Name(s)
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Project Number
38394

Project Title
Inexpensive, Fluid Convection Based Central Processing Unit Cooler

Abstract

Objectives/Goals
The following research was done on an attempt to design a low-cost CPU cooler capable of handling high heat loads normally produced by high-end CPUs utilized by gamers or overclockers. Although many high-end cooling solutions insist upon using a mechanical pump, natural movement of particles via heat-gradient induced convection shows promise in becoming a cooling solution suitable for dissipating high heat loads.

Methods/Materials
In this research, the cooler was required to effectively dissipate heat loads generated by three different maximum CPU configurations. The first and second configurations was two different CPUs, producing 2 different heat loads, 54 W and 95 W. Additionally, one of the CPUs overclocked from 4.3 GHz to 4.8 GHz to produce an overclock heat load of 180 W. The heat load(W), temperature(C) of CPU, and time was all measured using third-party open-source software. The prototype was constructed from 11 ft of copper tubing, stumps of vinyl tubing, a copper block(from a vendor), and later an Intel-certified aluminum heat spreader. A cooling fan was placed near the copper tube to aid with the heat dissipation. To test the efficacy of the prototype, the prototype had two different comparison standards. The first method was an Intel-licensed stock cooler complimentary with a new processor. The other cooling solution was a high-end pump-powered cooling system.

Results
After testing the two different heat loads, the prototype was 20C more efficient than the stock cooler. Unfortunately, the prototype failed to keep the CPU at safe temperatures at the designated overclock frequency. Furthermore, the pump-powered cooler was 28C cooler than the prototype at 95 W testing, with the prototype constant at 88C. Also, calculations made to determine thermal resistance found 1.055, 0.74074, and 0.444C/W, for the stock, prototype and pump cooling, respectively. Testing revealed evidence of convection, as the top pipe was warmer than the lower pipe.

Conclusions/Discussion
Ultimately, the prototype could not compete with the pump-powered cooler, but with a cost difference of $30 to $200, the prototype was a better value cooler. Overall, this research session concluded with the preliminary development of a convection-based cooler that could handle up to 100 W of heat load. With sufficient redesign and retest, this project may be a gateway into a world with more efficient, budget-oriented cooling systems.

Summary Statement
This project designs and tests an inexpensive CPU cooler prototype that relies on liquid convection rather than mechanical movement of fluids.

Help Received
None. I designed the prototype and built the computer systems, and pump cooler myself. I also tested and analyzed data.