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

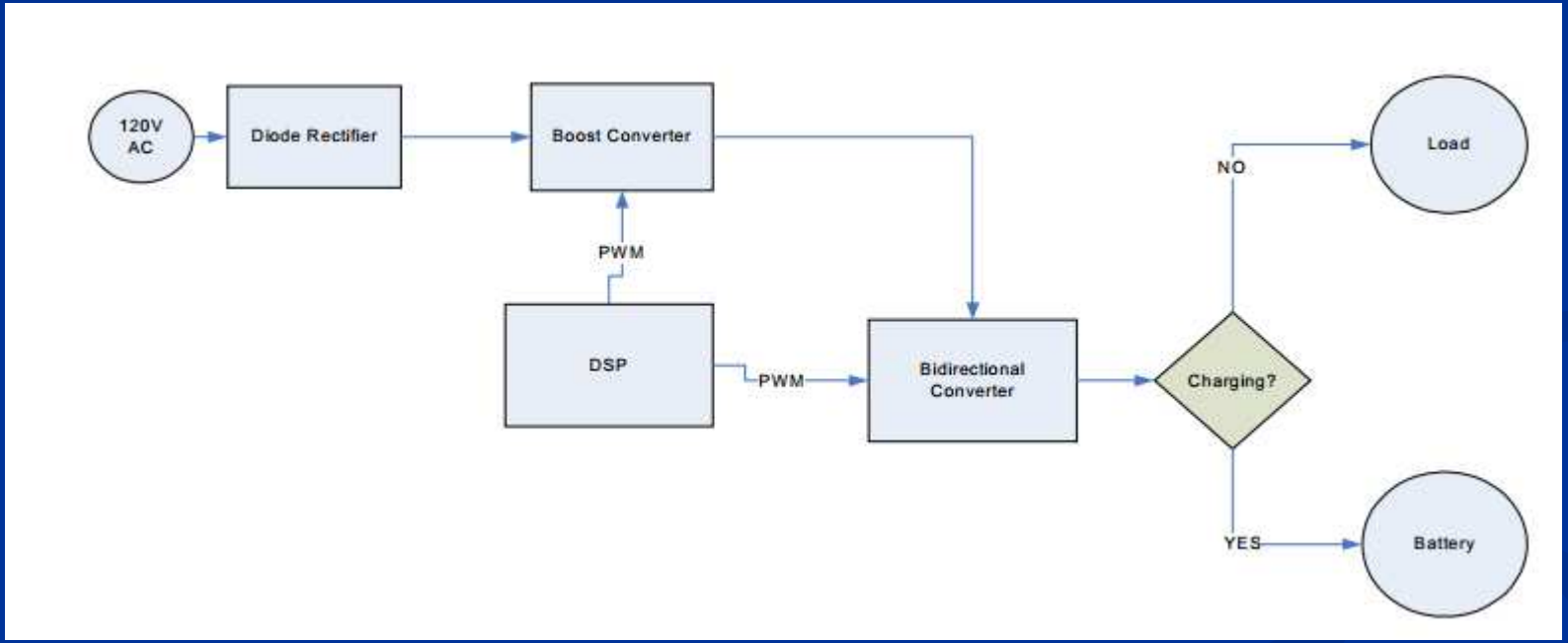


Figure 1: High Level System Block Diagram

Power Factor Correction

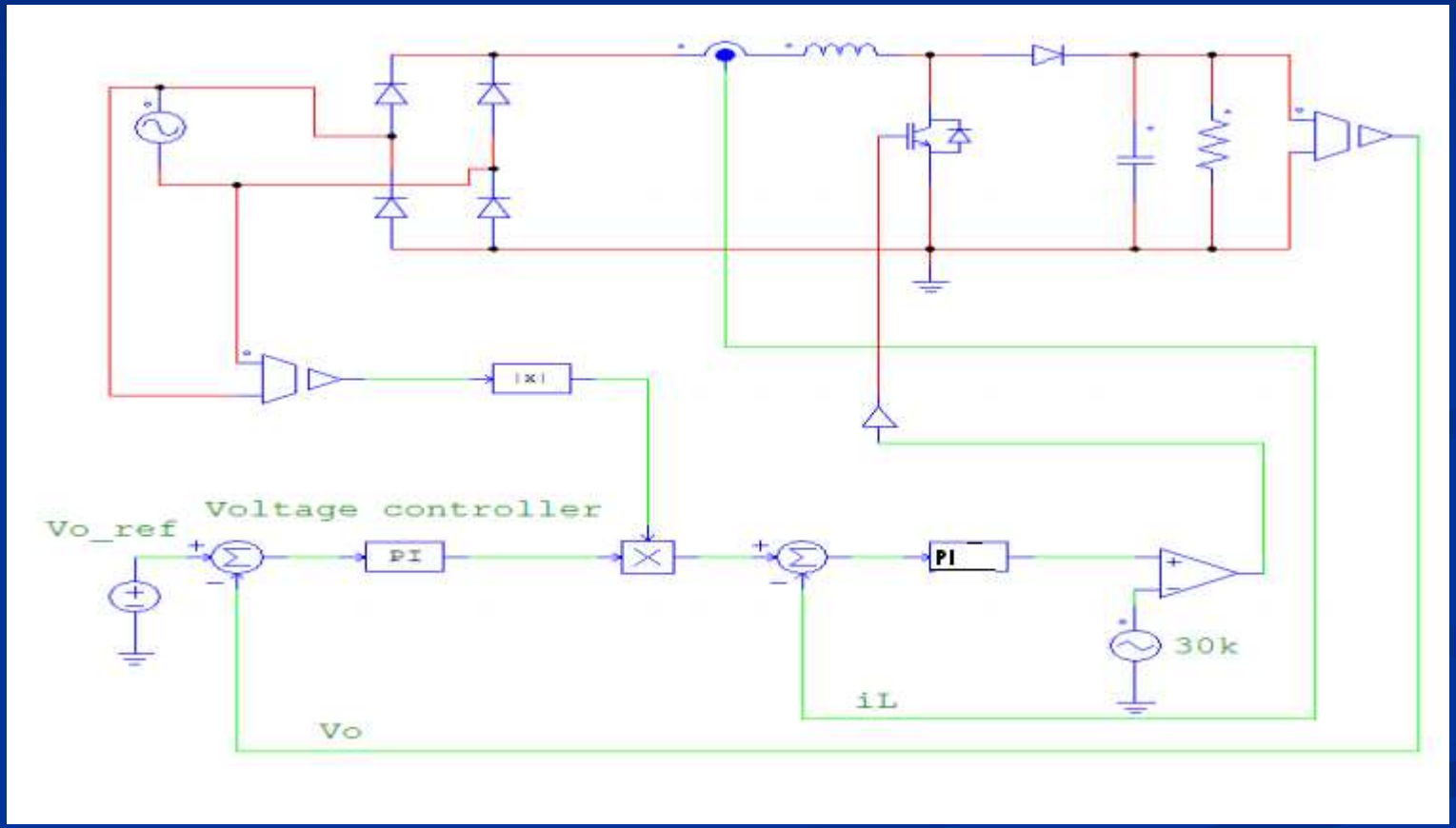


Figure 2: PFC Boost Converter with Controllers

