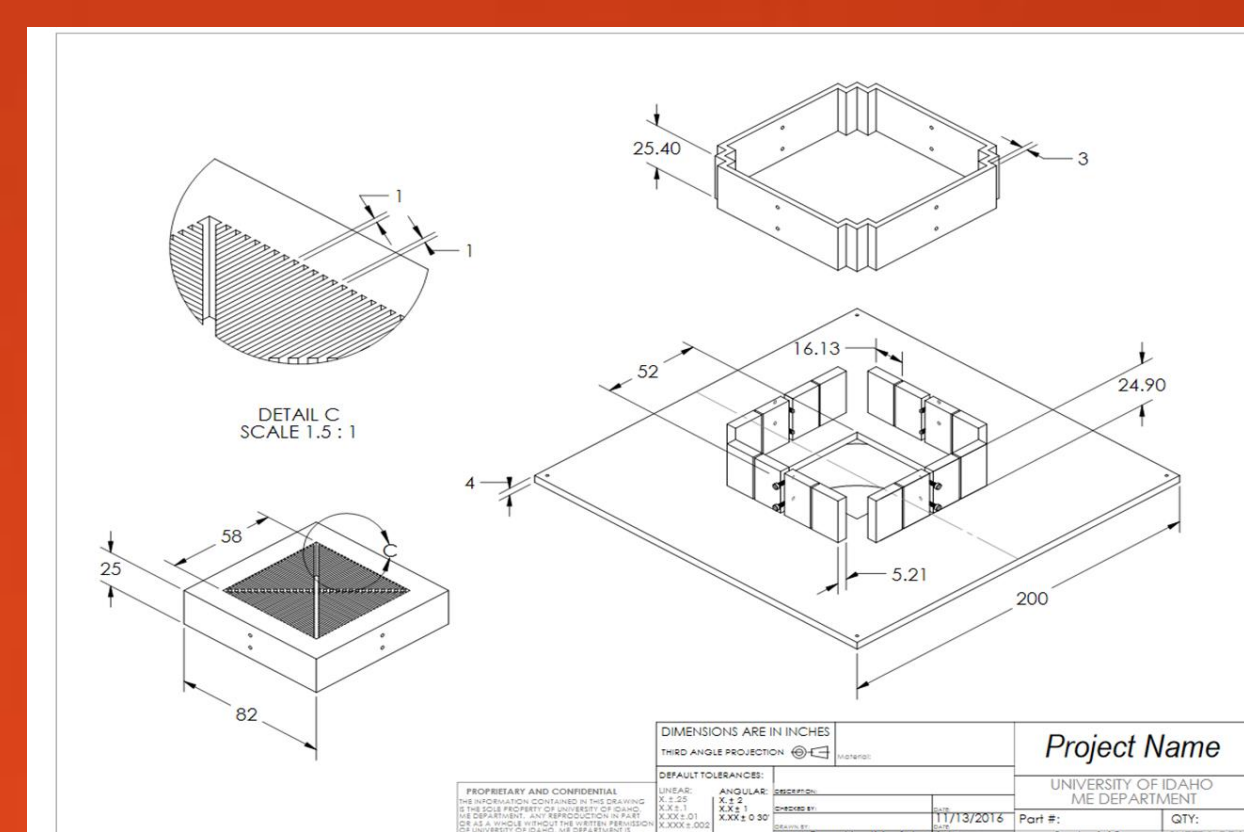


## TEAM-FRIGUS



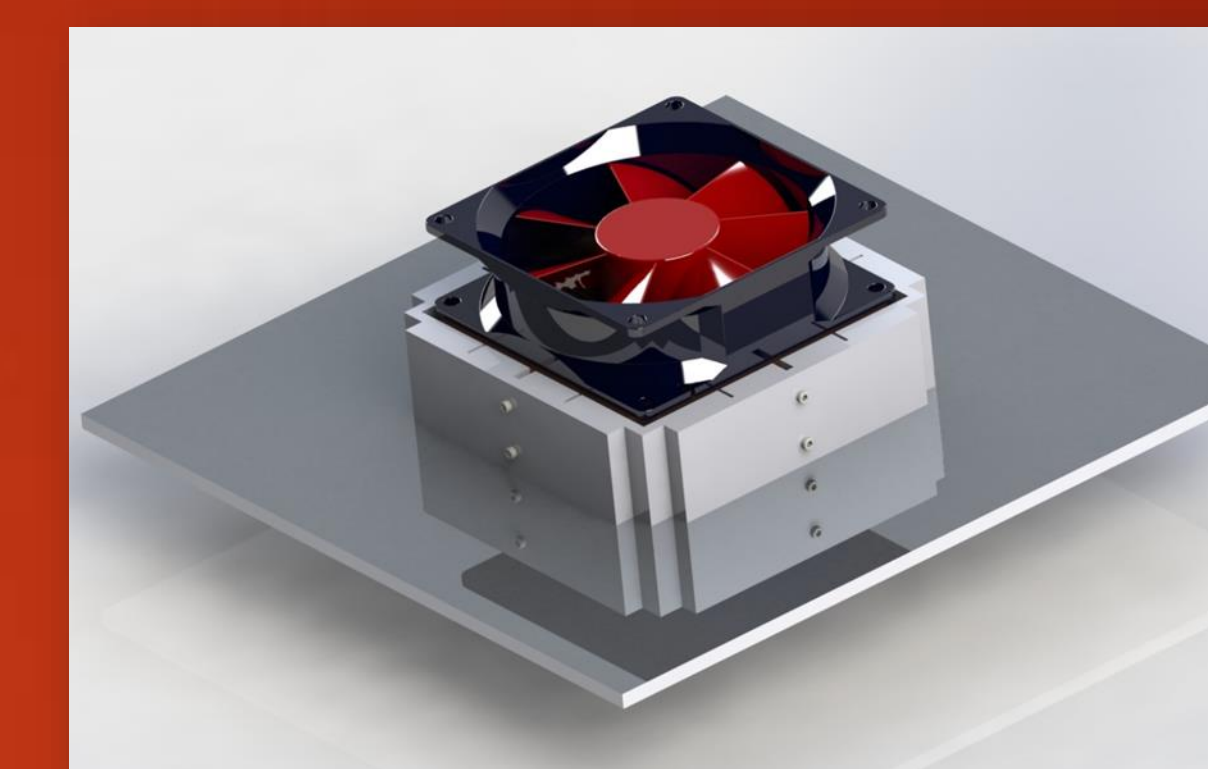
**FRIGUS TEAM MEMBERS:** JT SUTTON, CALEB JO, AND CONNOR TRULOCK  
**INSTRUCTORS:** HERBERT HESS, TAO XING, MARK ROLL, RACHEL PETERSON  
**SPONSOR:** US NAVY AND GLOBAL TECHNOLOGY CONNECTION

## PROBLEM



The objective of our Senior Design project was to design a thermal management system for a multi-kilowatt, multi-phase, power converter based around a unified thermal core with liquid or air cooling.

## PROJECT GOALS



This project consisted of 2 main phases:

- Phase 1- designing a heat sink to fit within the constraints for the thermal and physical properties defined by board configuration and switching device placement.
- Phase 2- focused around testing for the purpose of refining heat dissipation, functionality, and efficiency.

## DESIGN



Cross Hatched Sink

- Used solid works to make designs.
- Had Designs Simulated in COMSOL.
- Final designs include:
  - Water Cooled Heat Sink
  - Triangular Air Cooled Sink
  - Crossed Hatched Air Cooled Sink
  - Redesigned Cross Hatched Air Cooled Sink



