
Electric Assist Trike Battery System

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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:

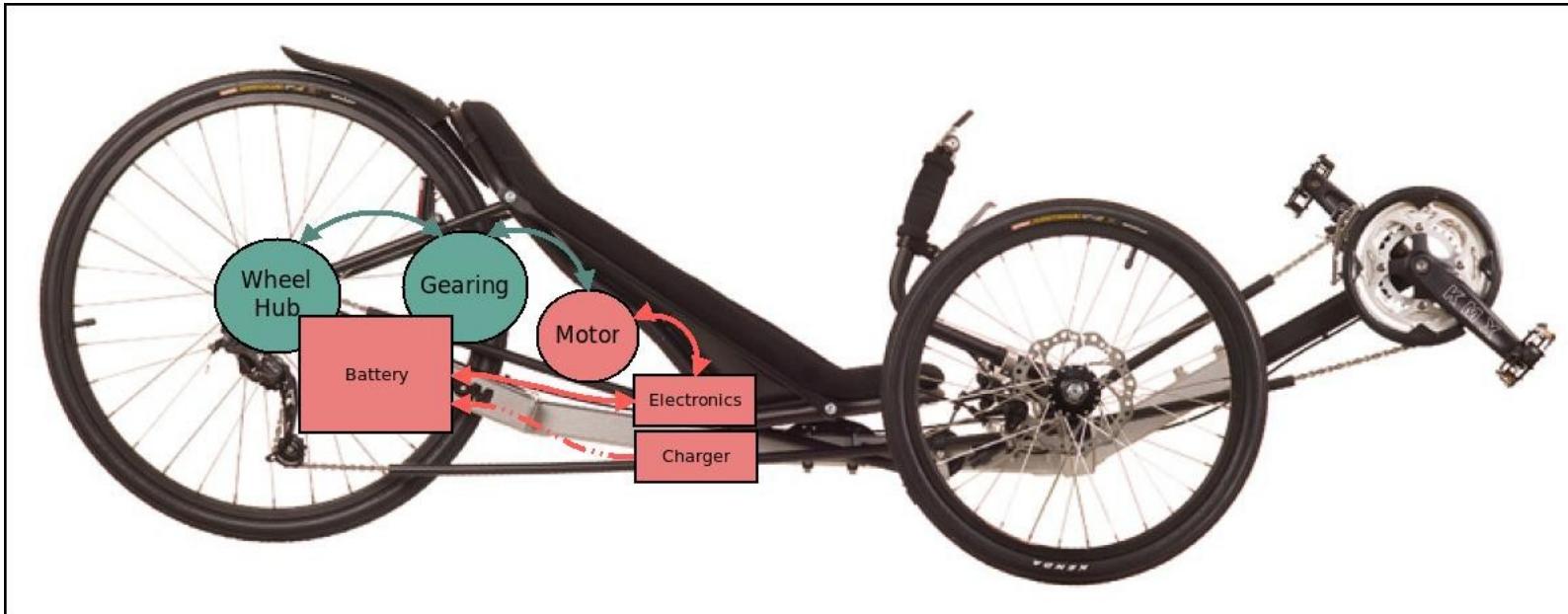
- Supplying power to the electric assist trike
- Supplying 5V of power to auxiliary systems
- Recharging from an wall AC power source.