Power Factor Waveforms

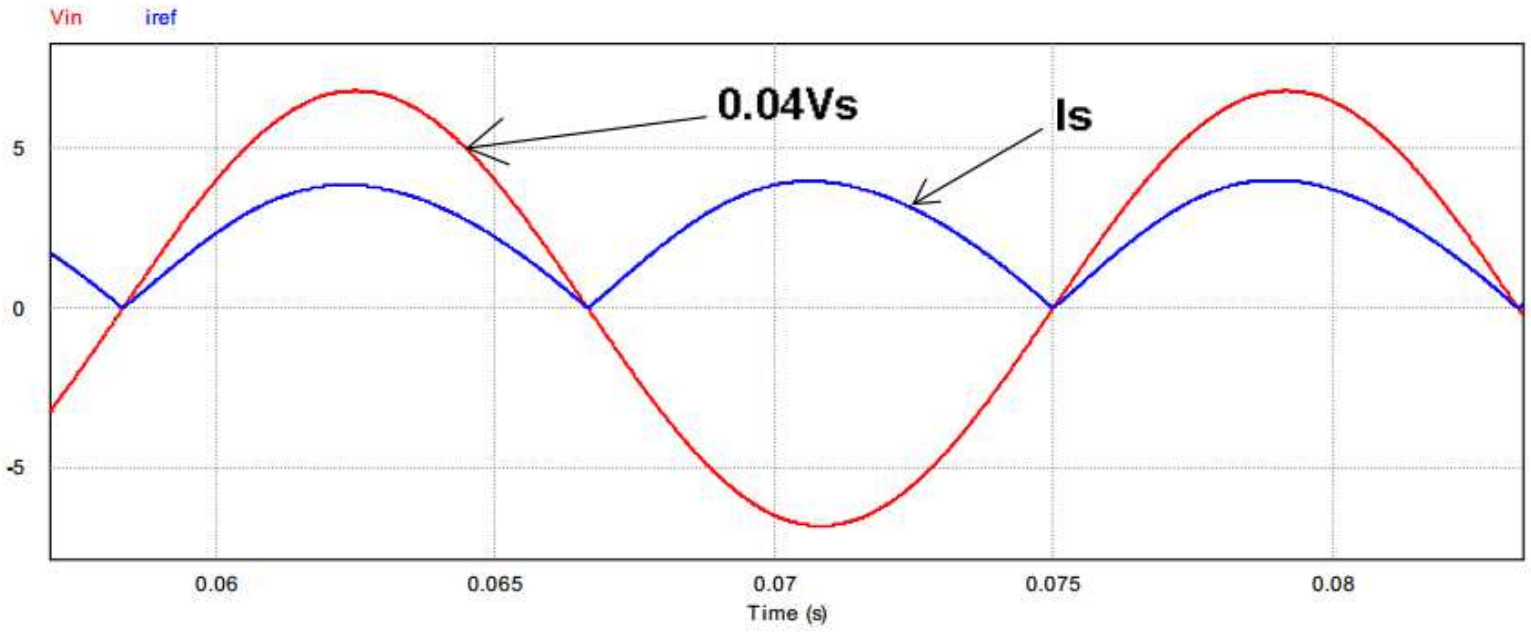


Figure 3: PFC Outputted Waveforms

Battery Specs for High and Low Voltage

- 7.4V
- 3000 MilliWatt hours

- 51.8V
- 10Amp-hours
- Maximum Discharge Rate 40A

Battery Testing Circuit

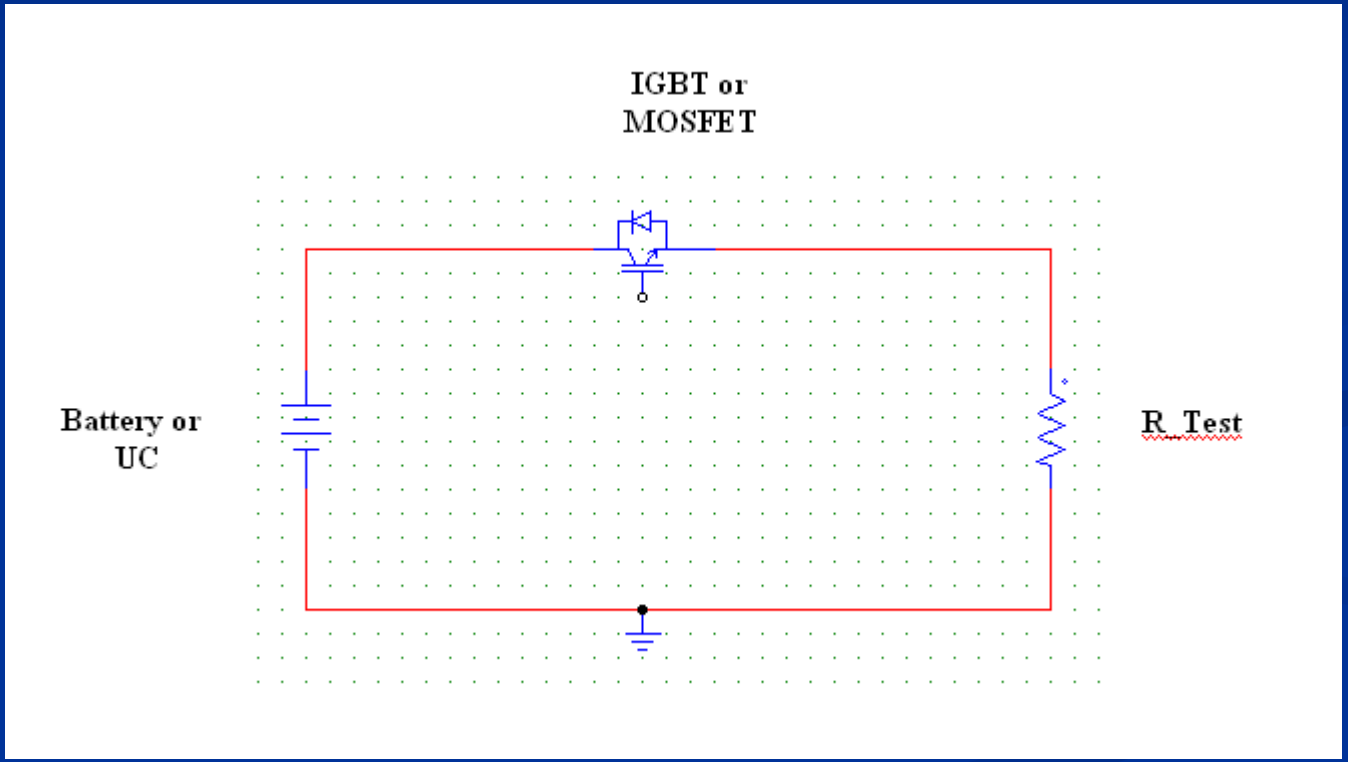