Testing Case



Cross Hatched Sink Redesign

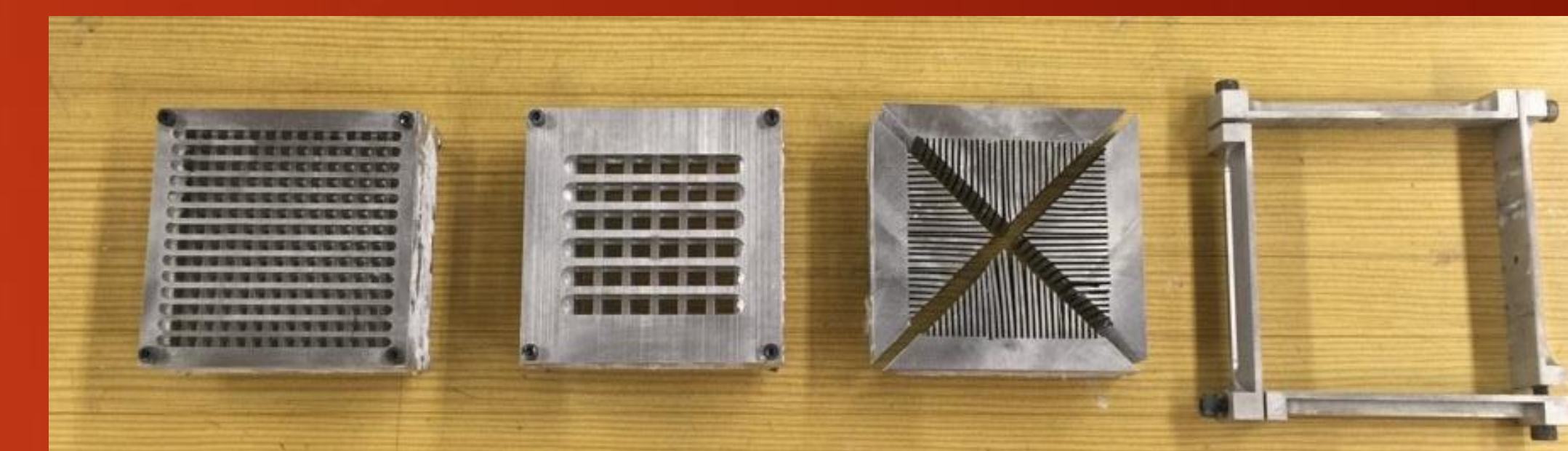


Triangular Sink



Water Cooled Sink

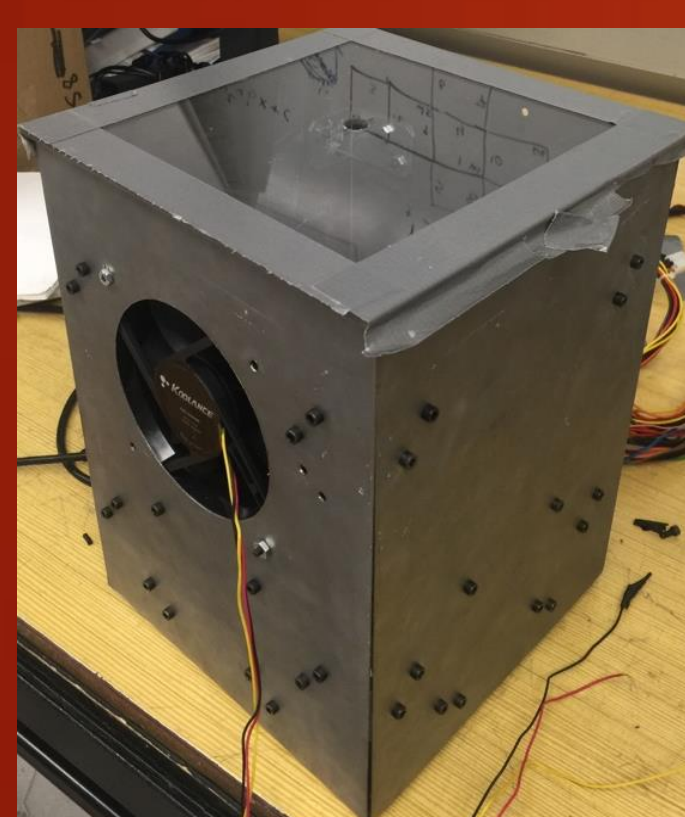
## FABRICATION



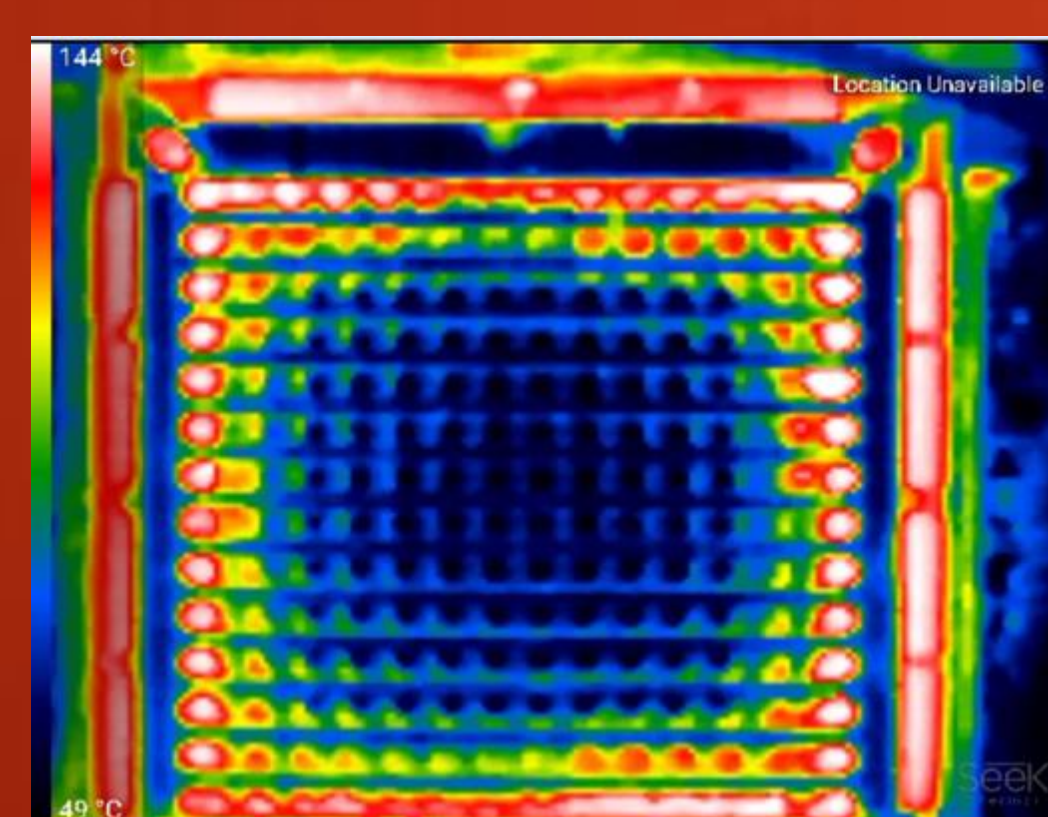
- We were able to manufacture all of our heatsinks and other components such as brackets and casing.
- Used equipment such as Drill press, Milling Machine, Lathe, and Haas CNC Milling Machine in the U of I Mechanical Engineering shop.