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

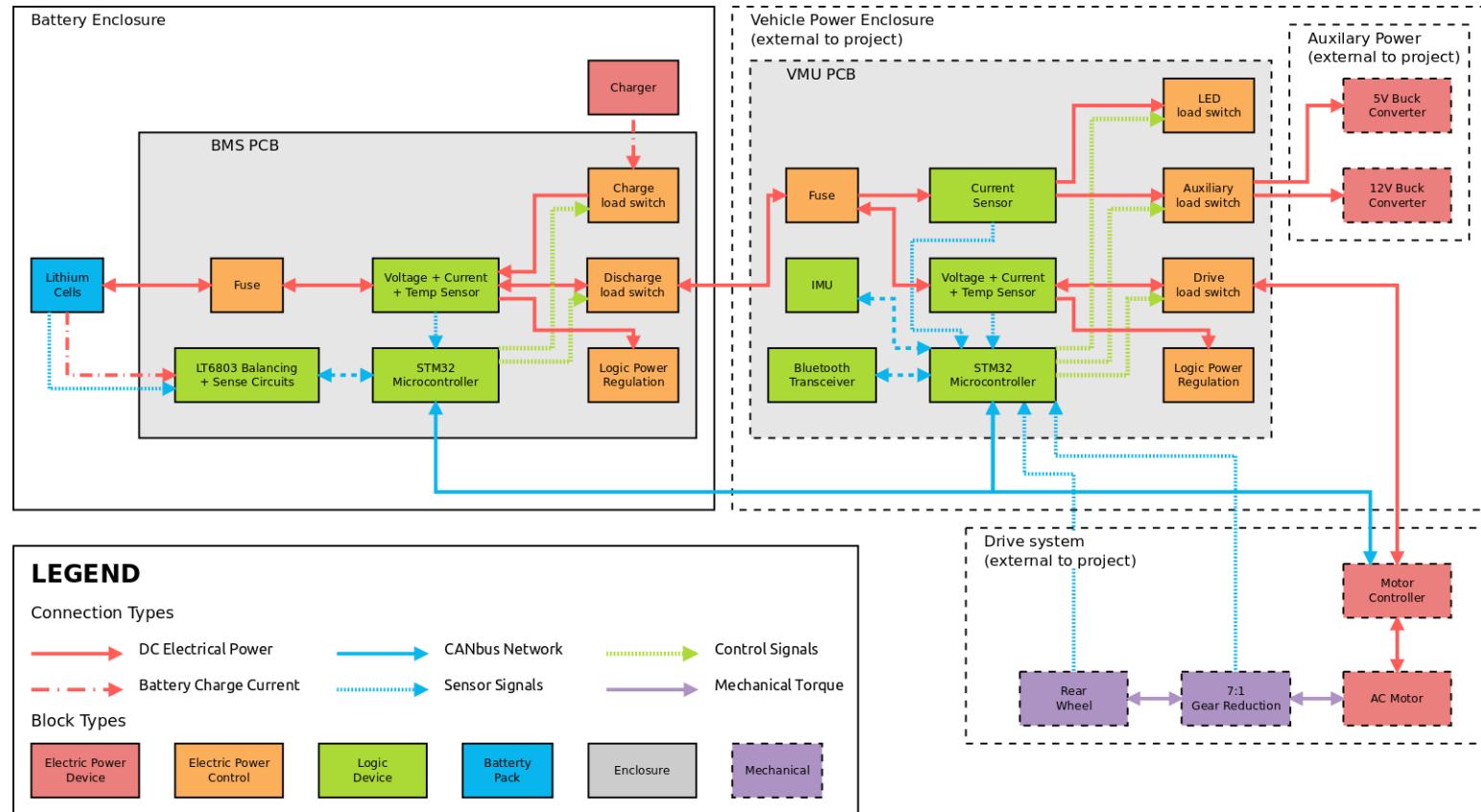
→ Electric Drive Power

