

Development and Systems Integration of a Modular Power Factor Corrected Pre-regulator, LiFePO4 Battery Charger, DC Motor Controller, and Battery Monitoring System

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Electric and hybrid electric vehicles are the state of the art in the automotive industry because they increase efficiency and reduce the negative environmental impacts of burning fossil fuels. The problem solved by this phase of the project is the electronic industry's lack of simple, expandable, adaptable, and low cost solutions to battery monitoring, power factor corrected battery charging, and motor control. The goal for this phase of the project is to use the basic circuits developed in previous phases of the project to develop a power electronics system to be used in the design of electric and hybrid vehicles. Each circuit developed in this project was simulated in electronic CAD programs and prototyped on a small scale in order to validate a successful design. A small pickup truck converted to be an electric vehicle was purchased from a previous ISEF competitor as a test platform for the system developed in this project. All the vehicle's existing components except the electric motor, battery contactors, fuses, and throttle linkage were removed. The electric vehicle systems developed in this project were then installed. The vehicle's existing 1,584 lb lead acid battery pack was replaced by a 115 volt, 6.9 kWh LiFePO4 lithium battery pack weighing only 250 lbs. A 5 mile driving test was performed as a real-life test of the vehicle power systems. Voltage transients, duty cycle, motor current, and vehicle speed were monitored during the driving tests. The driving test was successful, showing minimal voltage transients, minimal component heating, and smooth speed control. The scalability and modularity of the vehicle system developed in this project makes its components adaptable for use in other high power electronic systems such as alternative energy systems.

Awards Won:

Fourth Award of \$500

International Council on Systems Engineering - INCOSE: First Award of \$1,000

International Council on Systems Engineering - INCOSE: First Award of \$3,000