Figure 4: Battery Testing Circuit

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

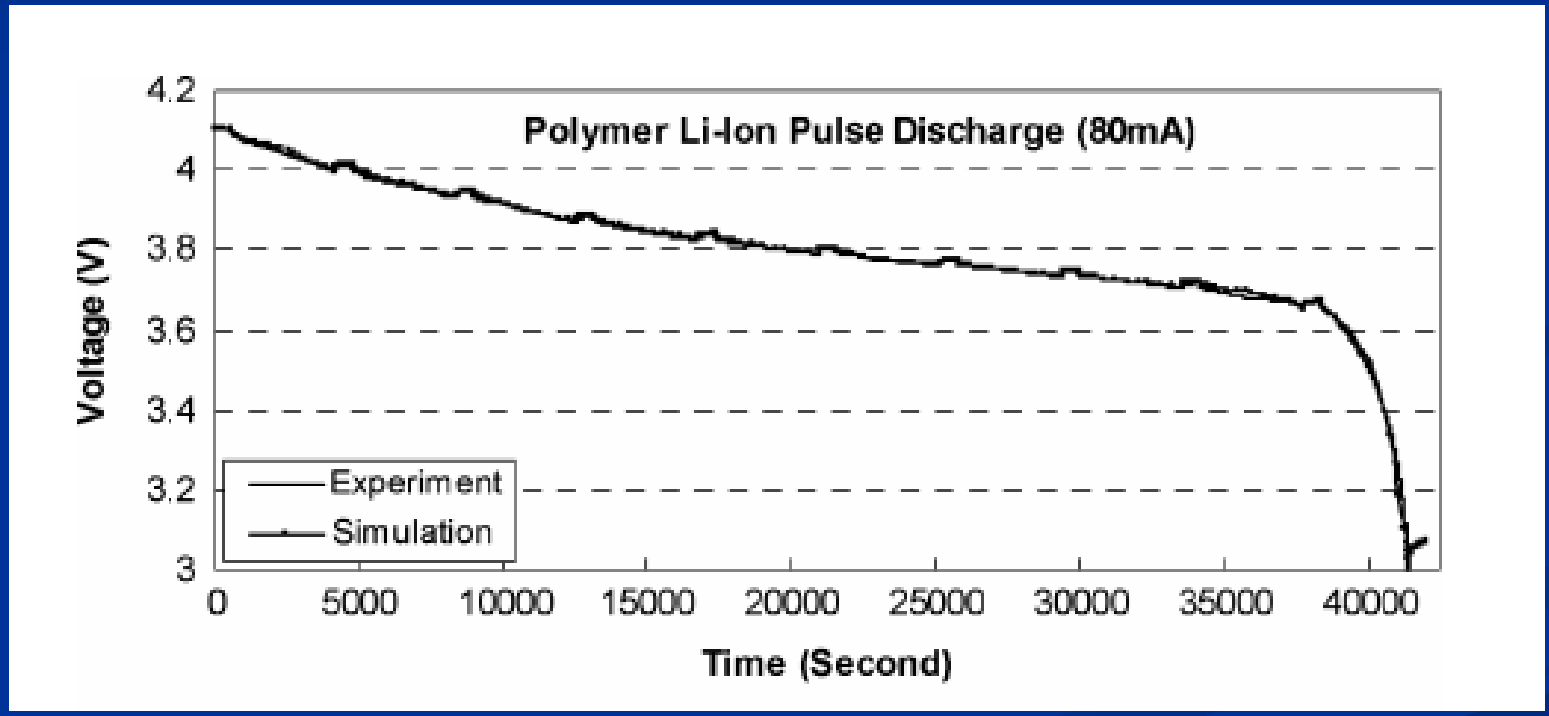


Figure 5: Battery Discharing Rate Plot

DSP Flowchart

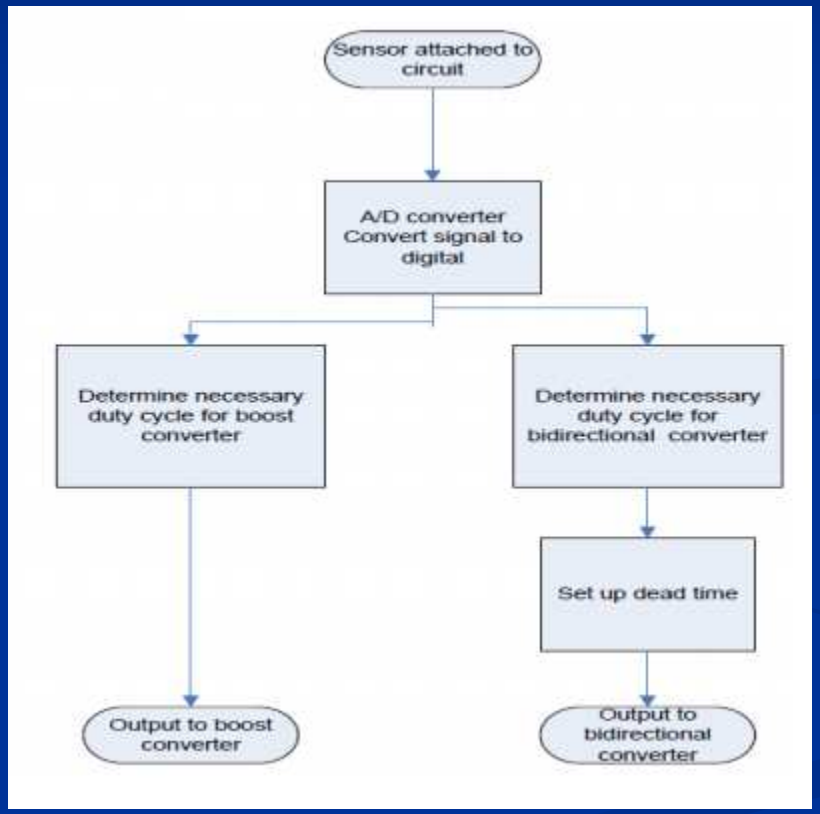


Figure 6: DSP Program Flow Chart