→ Battery Charge Power

→ Mechanical Torque

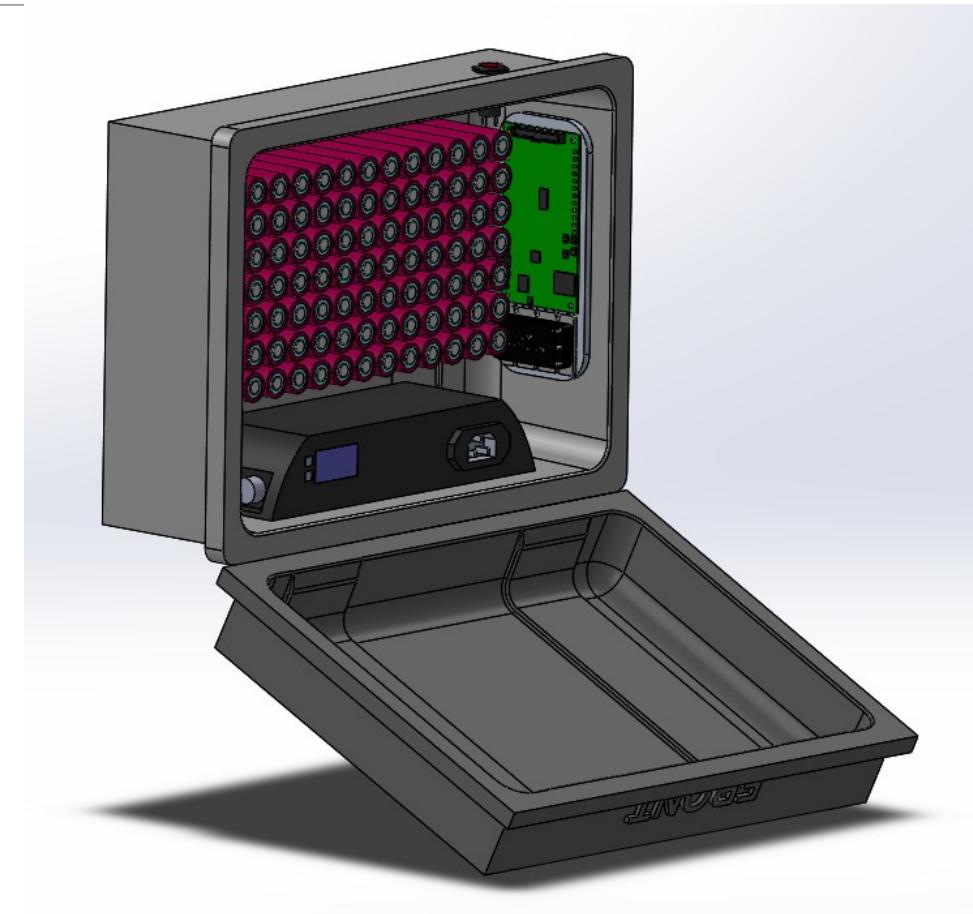
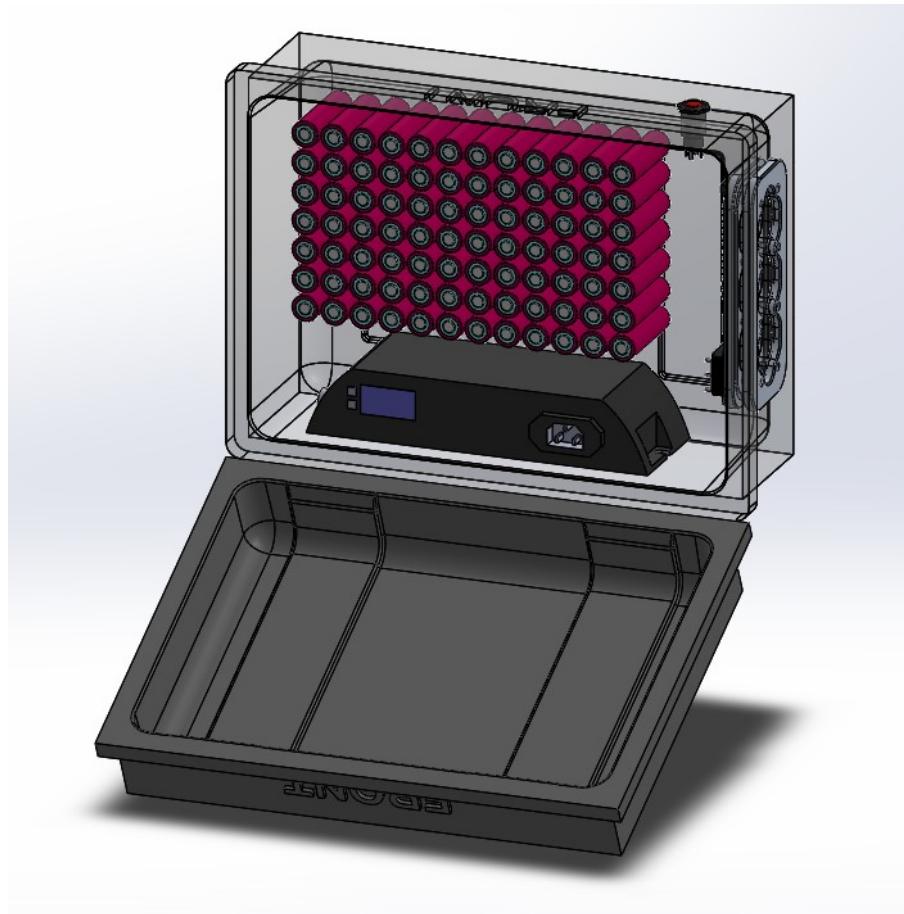
Project Review

