# Electric Motor Controller


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## Background

Electric vehicles are the future of low cost, low emission travel. To complete our capstone requirement we set out to design, build, and test an electric motor controller capable of handling extremely high power levels. This was accomplished by applying our knowledge of electrical engineering principles and research methods. What we achieved, in our opinion, is the most affordable and safest motor controller available today for high power applications.

## Design Objectives

When our team first started this project, we identified a few key objectives early on to maximize our effectiveness. It was decided that our primary objective for the motor controller would be the capability of handling abnormally high power levels. Secondly, our controller design would require multiple safety factors in order to be user safe. Finally, it would need a user interface that allowed the user insight into the motors status, helping to ensure proper function.

## Design Decisions

Due to the complexity of building a motor controller we had to make many decisions about our design. The most critical decision for our project was whether to use a micro controller or analog control circuitry. Utilizing a design matrix, our team determined that a micro controller would be the optimum choice for this project due to the flexibility programmability would give us. This led us to create a user interface with LEDs because a micro controller made LED control very simple. The enclosure seen in **Image 1** was chosen for its large cooling fins, ample space, and low cost (It was donated by our client).

Engineering Design

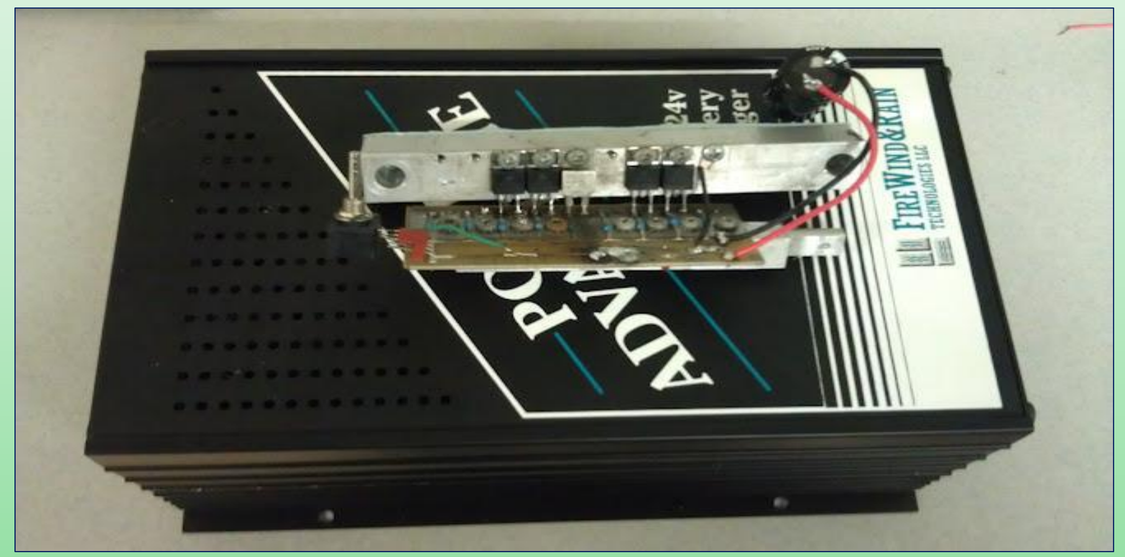

**Image 1:** The main power circuit sitting atop the enclosure prior to mounting.

## Bill Of Materials

Over the course of the semester we purchased materials to fabricate our project. **Figure 1** shows an itemized list of materials purchased, the quantity, their part number, and the purchase price.

| Quantity | Description | Mfr # | Mouser# | cost per unit | Total Cost |
|---|---|---|---|---|---|
| 2 | MicroController | MSP430F2012TN | 595-MSP430F2012IN | 2.4 | 4.8 |
| 2 | 3.3V line regulator | UA78M33CKCSE3 | 595-UA78M33CKCSE3 | 0.6 | 1.2 |
| 1 | DC/DC isoltated converter | PWR1308AC | 580-PWR1308AC | 31.79 | 31.79 |
| 5 | 3A gate driver | FOD3184 | 512-FOD3184 | 2.72 | 13.6 |
| 1 | Hall Effect Current sensor | HASS 600-S | | 27.5 | 27.5 |
| 2 | Comparator differental | TLC352IP | 595-TLC352IP | 1.39 | 2.78 |
| 10 | 10k ohm resistor | 293-10K-RC | 293-10K-RC | 0.15 | 1.5 |
| 2 | 10k Thermistor 1% | B57863S103F40 | 871-B57863S103F40 | 2.09 | 4.18 |
| 5 | 150ohm resistor for opto-coupler | MF1/2DC1500F | 660-MF1/2DC1500F | 0.16 | 0.8 |
| 20 | 15ohm resistor gate drive to mosfet | RN65D15R0FB14 | 71-RN65D-F-15 | 0.43 | 8.6 |
| 2 | diode 3 amp hold up for current sense | 1N5820 | 844-1N5820 | 0.26 | 0.52 |
| 10 | 100uF caps | EEU-TP1V101 | 667-EEU-TP1V101 | 0.92 | 9.2 |
| 12 | Power mosfets 140A 0.024 | IXFK140N30P | 747-IXFK140N30P | 15.37 | 184.44 |
| 10 | Switching diodes 150A 120ns | IDW100E60 | 726-IDW100E60 | 5.02 | 50.2 |
| 2 | nand gate | CD40107BE | 595-CD40107BE | 0.46 | 0.92 |
| 2 | 10 pin connector | 1725737 | 651-1725737 | 5.73 | 11.46 |
| 2 | 5 pin connector | 1725685 | 651-1725685 | 2.9 | 5.8 |
| 4 | BusBars Aluminum | | | | |
| | | | Total | 359.29 | |