Battery Testing Small Scale

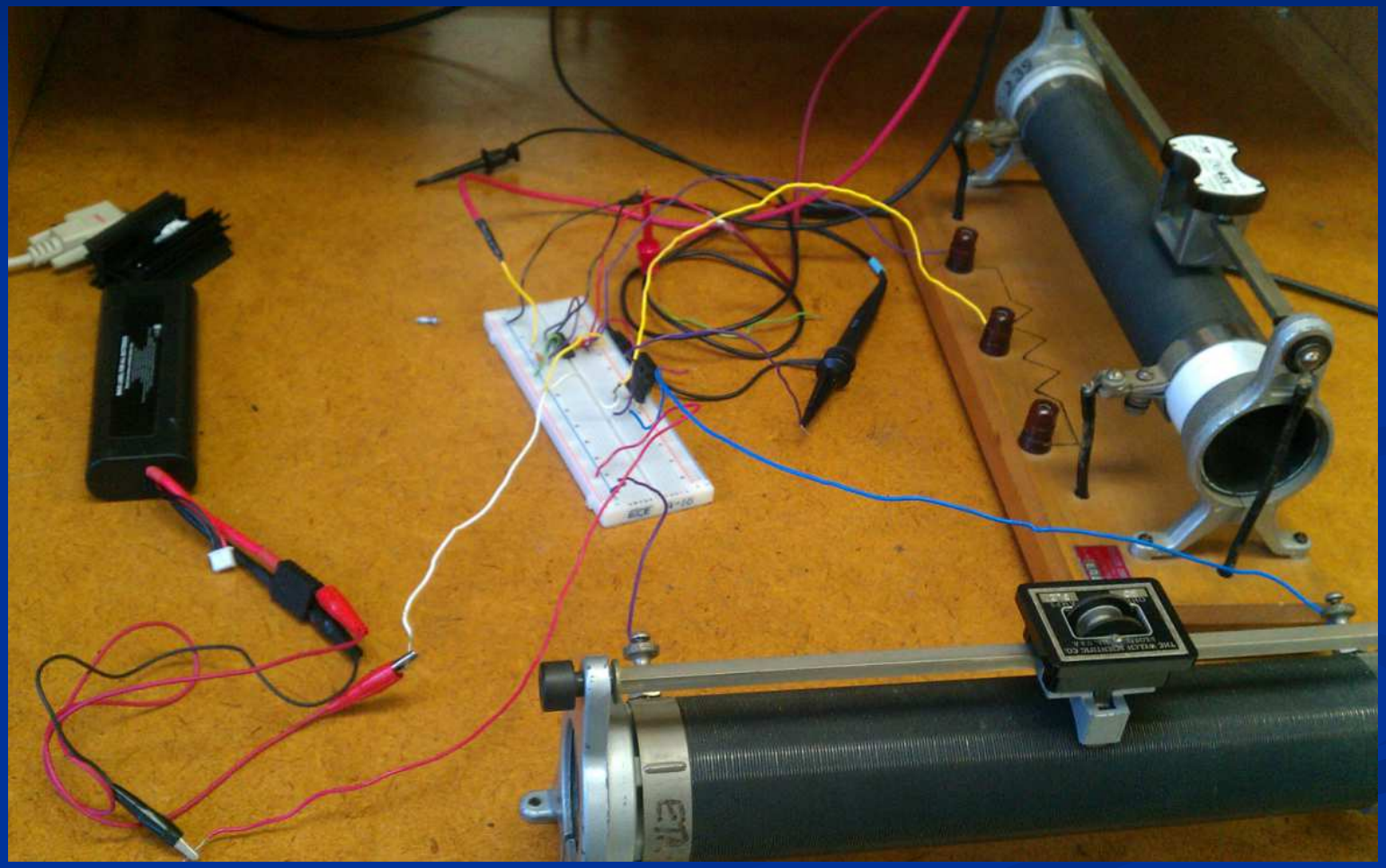


Figure 7: Small Scale Battery System

Small Scale Results

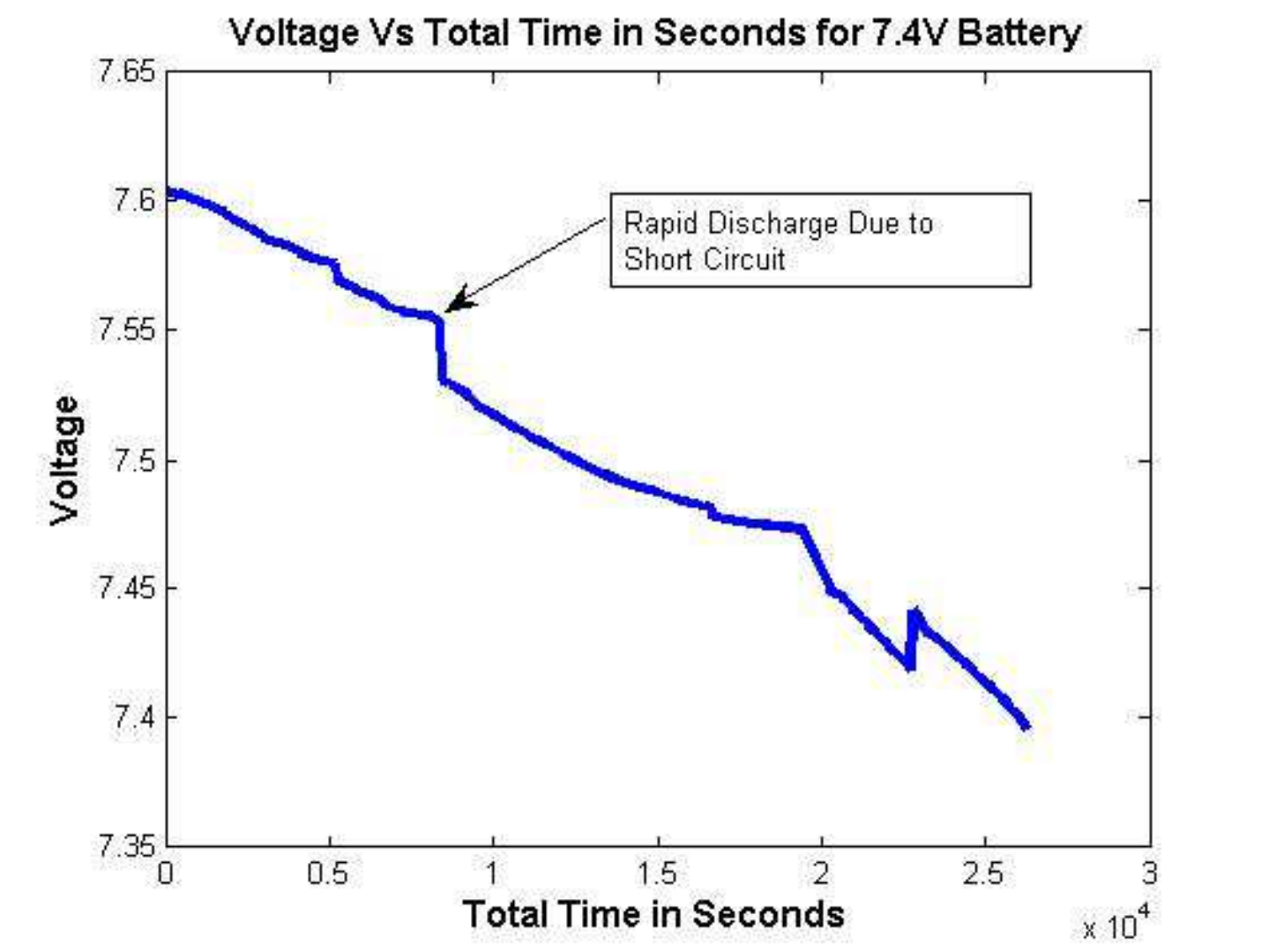
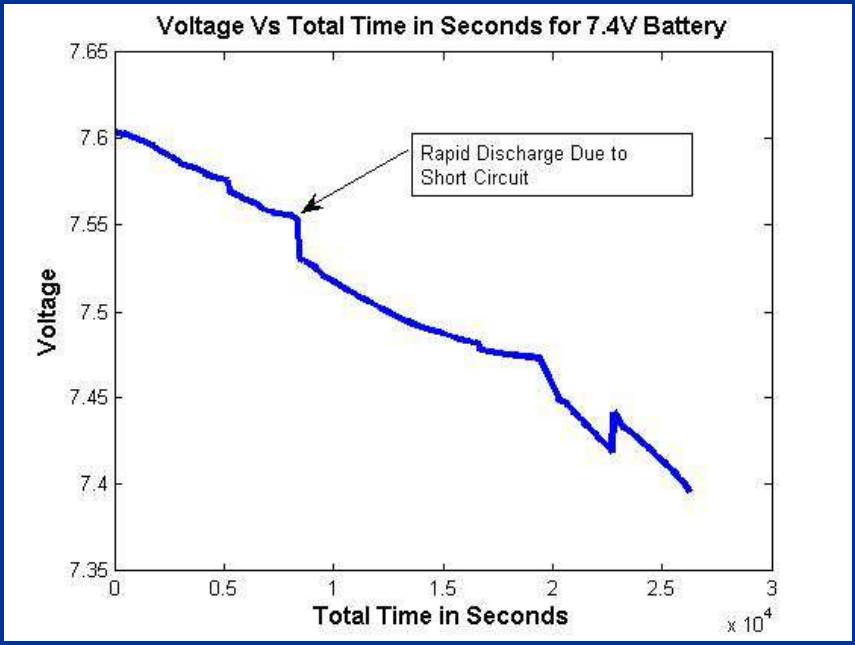


Figure 8: Discharing Rate Plot (7.4V)

