

## ECE 480 Progress Report

Compact DC/AC Power Inverter, Team Seven

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## Background

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The goal of group seven is to design, build, and test a direct current to alternating current power inverter. The project was inspired by *The Little Box Challenge*, a contest sponsored by Google and IEEE to create a power inverter both small enough to be used in many applications and powerful enough to supply a number of household appliances. Group seven is using the same design constraints with the exception of using lower voltages and halved power density.

## Completed Work

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PSpice simulation (09-15 to 10-02): The common theme through all conceptual designs was the use of a bridge. The H-bridge was present in most designs and allowed for an accurate square wave output. Filtering component values still need to be fine tuned for a smoother sinusoidal output.

Initial design (09-22 to 10-10): When working to solidify the group's voltage requirements it became evident that certain voltage inputs and outputs made finding certain components easier and others more difficult. It was decided to move forward with a 120 VAC output in order to have a broad range of test mechanisms. This means a 170 VDC rail is necessary for the H-bridge, but DC-DC converters with a 170 V output are not readily available on the market nor is 170 V a common input. A plan to overcome this obstacle is detailed in the future work section.

Parts ordered and obtained (10-13 to 10-17): Gate drivers for the MOSFETs were ordered and have been delivered to the group. An order has been placed for the four N-Channel MOSFETs that will be needed to create the designed H-bridge that will let the group achieve the desired 60 Hz output. The group has also obtained an Arduino that will be used to provide a signal to the gate drivers that will in turn drive each side of the H-bridge.

## Work in Progress

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Arduino programming (10-13 to 10-24): The team has started with learning how to program the Arduino. The programming for the two low side drivers at 60 Hz is complete. The teams high side pulse width modulation is still being looked at. Further testing will take place to ensure the Arduino appropriately interfaces with the gate drivers.

Heat considerations (10-13 to 10-31): With a 1 KVA power rating minimizing losses will be extremely important in maintaining an average exterior temperature of 60 degrees celsius. Beyond high efficiency, heat sinks will still be necessary. Conceptual heat sink designing has begun, but final size will be determined by final circuit size to assure that the total size constraint is met.

Enclosure design (10-13 to 11-14): Three major constraints for the enclosure design have been laid out: the enclosure is to be 3D-printed using the DECS machines available to the group, the exterior temperature is not to exceed 60 degrees celsius, and the volume of the box will be less than or equal to 40 cubic inches.

Silicon Prototype (10-20 to 10-31): In order to fully identify all necessary heat considerations a silicon H-bridge prototype is built and tested. This will allow all components to be tested without the possibility of harming the expensing silicon carbide MOSFETS.

## **Future Work**

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Testing (10-20 to 11-21): The team is setting out to do enough testing to ensure the design works, the software operates correctly autonomously, and the heat dissipated efficiently as not to melt the enclosure. The silicon prototype will be tested until its thermal rating is reached. The current goal is to complete approximately 50 hours of testing with a number of different resistive loads for the silicon carbide build. This will require that at least 2 team members be present at all times for safety reasons.

DC-DC converters (10-24 to 11-12): As 170 VDC is necessary for the H-bridge rail and 5 VDC is necessary to power the arduino, stepping down the input voltage will be important. The current conceptual design is to step down the voltage using the same techniques used in class D amplifiers.

Possible ordering of more parts (10-20 to 11-21): Although the group will use utmost caution in testing each of the recursive designs there is still a possibility that some parts will be destroyed or damaged in the testing process. With this in mind the group will budget a buffer period in November to be able to order parts and rebuild if necessary.

Assembly of final design (11-14 to 11-21): After completing testing using the cheaper silicon parts the group will use the more expensive parts to start completing the final design. Once the design has been constructed the group will slowly start to pull more power through the circuit and monitor the design temperature to ensure that no parts are harmed. This final design will be constructed to abide by the 40 cubic inch size constraint.