Physical Block Diagram



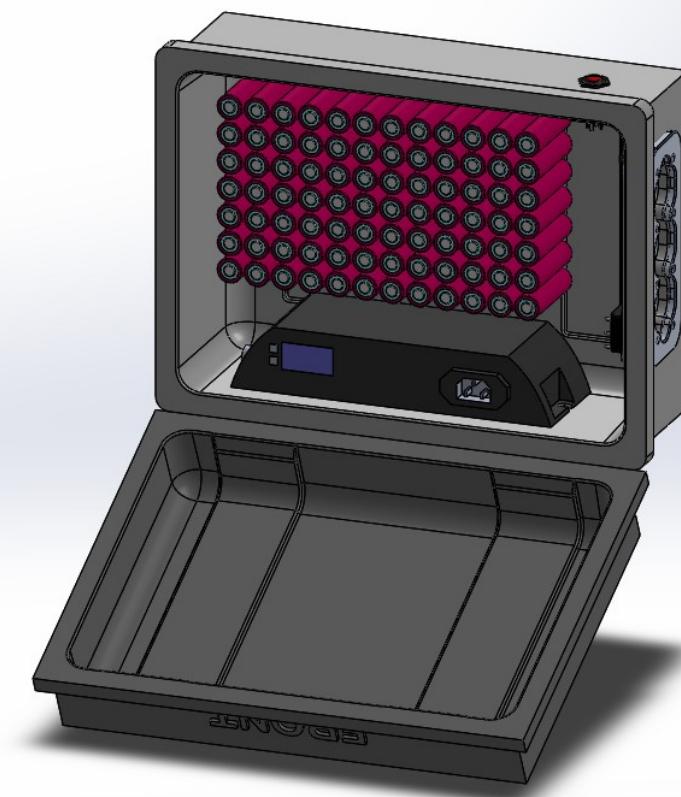
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Mechanical Design