Comparison of Discharging Rate



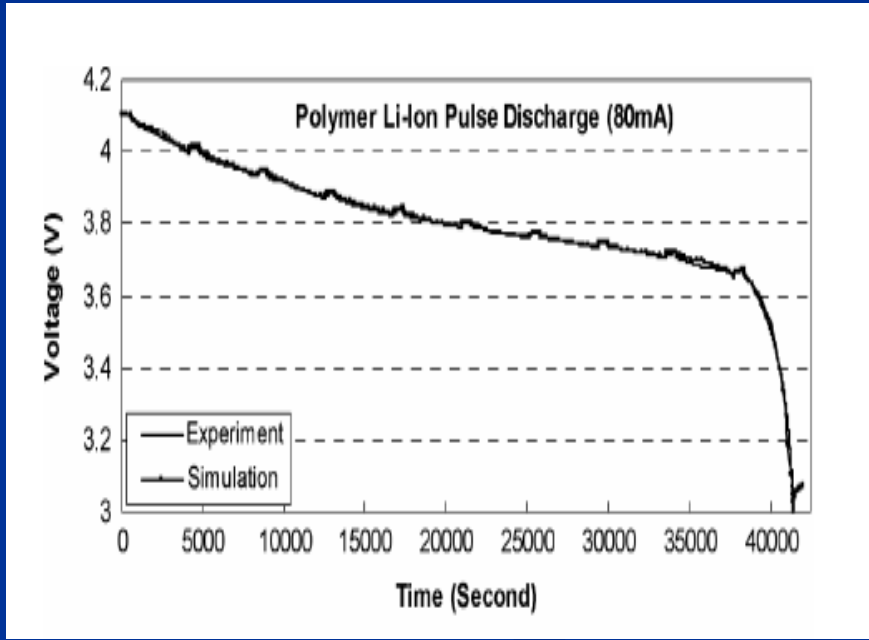


Figure 9 & 10: Experimental Vs. Theoretical Plot

Discharging Rate of 51.8V Battery

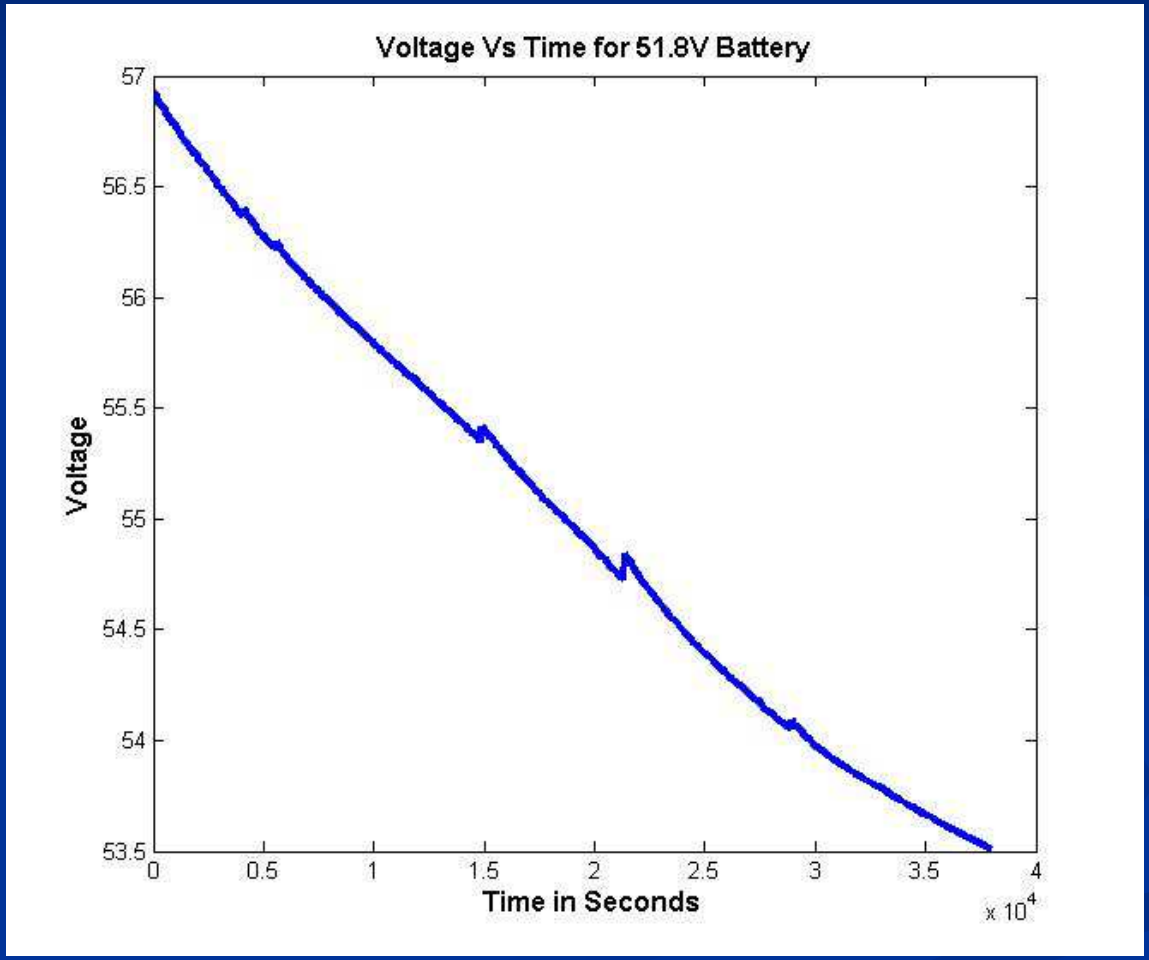


Figure 11: Discharging Rate (51.8V)

