
Electric Assist Trike Battery System

JONE LAY

PRESENTED 2015-04-28

Battery System Final Presentation Outline

- ❑ Project Overview
- ❑ Hardware Review
- ❑ Design and Assembly
- ❑ Testing Progress
- ❑ Project Reflections

Project Review

Primary Objectives

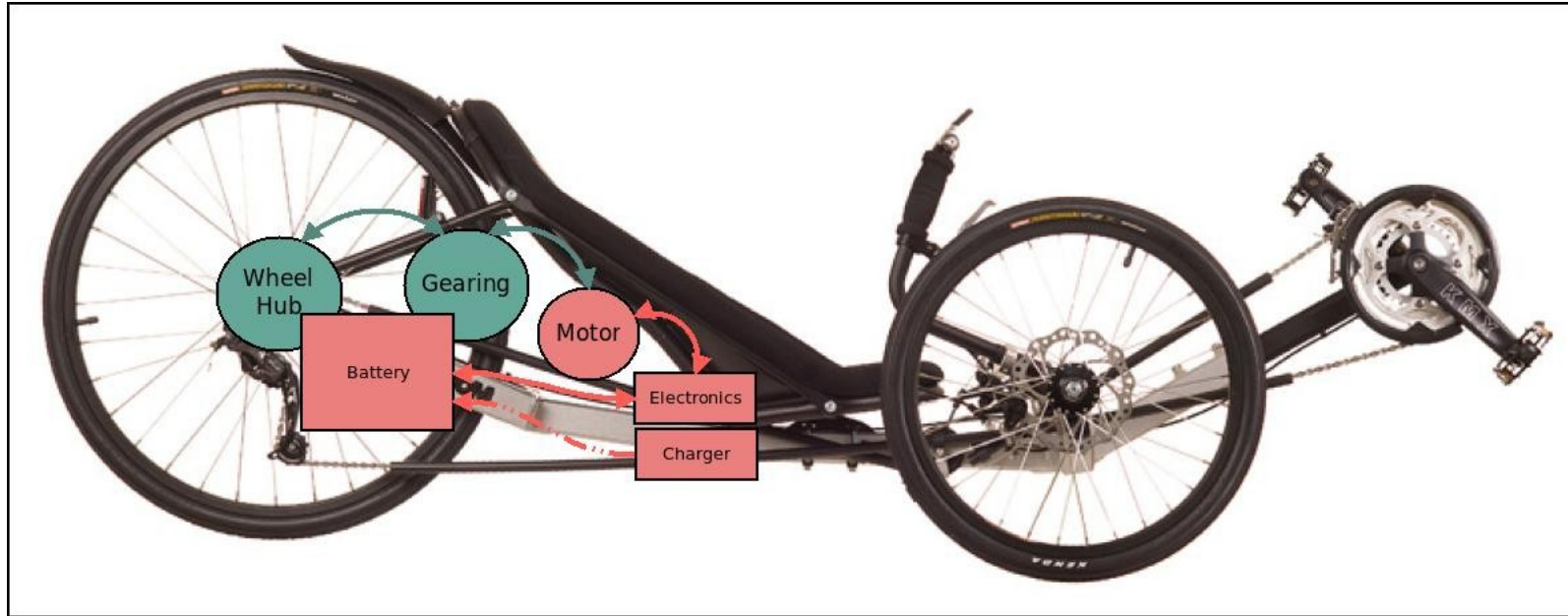
The battery system is responsible for:

- ☐ Supplying power to the electric assist trike
- ☐ Supplying 5V of power to auxiliary systems
- ☐ Recharging from an wall AC power source.

The battery system is comprised of:

- ☐ Battery Management System (BMS) Printed Circuit Board (PCB)
- ☐ 84 Lithium Cells
- ☐ Mechanical enclosure and heatsink