**Figure 1:** Price list for materials

## PCB Design

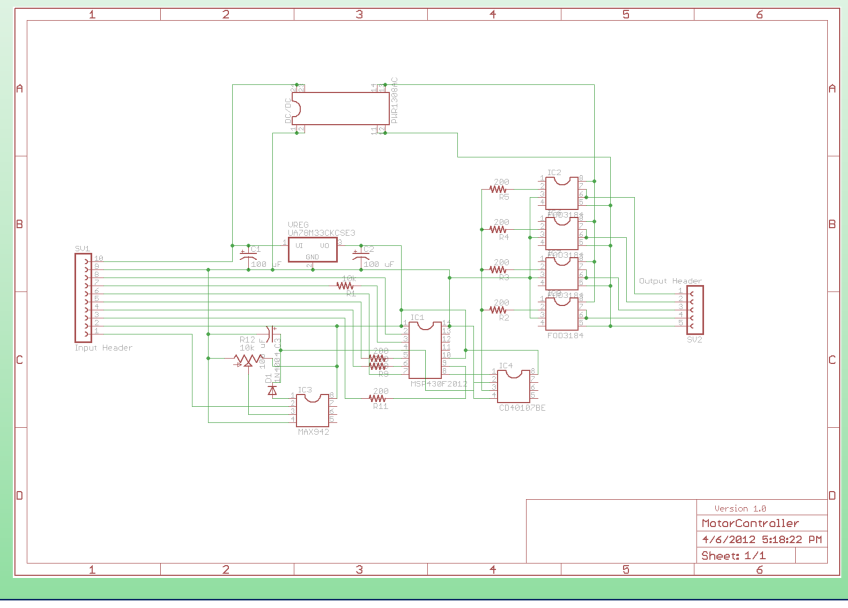

**Image 2:** PCB Schematic Layout

In designing the controlling circuit we started with a schematic layout shown in **Image 2** which later became what is known as a Gerber file. The Gerber file is what was used to manufacture the physical circuit. This is shown in **Image 3**.

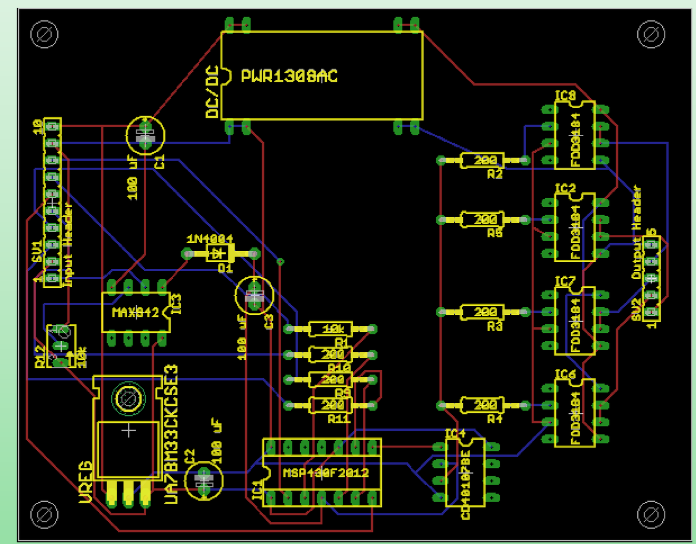

**Image 3:** Gerber File

## Simulation Results

Thanks to the program "Matlab Simulink", we were able to simulate our controller design before constructing it. This saved us a lot of time by allowing us to see the effect of changes without rebuilding the whole circuit.

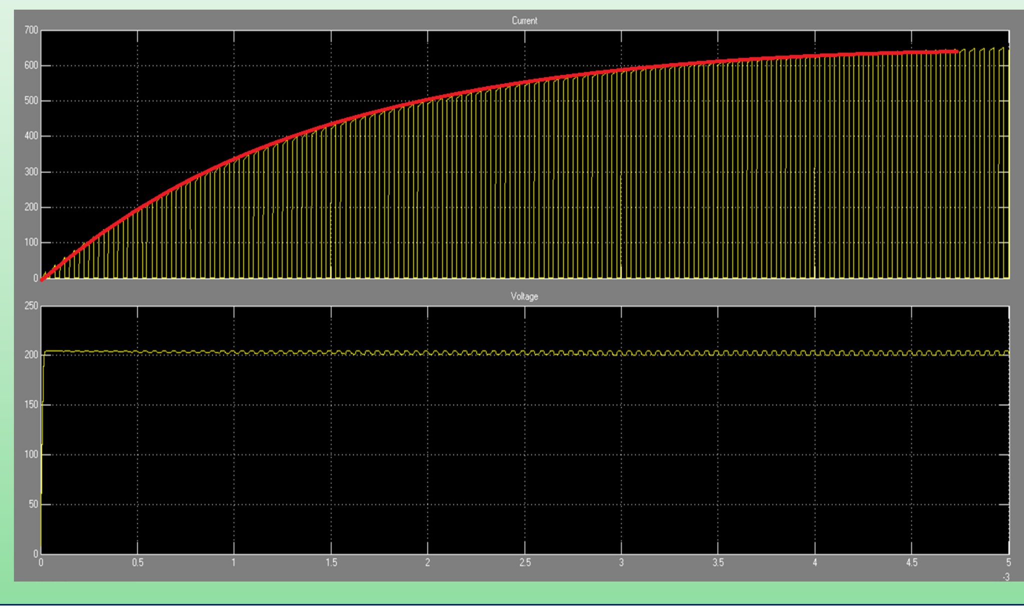

**Image 4:** Wave forms returned from simulation showing pulse by pulse current limiting

## Acknowledgements


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