Voltage

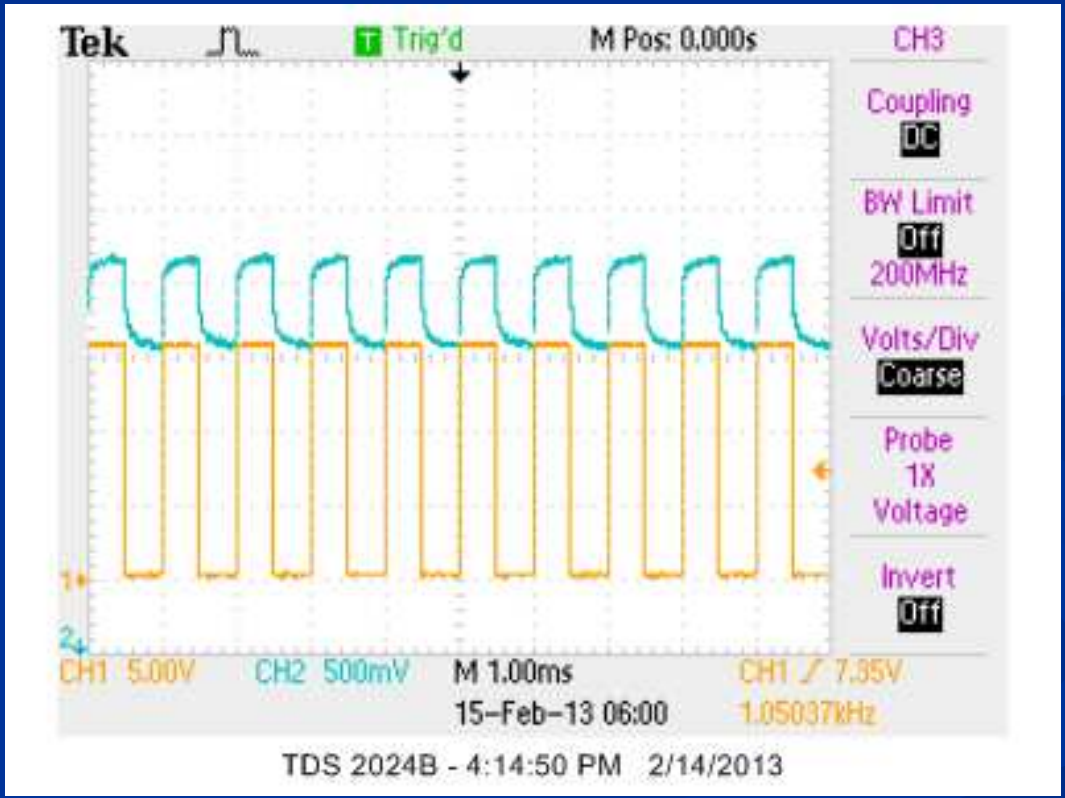


Figure 12: Voltage From 51.8V Battery

Current

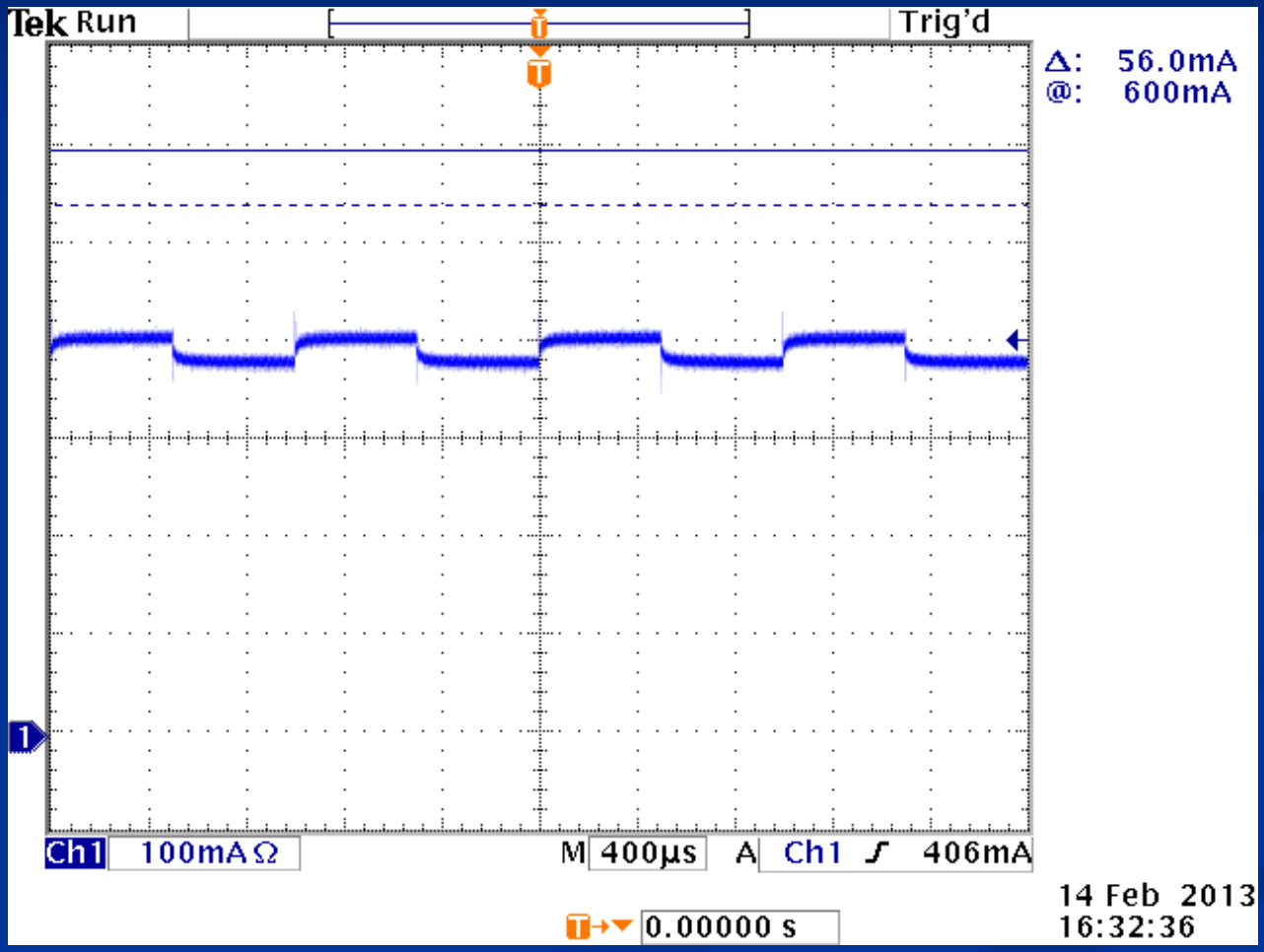


Figure 13: Current from 51.8V Battery

Bi-Directional Converter

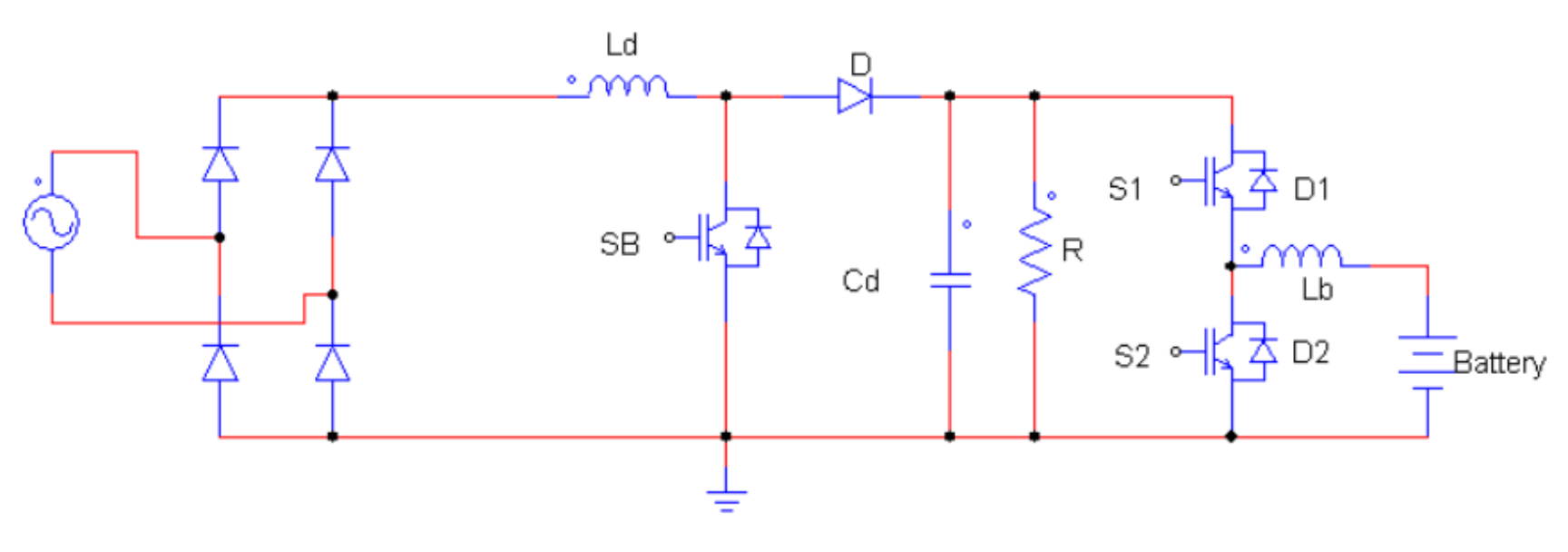


Figure 14: PFC Boost Converter and Boost Converter

Designing the voltage sensing circuit

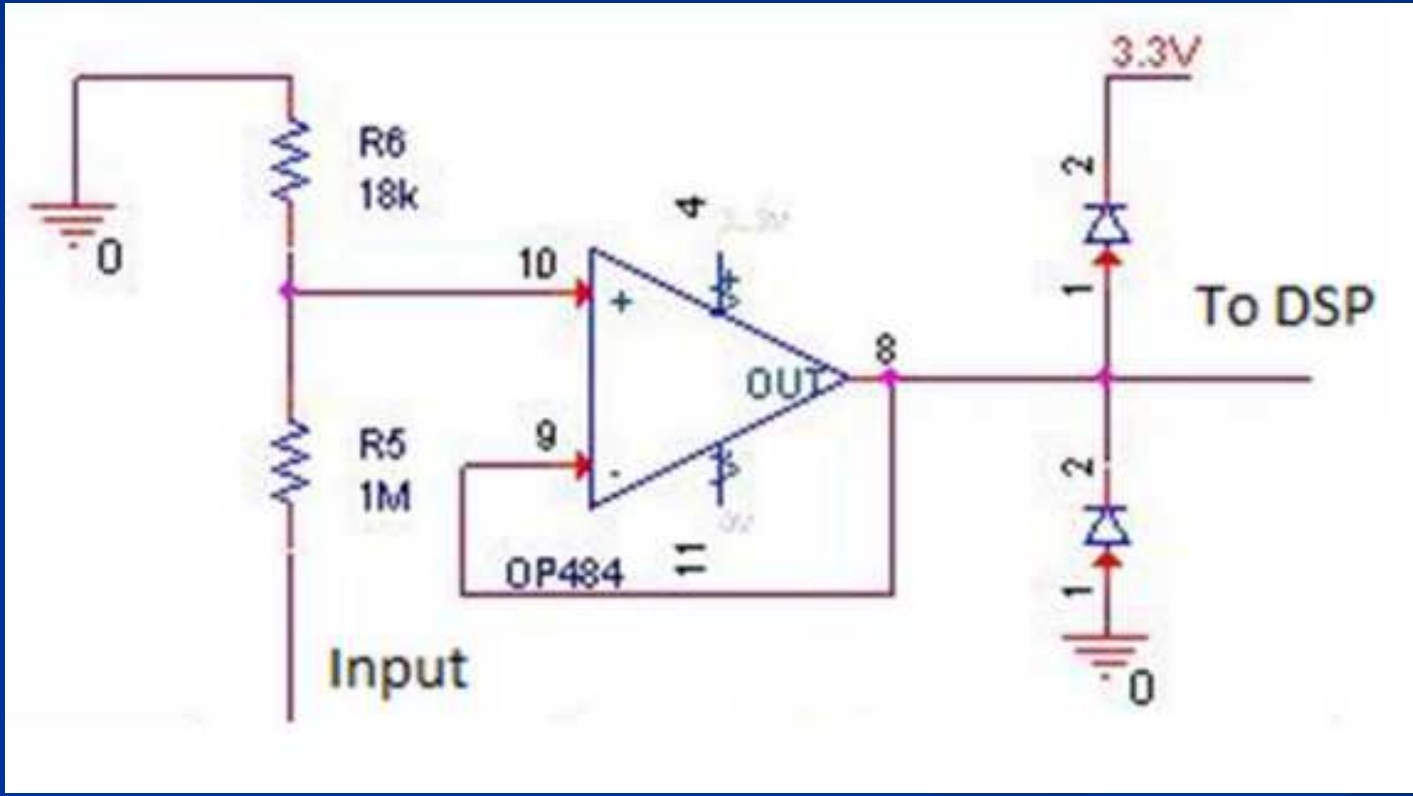


Figure 15: Sensing Circuit Design

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

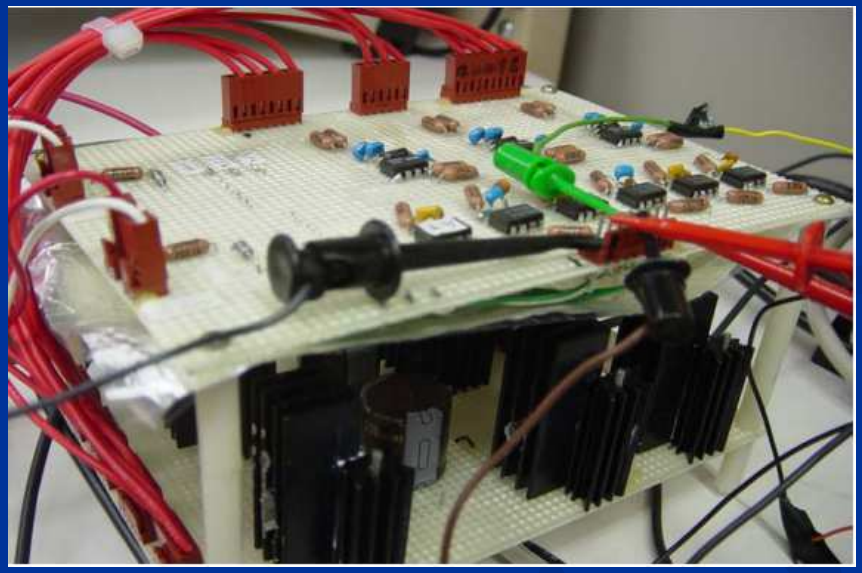