Project Review Trike Systems

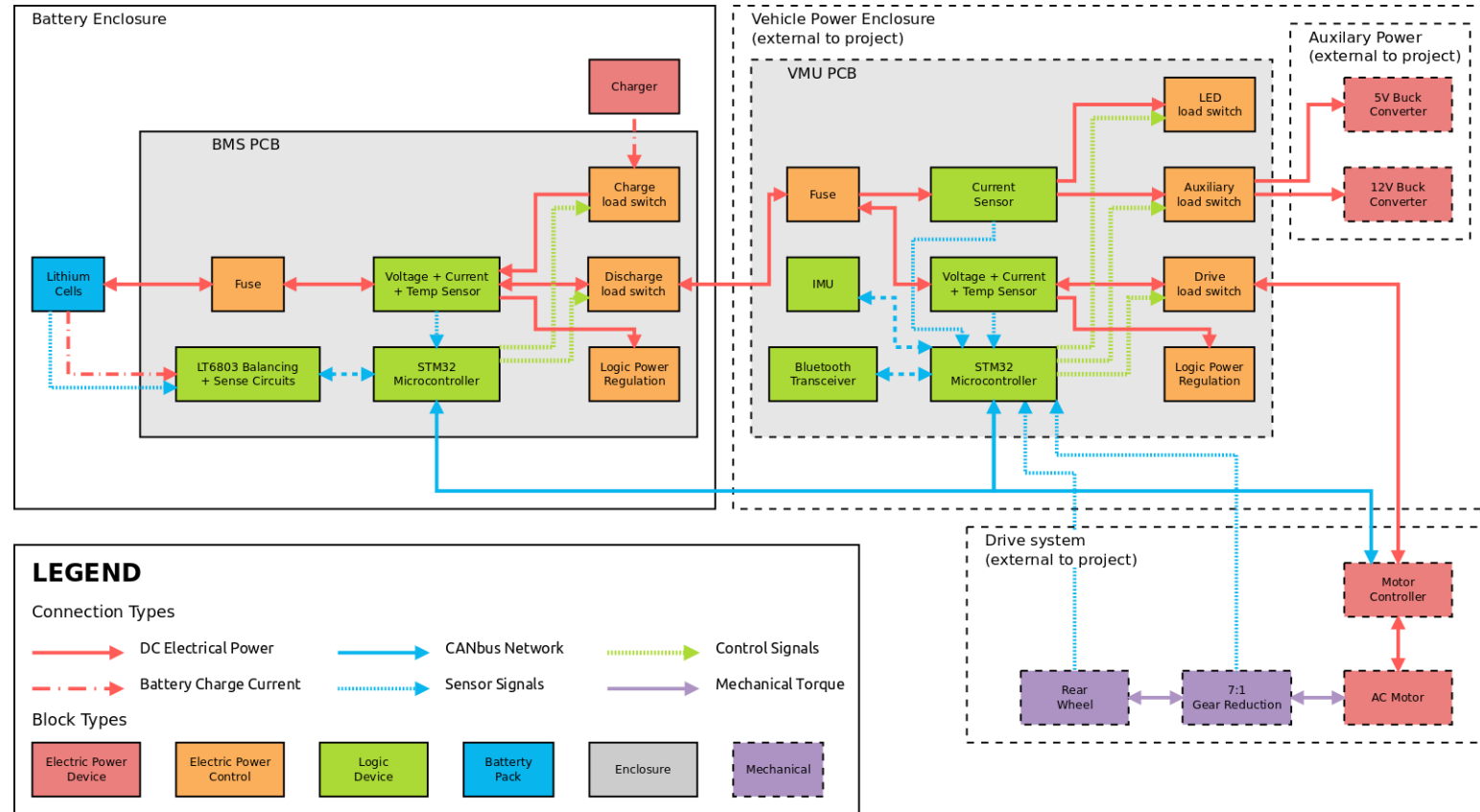


Connection Types

- Electric Drive Power
- Battery Charge Power