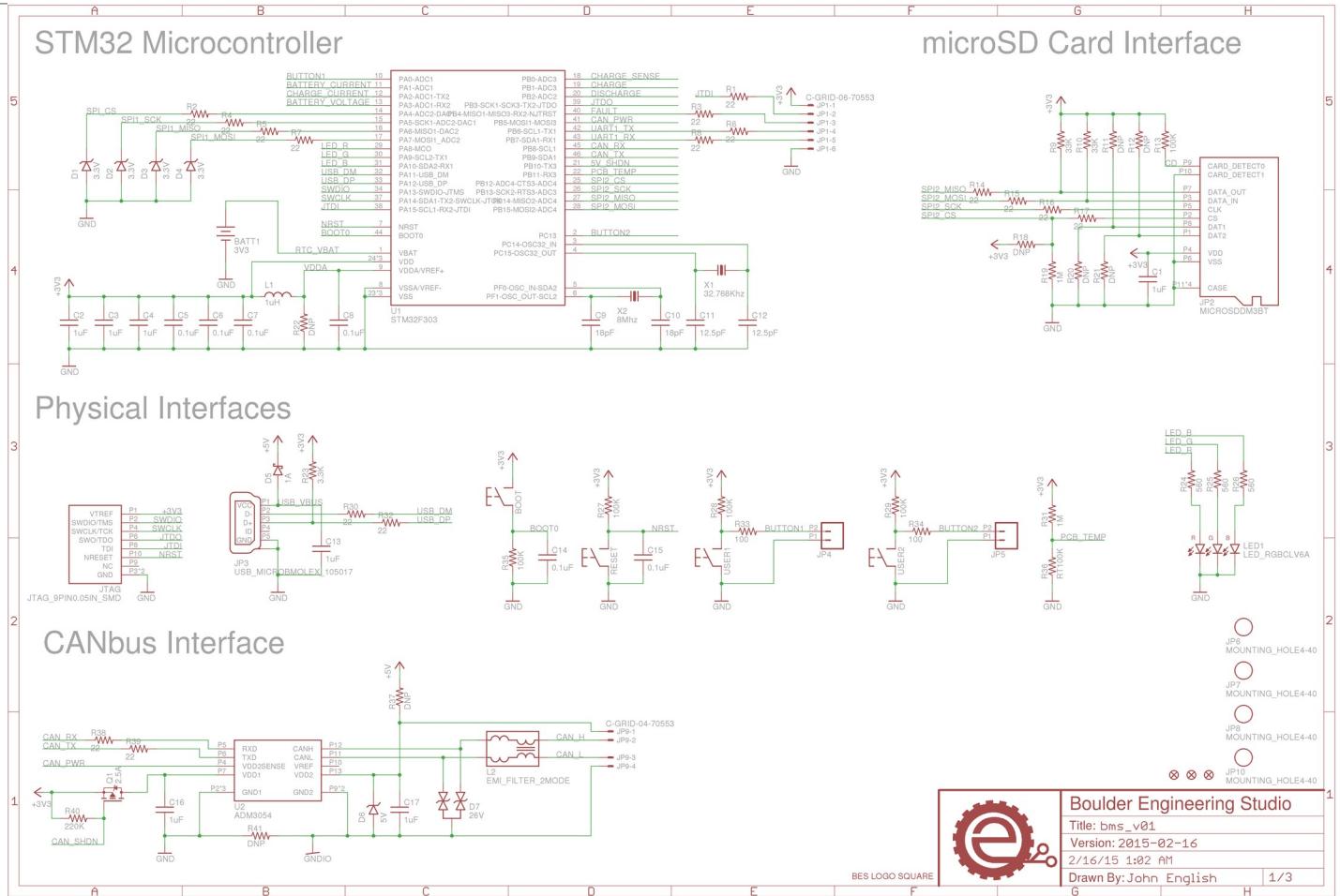
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Mechanical Integration