Figure 16: Lining Zhou's DC-AC Converter

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)

Figure 17: Bridge Diode Rectifier (MCC25010-RH)

Updated Parts List – Voltage Regulator

- Change from LM1117T-5.0/NOPB to LM1117T-3.3/NOPB
- Previous regulator not in stock or not compatible
- Vin = 15V
- Vout = 3.3V

Figure 18: Voltage Regulator (LM1117T-3.3/NOPB)

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

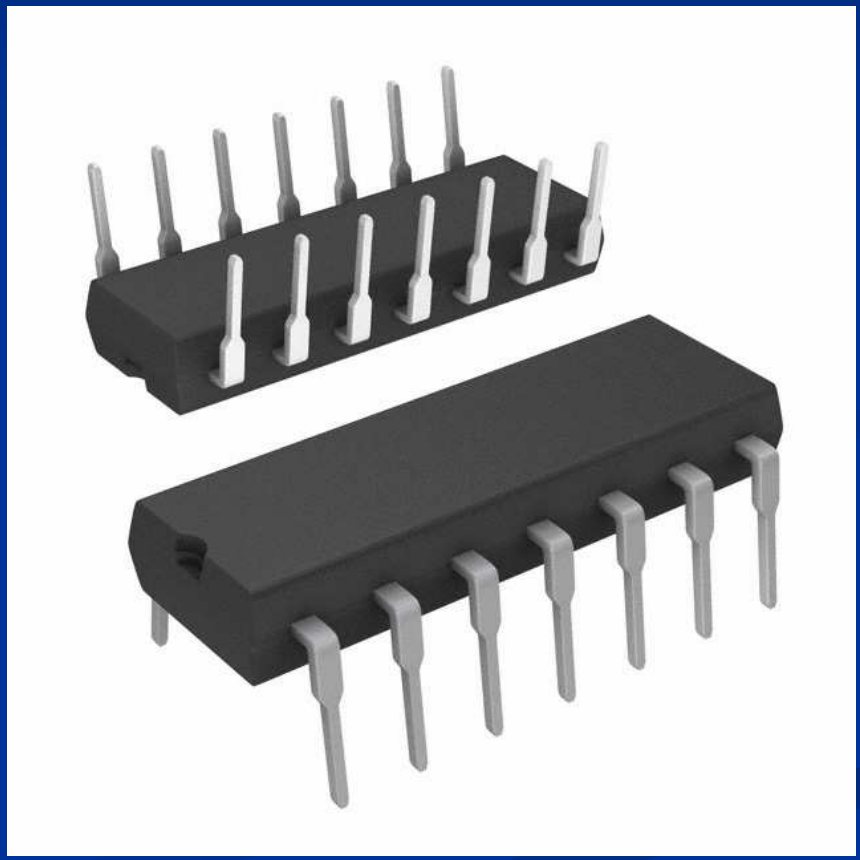


Figure 19: Gate Driver (IR2181)

