Electric Vehicle Power Converter

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Outline

- Brief Summary of Project
- Functional Description, System Block Diagram, and Performance Specifications
- Battery Testing Results and DSP
- Schedule and Milestones
Project Summary

- PFC Circuit (Power Factor Correction)
- Battery Testing Circuit
- DSP Programming
- Bidirectional Converter
System Block Diagram

Figure 1: High Level System Block Diagram
Power Factor Correction

Figure 2: PFC Boost Converter with Controllers
Power Factor Waveforms

Figure 3: PFC Outputted Waveforms
Battery Specs for High and Low Voltage

- **7.4V**
- **3000 MilliWatt hours**

- **51.8V**
- **10Amp-hours**
- **Maximum Discharge Rate 40A**
Battery Testing Circuit

Figure 4: Battery Testing Circuit
Battery Testing Circuit

- IR2110 used as Gate Driver
- G4PC30UD IGBT used
- 20 ohm resistor used for Small Scale
- 100 ohm resistor used for Large Scale
Battery Discharging Rate

Figure 5: Battery Discharing Rate Plot
Figure 6: DSP Program Flow Chart
Battery Testing Small Scale

Figure 7: Small Scale Battery System
Small Scale Results

Figure 8: Discharging Rate Plot (7.4V)
Comparison of Discharging Rate

Figure 9 & 10: Experimental Vs. Theoretical Plot
Discharging Rate of 51.8V Battery

Figure 11: Discharging Rate (51.8V)
Figure 12: Voltage From 51.8V Battery
Figure 13: Current from 51.8V Battery
Bi-Directional Converter

Figure 14: PFC Boost Converter and Boost Converter
Designing the voltage sensing circuit

Figure 15: Sensing Circuit Design
Possible Approach to Design

- Taken from Florida State University’s Lining Zhou
- Build power circuit on one side and control on the other
- Layered Approach
- Prototype level
- DC-AC Converter

Figure 16: Lining Zhou's DC-AC Converter
Updated Parts List – Bridge Diode Rectifier

- Replacing NTE5328 with
  MCC25010-RH
- Max RMS Bridge Input Voltage = 800 V
- Surge Overload Rating = 400 A (Peak)
- Average Forward Current
  (TC=+55C, IF(AV) = 25A)
Updated Parts List – Voltage Regulator

- Change from LM1117T-5.0/NOPB to LM1117T-3.3/NOPB
- Previous regulator not in stock or not compatible
- $V_{in} = 15V$
- $V_{out} = 3.3V$
Updated Parts List – Gate Driver

- Change IR2110 to IR2181
- Fully operational to +600V
- Gate drive supply range from 10 to 20V
- 3.3V and 5V input logic compatible
- Can drive two IGBT’s
IR2181 Gate Driver Layout

Typical Connection

(Refer to Lead Assignments for correct pin configuration). This/These diagram(s) show electrical connections only. Please refer to our Application Notes and Design Tips for proper circuit board layout.
IR2181 Setup

- Isolate the DSP board from the power circuit
- Optocoupler connects to both High and Low sides
- General design that will used towards our system
Overall System Design

Figure 22: Overall System Design for Project
Battery Safety

- Battery can be dangerous
- Need sufficient safety when testing
- Battery safety equipment
- Bags, enclosures, glasses, etc.

Figure 23: Battery Protection Bag
## Remaining Updated Schedule

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Figure 24: Updated Schedule
Goals

- Previous Goals
  - PCB Designing
  - DSP Designing
  - Battery Testing
  - Simulation of Full System
  - Implementation of Full System

- New Goals
  - DSP Designing
  - Simulation of Full System
  - Implementation of Full System
  - Battery Safety
References

Questions?