SOLID STATE THERMOELECTRIC AIR HEATER/COOLER

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FUNDED BY LAB FUND ENGINEERING STUDENTS

Problem Statement

- Develop a dual purpose device that both cools and heats air
- Provide sufficient temperature difference for standard climate conditions
- Develop a device below the cost of currently available alternatives

Design Objectives

- Reduce the amounts of components found in traditional refrigeration cycle A/C units
- Develop a device that is quieter than traditional A/C units
- Maintain a sleek construction without sacrificing functionality
- Design a heat sink subassembly that can produce a desired heat transfer for both airflow and rejection

Future Recommendations

- Reduce weight through the use of lighter materials and a more compact design
- Optimize heat sink subassembly through extensive simulation
- Increase fan CFM

Design Calculations

Temperature Difference

$\Delta T_c = (T_{ambient} - T_{cooler}) = (25^oC - 5^oC)$

$= 20^oC$

Heat removal rate by one module

$Q_c(W) = 8W$ (from performance curve graph (Figure 5) – STEP 1)

Voltage required

V = 4 V (from performance curve graph (Figure 5) – STEP 2)

Power required for each TEC

$P_{in} = I*V = (1.5A) * (4V) = 6\ W$

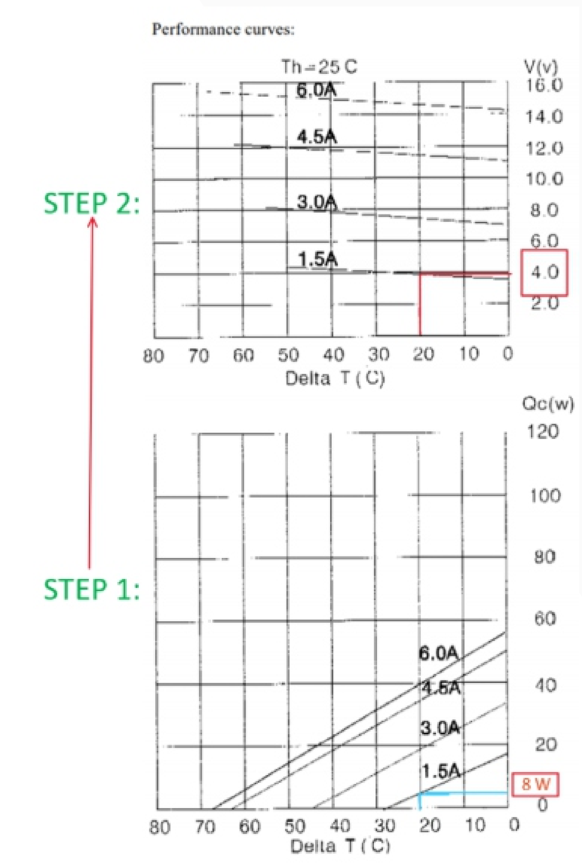
Coefficient of Performance

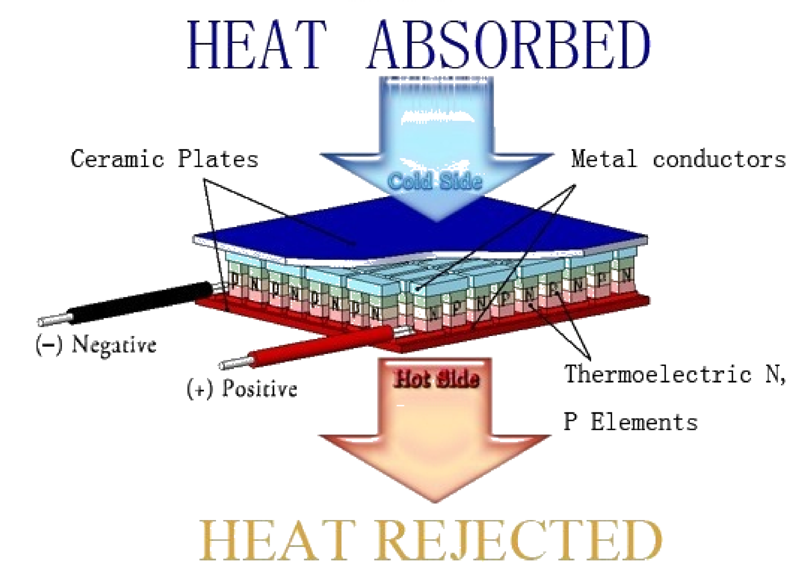
$$COP_R = \frac{Q_c}{P_{in}} = \frac{8}{6} = 1.333$$