- Mechanical Torque

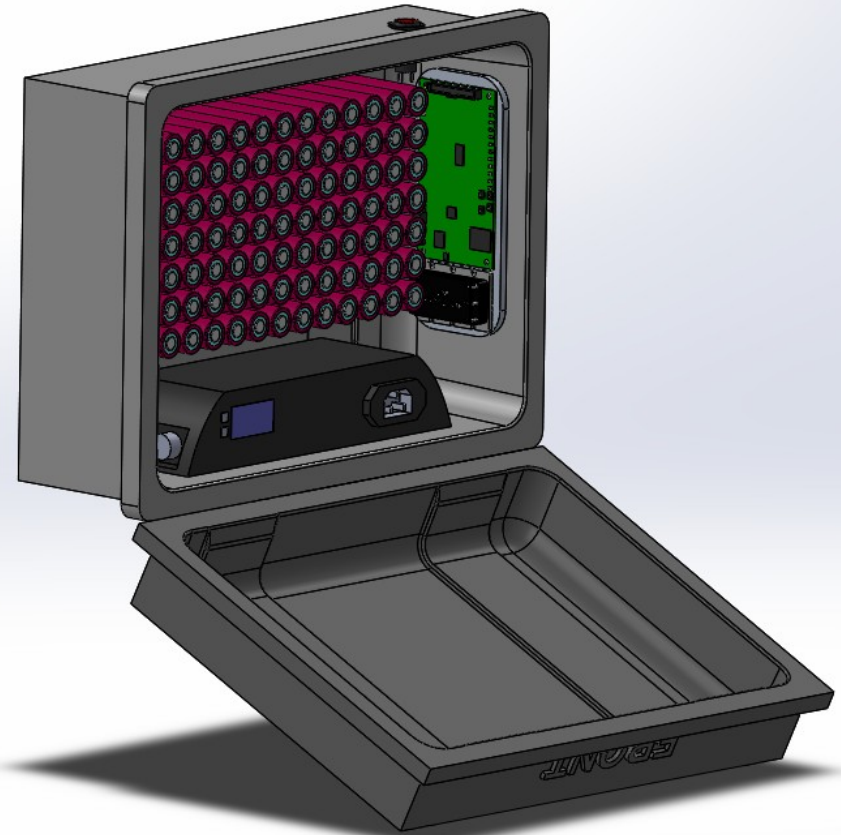
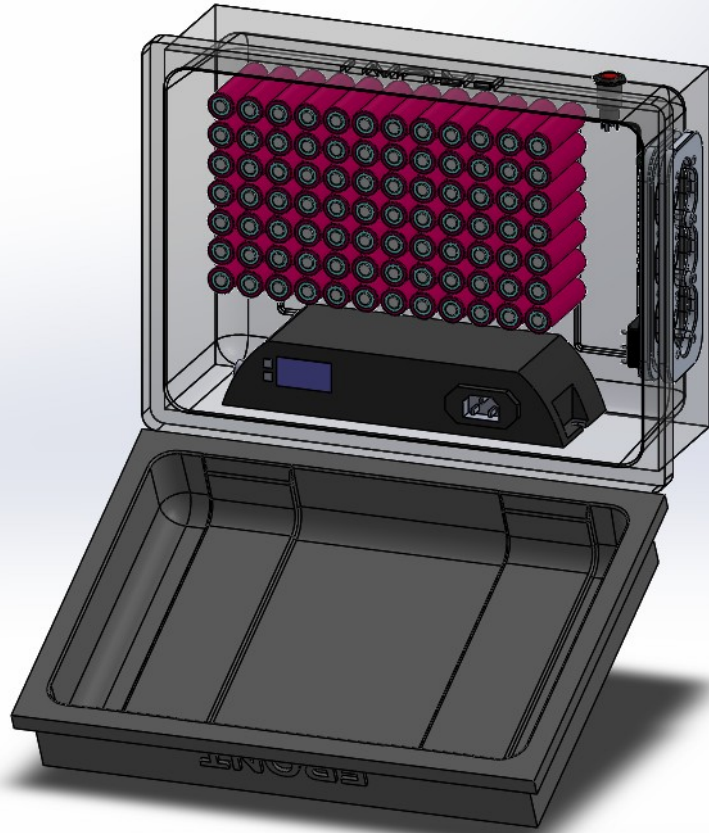
Project Review

