Design of a Thermoelectric Cooler

Team of 2 or 3 students are to design a system to cool one cup of water from room temperature to 50˚F in the shortest amount of time. Each design team will be provided with the following supplies:

- 33.4W thermoelectric cooler Peltier plate from www.customthermoelectric.com
  - Model 12711-5L31-04CQ
  - Sealed with
  - Maximum current: 4A
  - Maximum voltage: 15.4 V
  - Dimensions: 1.57 inch x 1.57 inch x 0.185 inch
- One 12VDC battery charger to serve as a power supply (Schumacher SE-82-6)
- One aluminum cup (3.25 inch ID, 3 inches deep, diameter of lip = 4 inches)
- Ceramique thermal grease from www.customthermoelectric.com (TGCMQ-22G)
- Three AD592 temperature probes (Parallax Part Number 28130)
  - Immerse sensor 1 in the water cup (halfway between the top and bottom)
  - Tape sensor 2 in conductive grease on the cold side of the Peltier plate
  - Tape sensor 3 in conductive grease on the hot side of the Peltier plate (on heat sink)
- 12VDC fan (Cooltron, FD8025S12W3-71, 0.083A, 25.6 CFM, 10” leads, 3-1/8” square, 1” thick)

		
Peltier plate	6 amp power supply	aluminum cup

		
thermal grease	AD592 temperature probe	12VDC box fan

The constraints on the design problem are provided below.

- You must utilize a Boe-Bot to log temperature versus time for your system
- The provided Peltier plate is the only cooling element that can be utilized
- The entire system (except Boe-Bot) must be powered by the provided 12VDC battery charger
- Your system must include a heat sink on the hot side of the Peltier plate (see examples on Youtube and on the Internet)
- You may include one or more fans or other devices to increase convective heat transfer
- You may include insulation and other materials to improve system performance

Each team is required to write a report summarizing their design and reporting on the performance of their cooling system. The report must include the following information:

- Title page
- Executive summary (1/2 page summarizing the challenge, the design, and system performance)
- Design (description, innovative features, photos/drawings)
- Performance
    - Plot of water temperature versus time (from room temperature to 50˚F)
    - Plot of hot side and cold side temperatures versus time (both curves on one plot)
    - Plot of voltage and current versus time for system as provided by battery charger
    - System efficiency AND maximum theoretical efficiency versus time
- Discussion of system performance
- Recommendations
- References

Part of the grade will be based on the length of time required for the water to be cooled to the desired temperature. All projects will be tested simultaneously in class.

Grading:

Evaluation of prototype (, quality of fabrication): 30%
Report: 50%
Performance: 20%