Functionality

- Convert DC voltage to 120vAC
- Output is at 60.25Hz
- Interface with RPI and ESS
- Handle variable loads

Design

- Input voltage is determined by the battery voltage ranging from 160v to 235v (205v nominal)
- Output 120vAC

Design Elements:

- Voltage inverted using an H-bridge
- Signals to the H-bridge are driven by an Atmega128 microcontroller using a uni-polar PWM scheme
- Low and High voltage signals are isolated
- LC filter is used to filter the output of the H-bridge into a sine wave
- Transformer isolates the load

PWM Scheme:

- The uni-polar PWM scheme is created by comparing reference sine waves to a triangle wave
- This reduces the harmonics

Differential Amplifier Circuit

- A diff-amp was designed to measure the output voltage after the filter
- The diff-amp could regulate the output voltage with a closed loop system

Implementation

- System converts 210vDC (from power supply) to 124Vac
- Two PCB boards
  - One fabricated at Lafayette (Right)
  - One copy-cap board from ESS with sensors (Left)
- Filter board was mounted vertically on the side of the case

Distortion:

- At high voltage the sine wave became distorted
- This may be due to resonance in the filter
- There may be core saturation in the inductors

Custom Parts Designed:

- Parts designed
  - H-Bridge/Inverter
  - Isolation Transformer
  - Differential Voltage measurement
    - 12v DC-to-DC converter (hi-lo voltage isolation)
  - Filter microcontroller

- Parts purchased

Problems interfacing with ESS:

- When ESS is connected to EDS it appears an initial current surge occurs
- This causes damage to the IGBTs
- The Hi-Lo isolation worked and no low side components were harmed

Next Steps:

- Implement a buck converter and use a Maximum Power Point Tracking algorithm to increase power intake 12-15%
- Create a current controller for the current going to ESS to improve efficiency in storing excess voltage in the batteries

Conclusion

- EDS met basic requirements of changing DC voltage into AC voltage
- Requirements on THD (less than 3%) and frequency accuracy (60 +/- 0.05%) were failed
- There was not enough time to implement a closed loop system for voltage regulation
- New inductors may produce better response at high voltage and current
- A delay circuit could be designed to prevent the problem interfacing EDS with ESS

Demonstration:

- With the EDS board connected to a 210vDC supply we cooked burgers on a George Foreman Grill using the AC voltage out of the EDS board