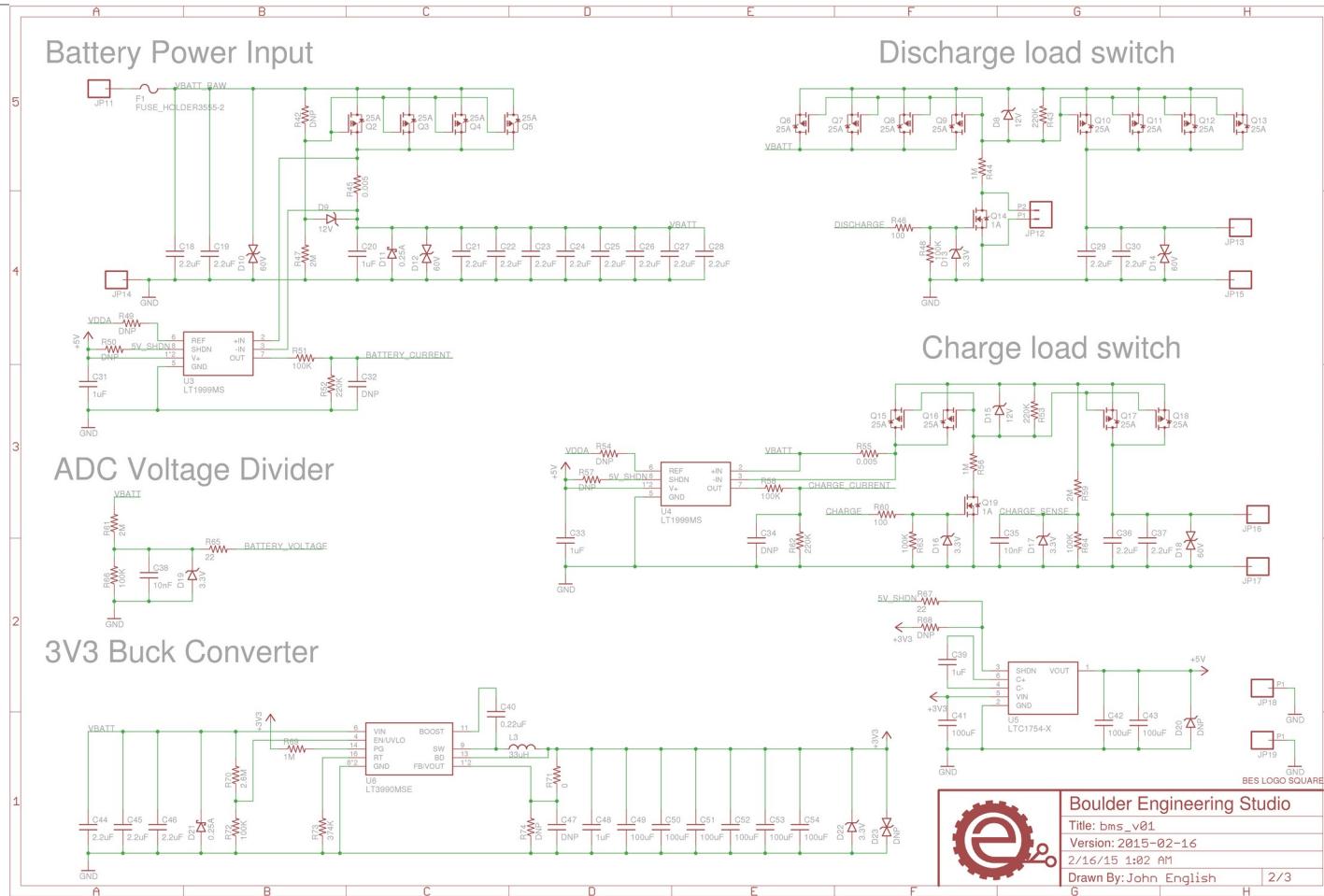
Project Review

Digital Logic Schematic



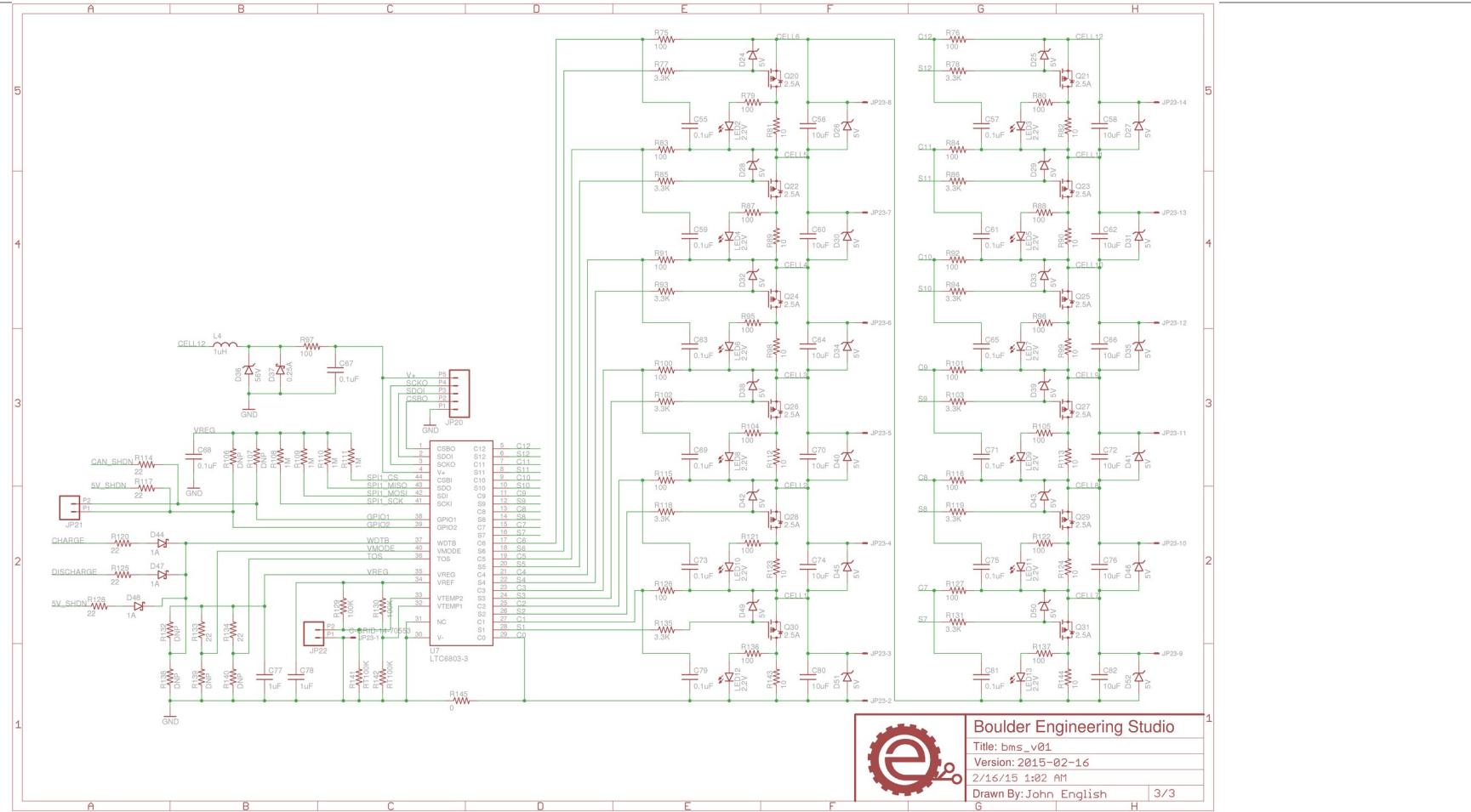
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Power Electronics Schematic