## TESTING

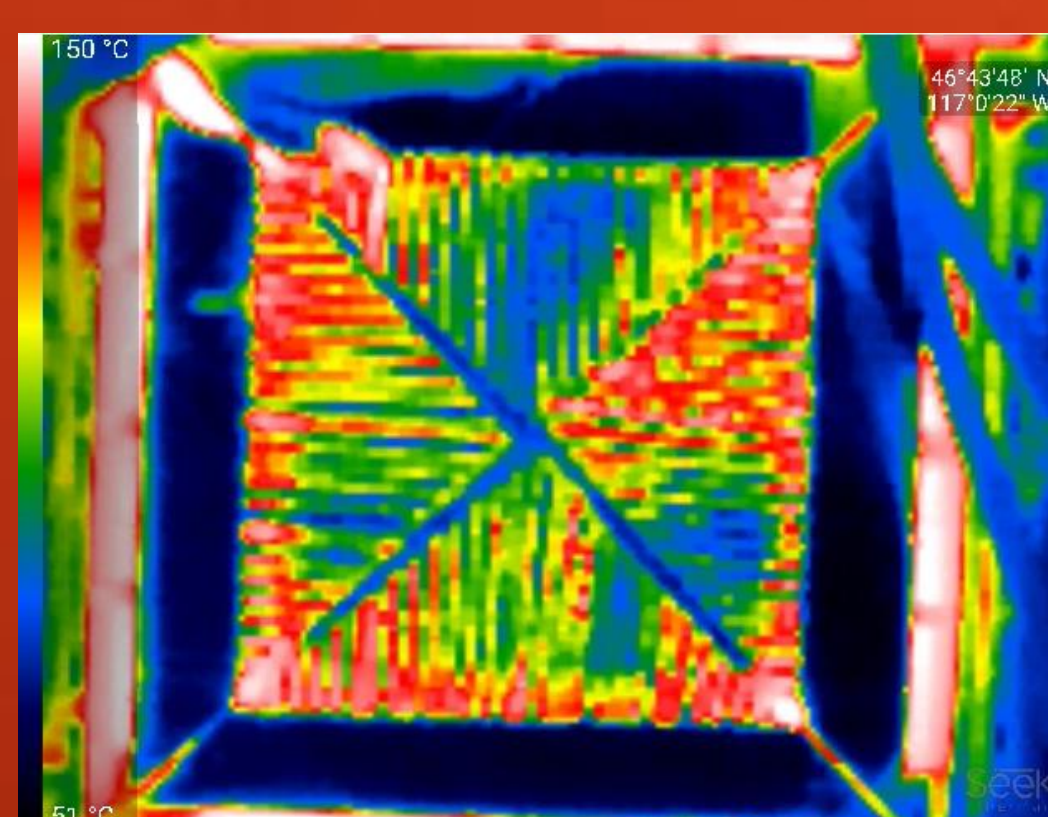
Testing Case



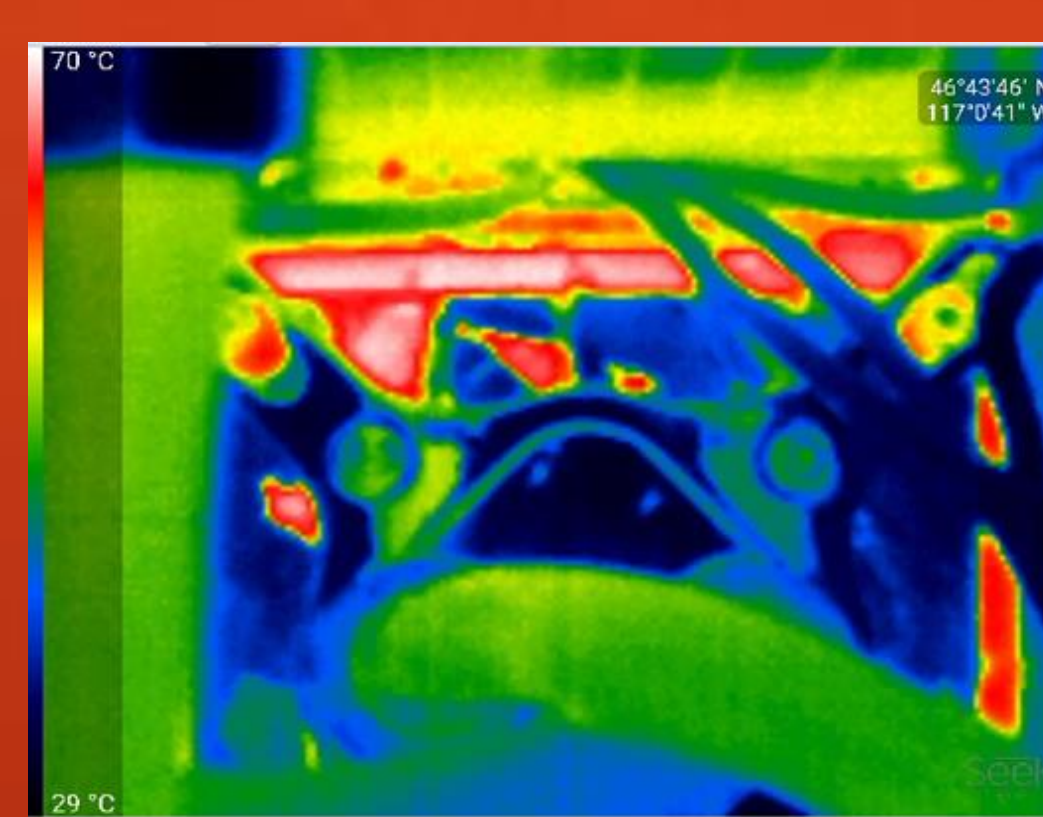
Cross Hatched Sink



Triangular Sink



Water Cooled Sink



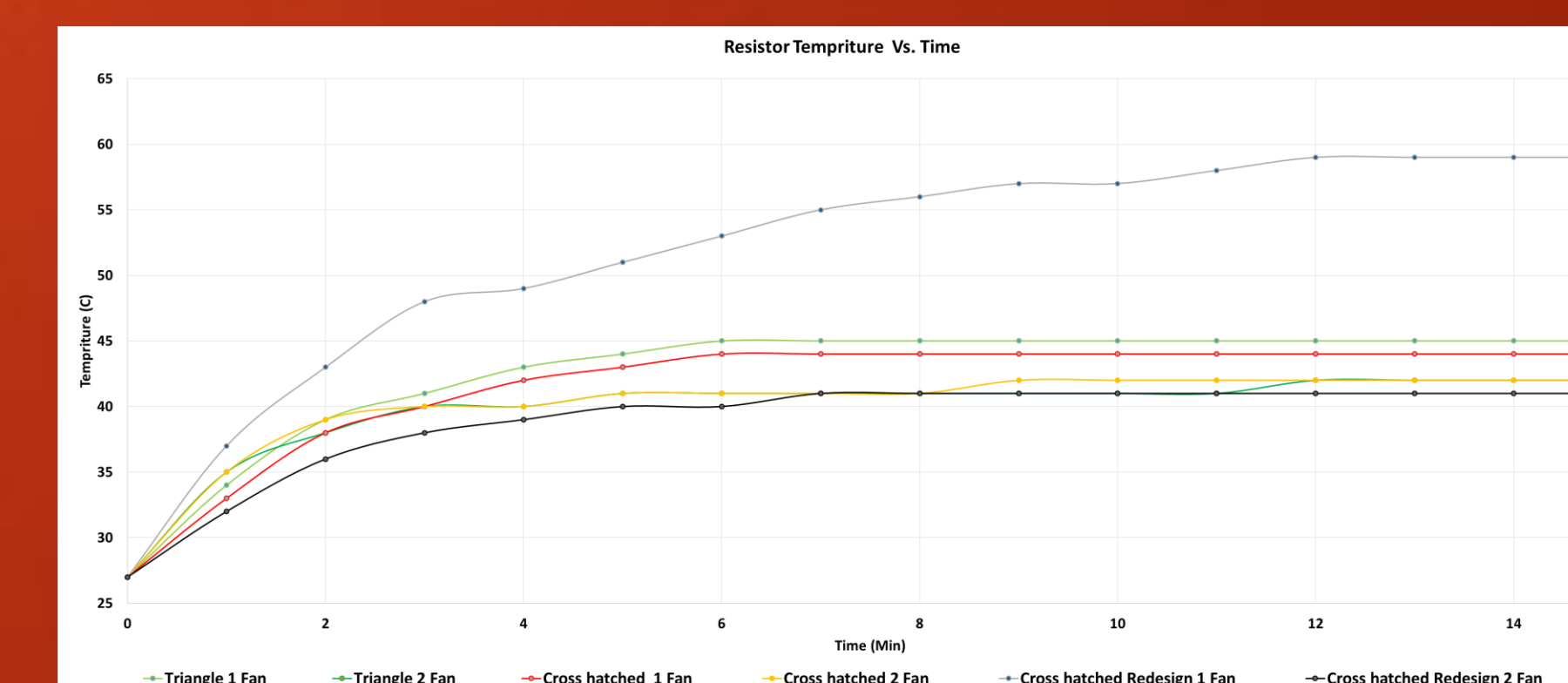
(Tests Pictures at 30 Minute Mark )

- We tested our various heat sinks with the goal of optimizing one to be our final project based on the test results of all three.
- We accomplished our testing with the use of a IR Thermal imaging camera.

## SOLUTION & CONCLUSION



Testing variable	Energy (watts)	weight (grams)	Manufacturing
Water cooling	33	1891	1
Triangle 1 fan	9	432	6
Triangle 2 fan	27	560	7
Cross hatched 1 fan	9	442	4
Cross hatched 2 fan	27	570	5
Cross hatched redesign 1 fan	9	526	2
Cross hatched redesign 2 fan	27	534	3



Testing variable	Water cooling	Triangle 1 fan	Triangle 2 fan	Cross hatched 1 fan	Cross hatched 2 fan	Cross hatched redesign 1 fan	Cross hatched redesign 2 fan
Thermal Resistivity (C/W)	0.07	0.1925	0.1674	0.1912	0.1663	0.3058	0.12475

- Compiled all test data
- Calculated thermal resistivity of each sink
- Applied weights to test and system variables
- Characterized heat sink by:
  - Thermal Resistivity
  - Power Draw
  - Weight
  - Manufacturability
- Determined that the Crosshatched Heat sink with 1 fans attached, was the most viable solution