IR2181 Gate Driver Layout

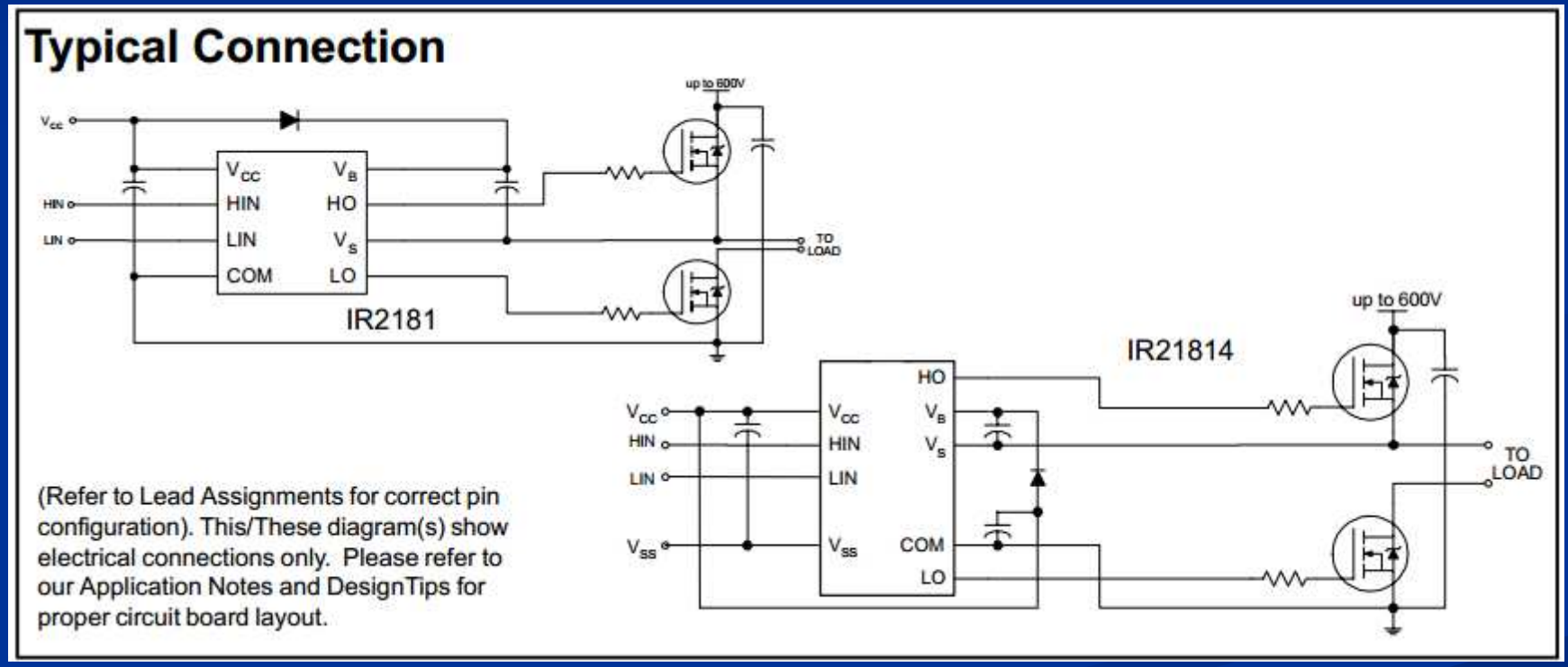


Figure 20: Gate Driver Diagram

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

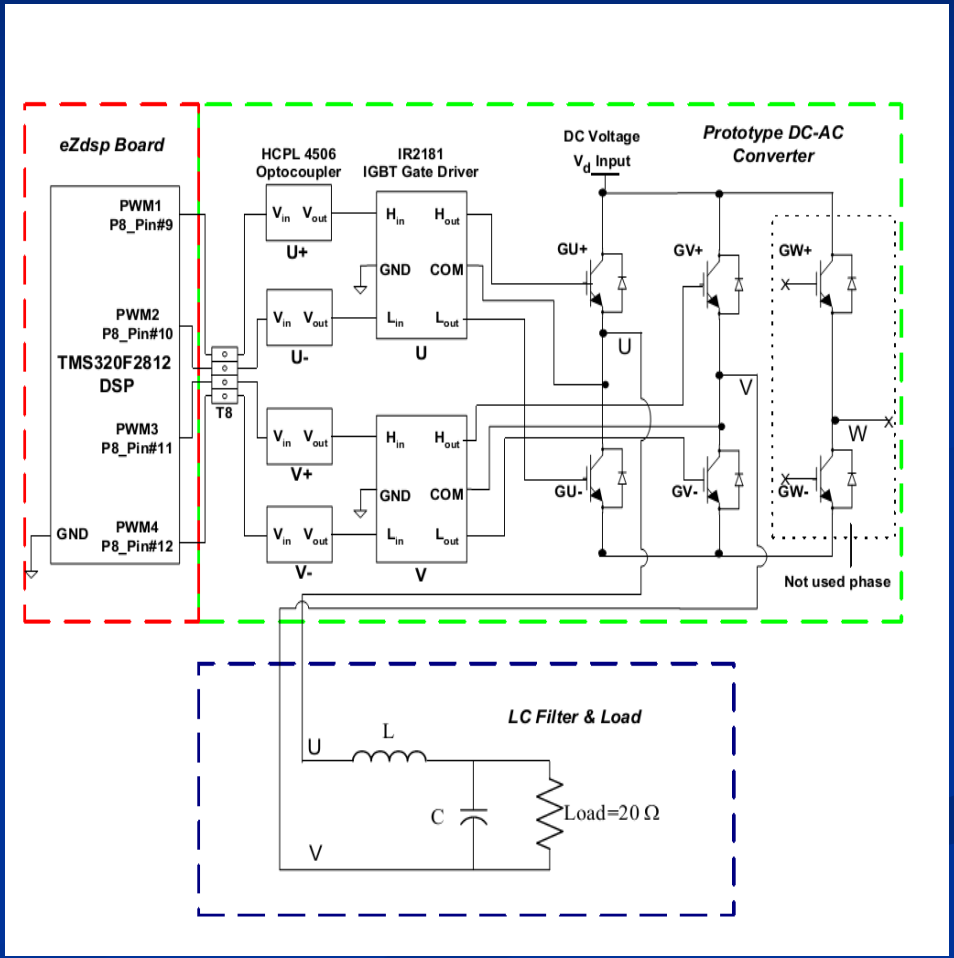


Figure 21: IR2181 Setup Diagram

Overall System Design

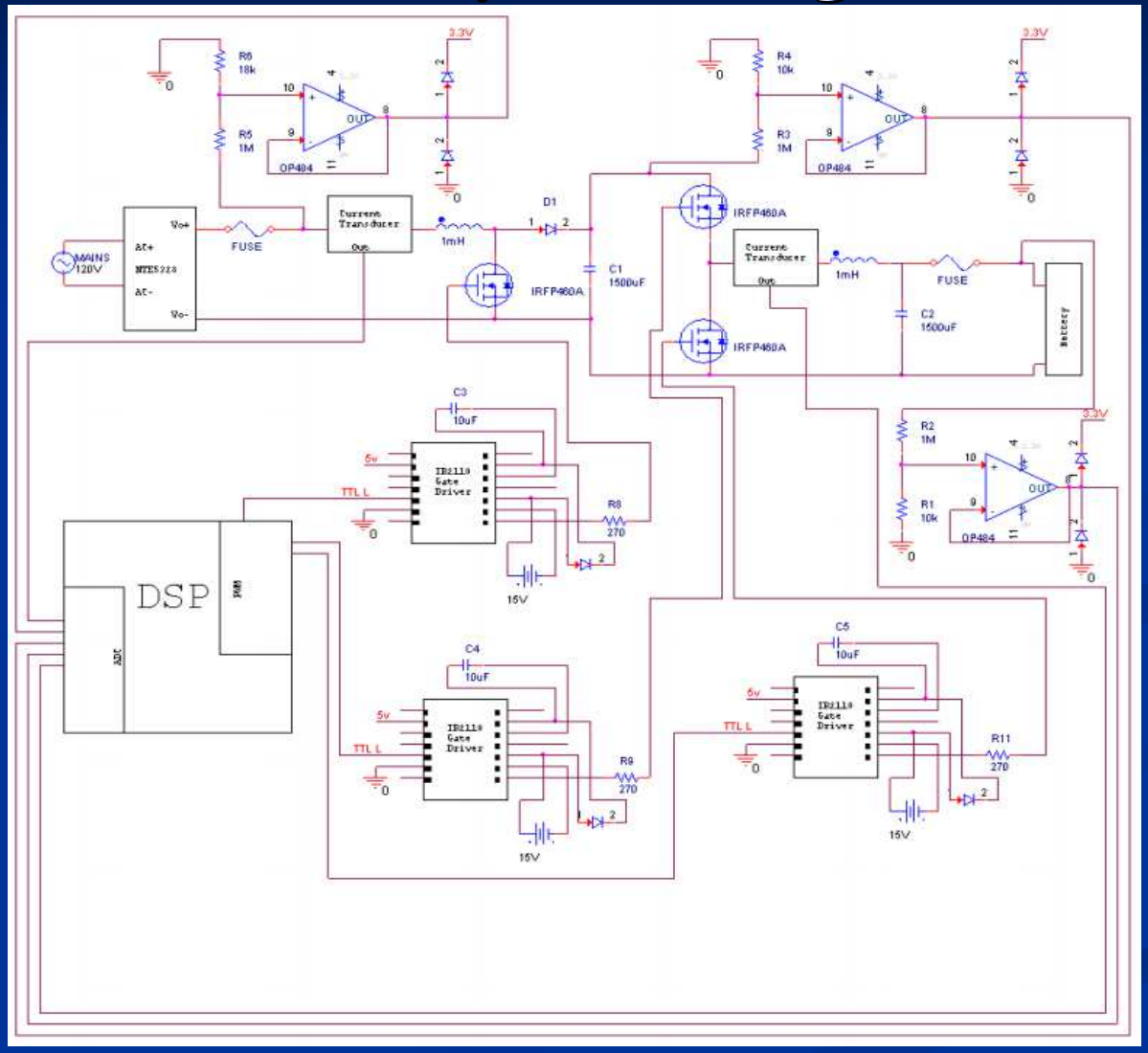


Figure 22: Overall System Design for Project

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

Week 6: DSP Design/Interfacing Circuit Building
Week 7: DSP Design/Interfacing Circuit Building
Week 8: DSP Design/Bidirectional Circuit Building
Week 9: Small Scale Testing/Bidirectional Circuit Building
Week 10: Small Scale Testing
Week 11: Large Scale Testing/Final Implementation
Week 12: Large Scale Testing/Final Implementation

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

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Questions?