Physical Block Diagram



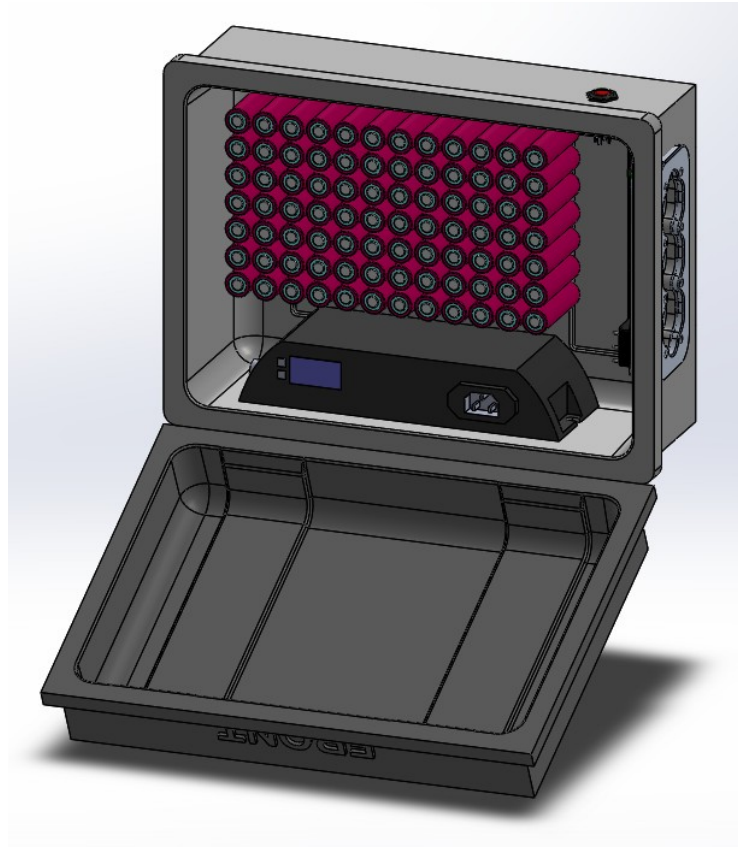
Project Review

Mechanical Design