Number of TEC modules required

$$n = \frac{Q_{in}}{Q_c} = \frac{160\ W}{8\ W} = 20\ required$$

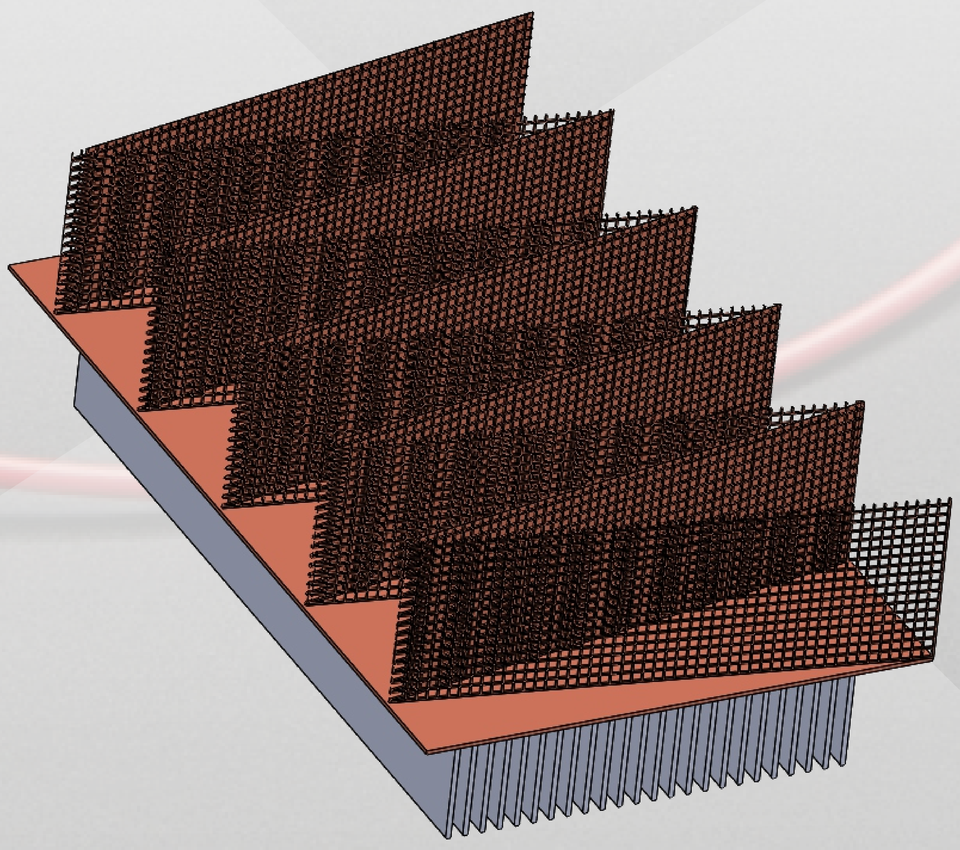
∴ Cannot exceed 20 TEC modules per power supply.

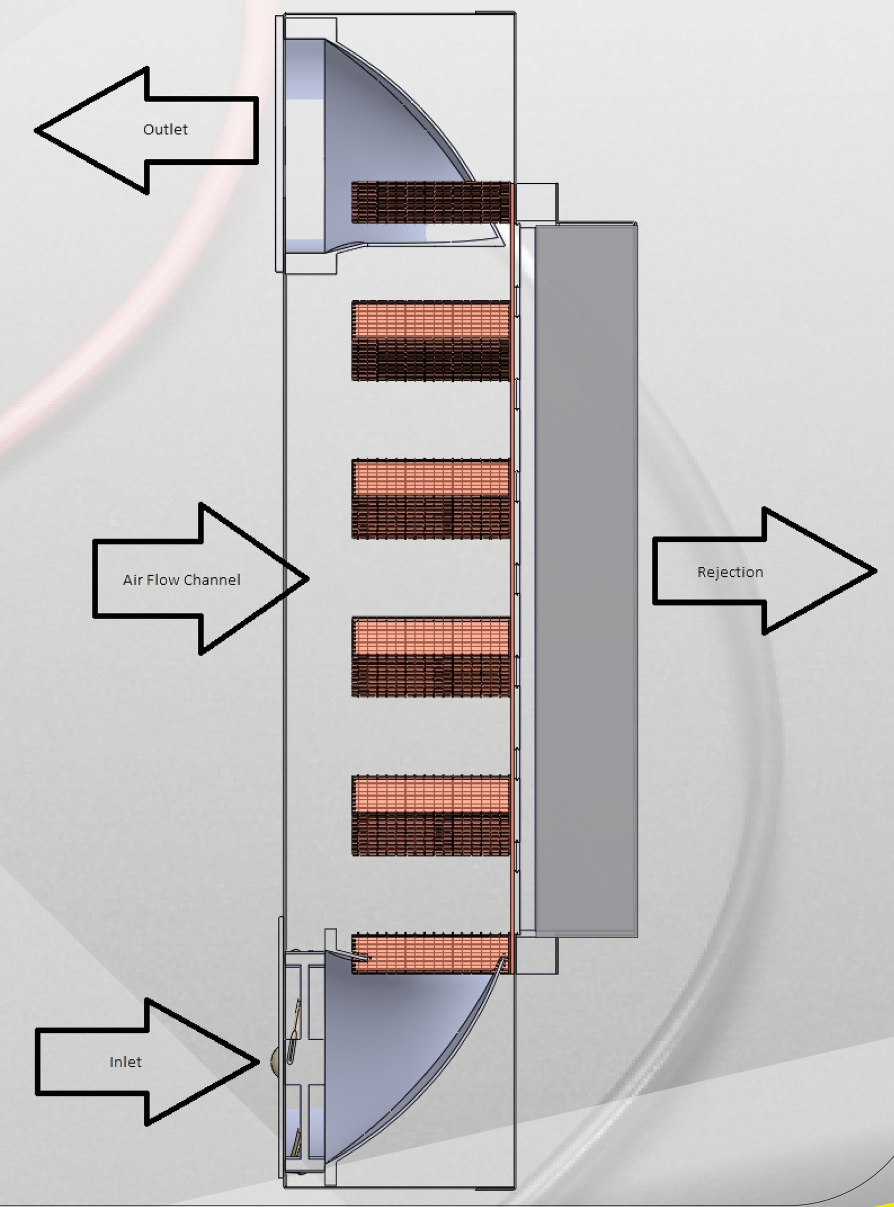




Design Solution

- 30 TEC modules
- 3D printed air flow ducts
- Custom fabricated sheet metal case
- Copper mesh and extruded aluminum heat sink subassembly
- Thermal sensors to monitor temperature inlet/outlet





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