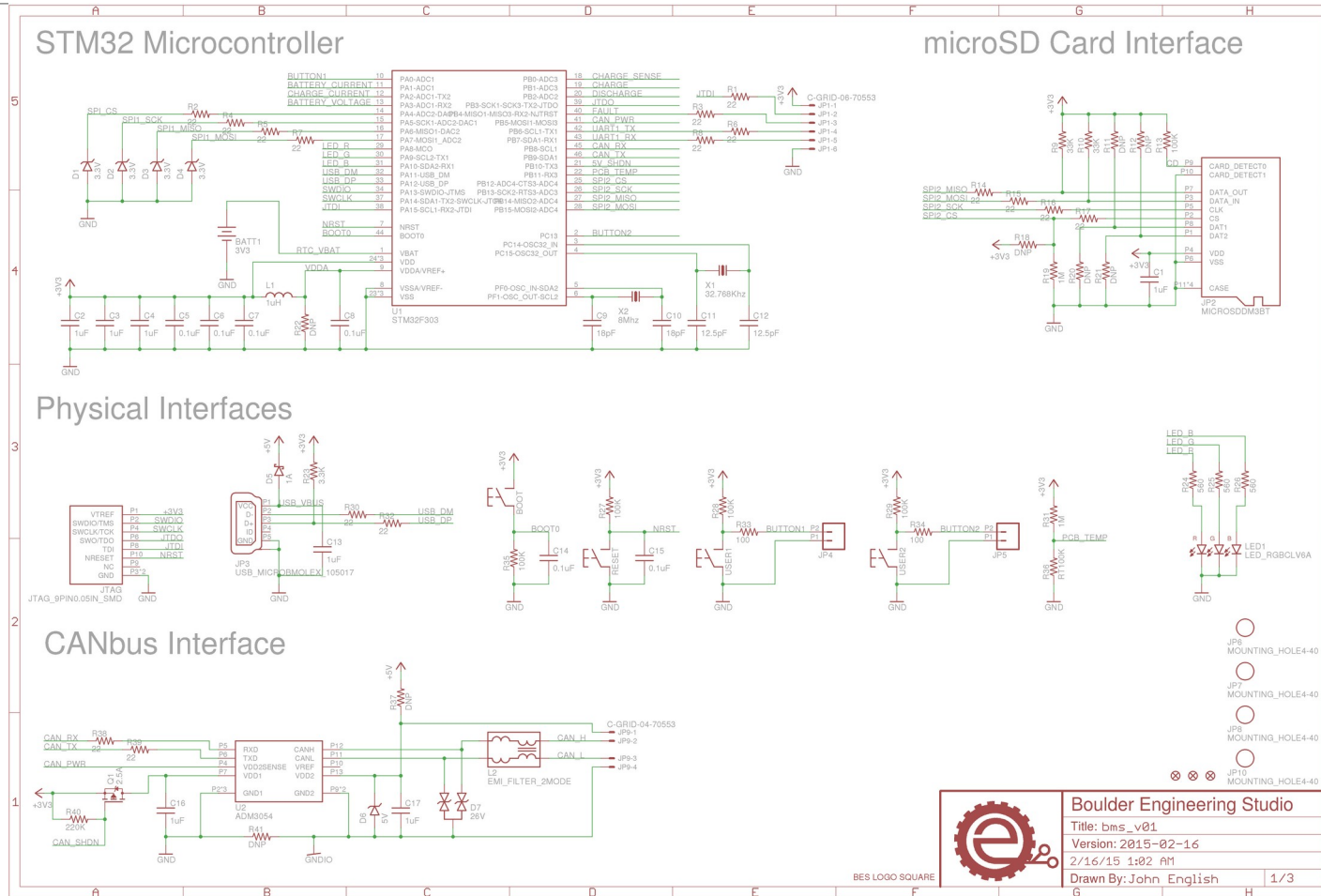
Project Review

Mechanical Integration



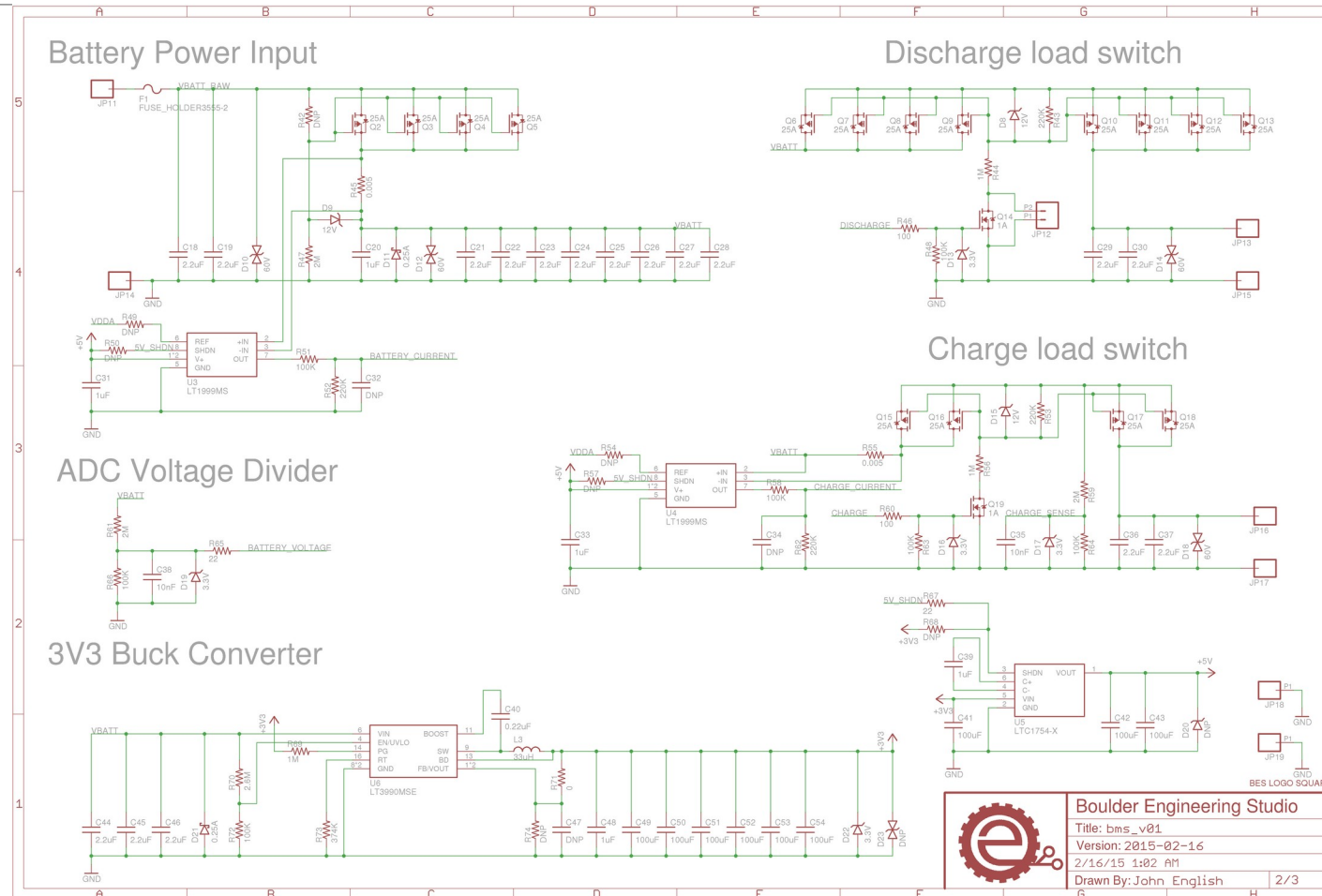
Project Review

Digital Logic Schematic

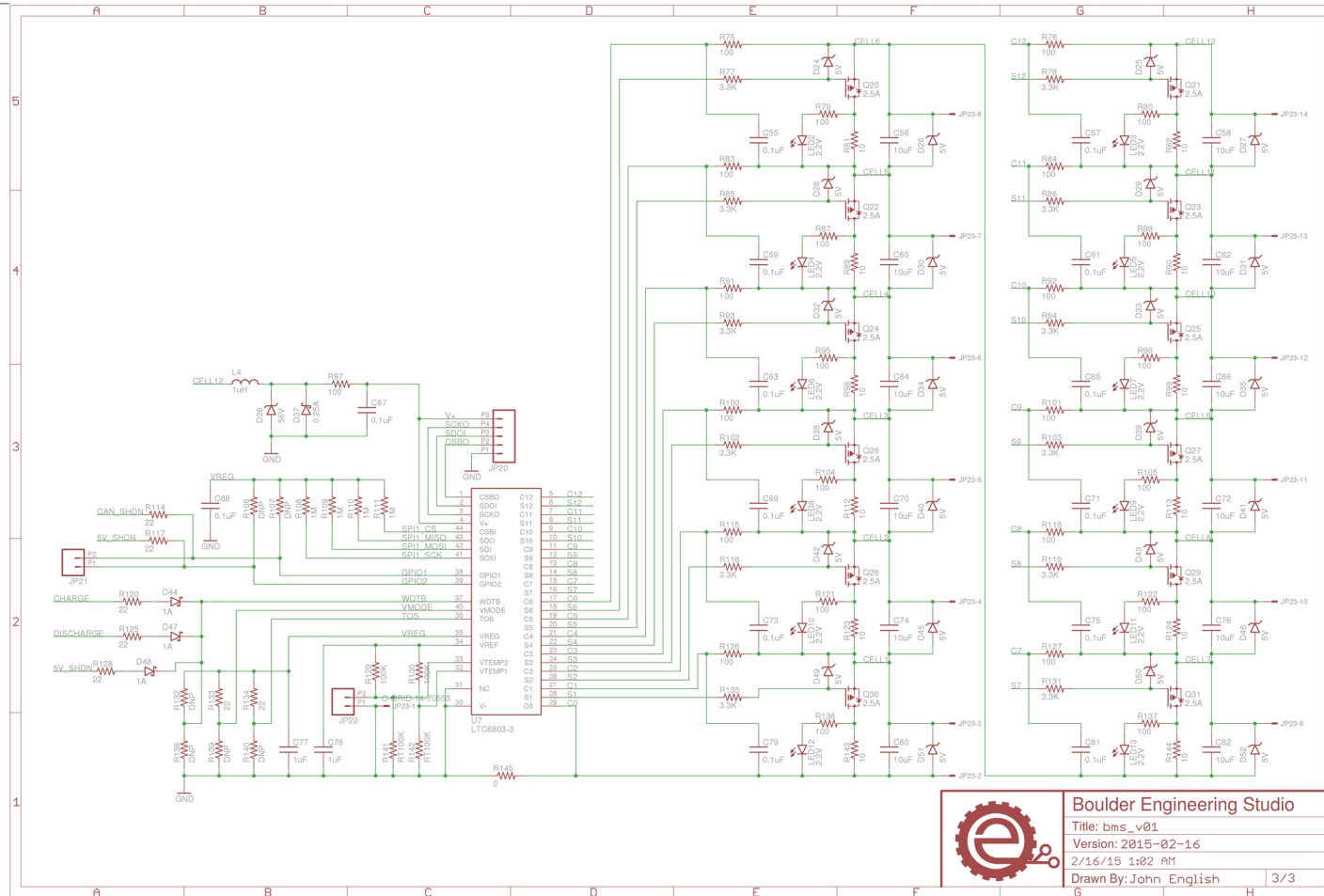


Project Review

Power Electronics Schematic

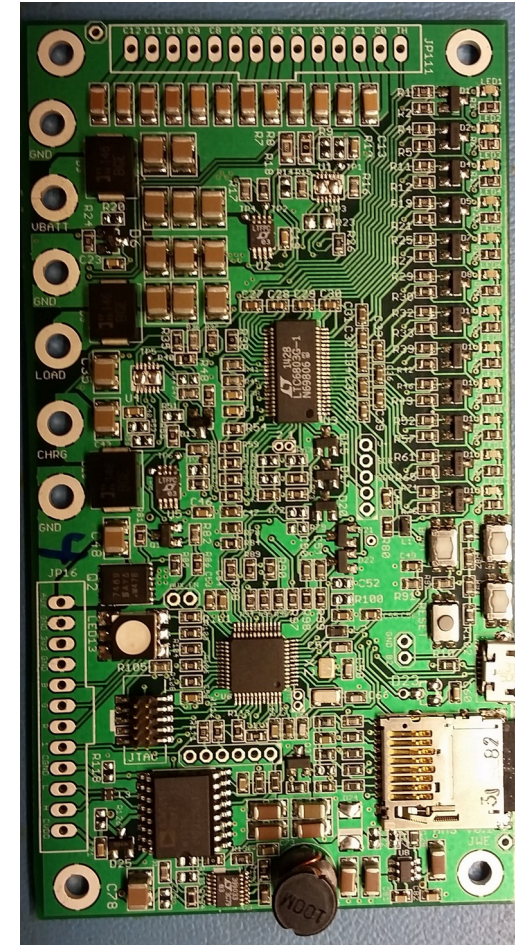
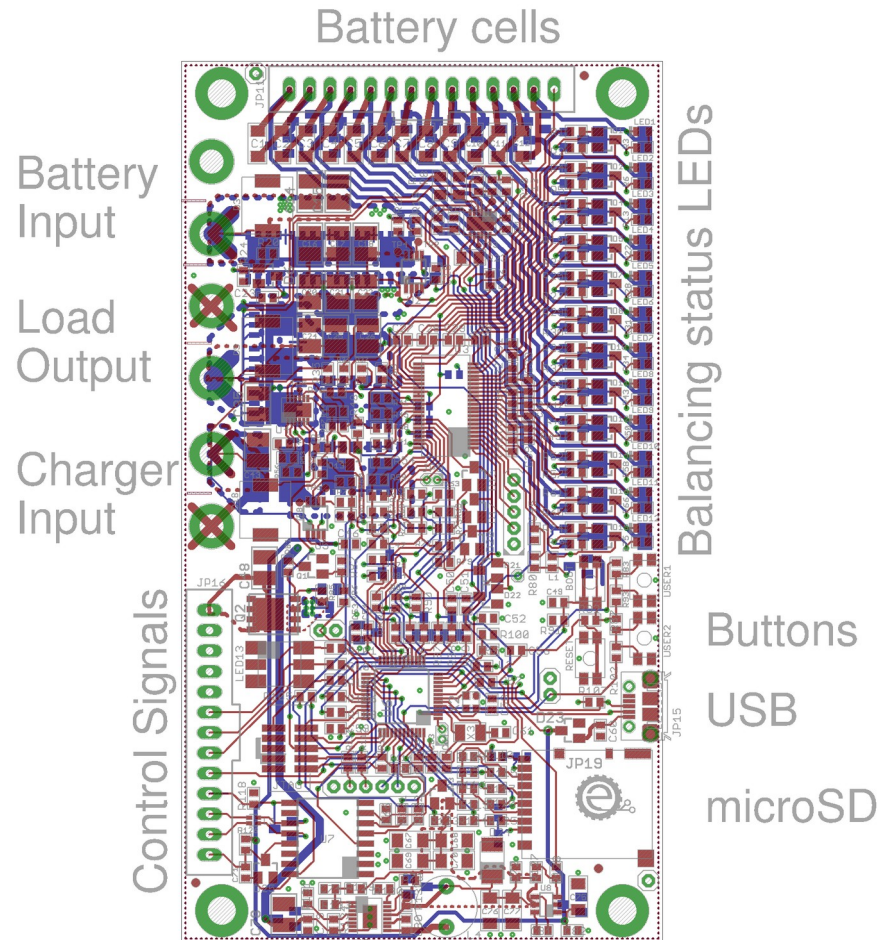


Project Review Balancing Schematic



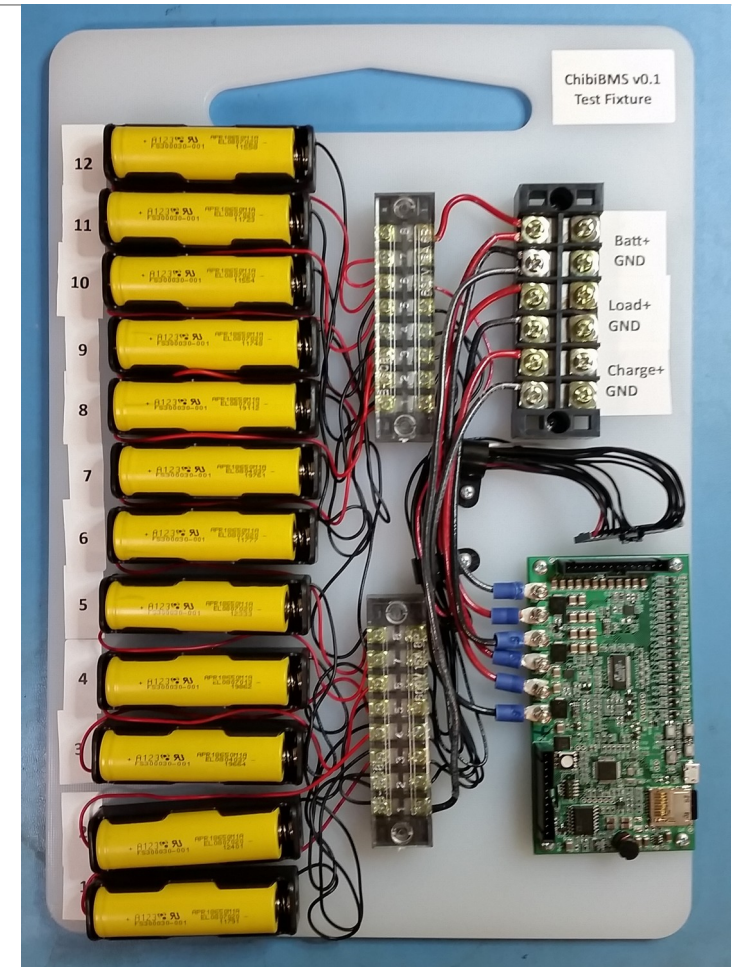
Project Review

BMS PCB Layout

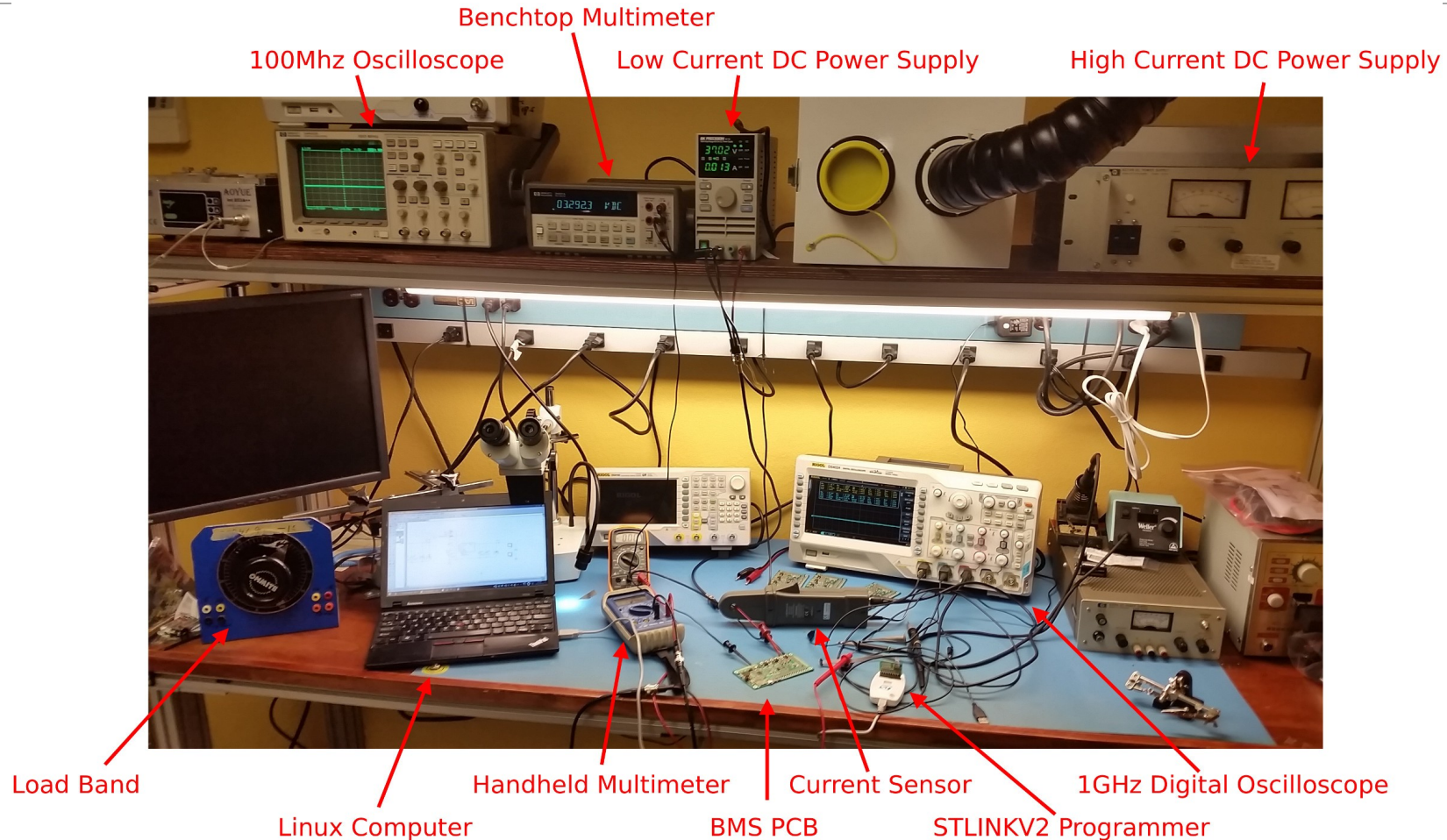


Development and Testing BMS PCB Test Fixture

- ❑ Small-scale battery pack (12s1p)
- ❑ Assembled with scrap office materials and cutting board
 - ❑ Poor thermal performance (imposes power limitation)
- ❑ Wire harness routing
- ❑ Provides rigid mounting for test points



Development and Testing BMS PCB Test Equipment



Development and Testing

Test Progress

☐ Tested **Good**

- ☐ Microcontroller JTAG, SWD and USB DFU interfaces
- ☐ 3.3 & 5V power regulation and undervoltage protection
- ☐ Auxiliary power output control
- ☐ Cell Balancing MOSFET control
- ☐ Battery reverse input protection
- ☐ Voltage divider analog inputs
- ☐ Temperature sensors

☐ Tested **Bad**

- ☐ Charger reverse input protection
- ☐ Current sense amplifiers at lower currents (<10mA)
- ☐ Total system quiescent current (measure >2mA)

☐ Untested

- ☐ Over-current protection (analog and digital)
- ☐ LTC6803 SPI communication
- ☐ Watchdog timer
- ☐ SD card interface
- ☐ CANbus interface
- ☐ Temp sensor accuracy at <0°C or >60 °C
- ☐ 16Mhz crystal accuracy
- ☐ 32.768Khz RTC accuracy
- ☐ RTC power consumption

Conclusion

Project Reflections

- ❑ Evolution of Scope
 - ❑ Began too broadly focused
 - ❑ Uneven attention for subsystems
- ❑ Technical Changes
 - ❑ Power Distribution: Thicker copper layers or bus bar
 - ❑ Press-fit PCB connectors for power input
- ❑ Upcoming work
 - ❑ Firmware development
 - ❑ Inductive load testing
 - ❑ Mechanical fabrication and assembly
 - ❑ Trike testing