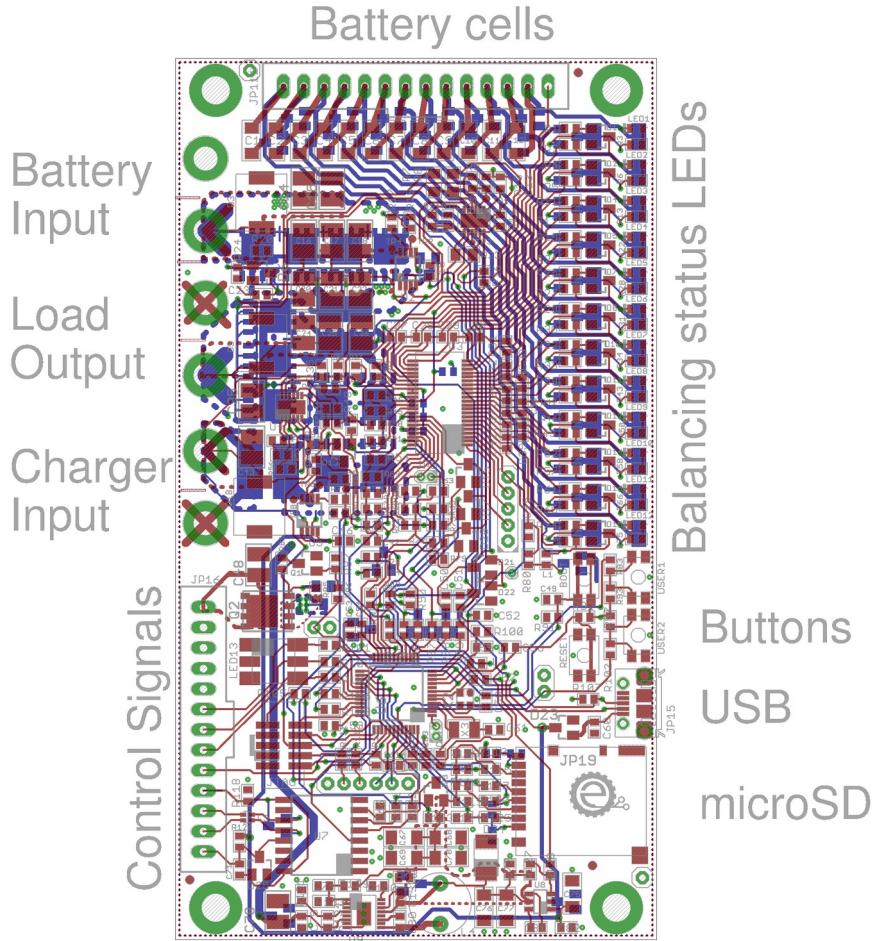
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Balancing Schematic



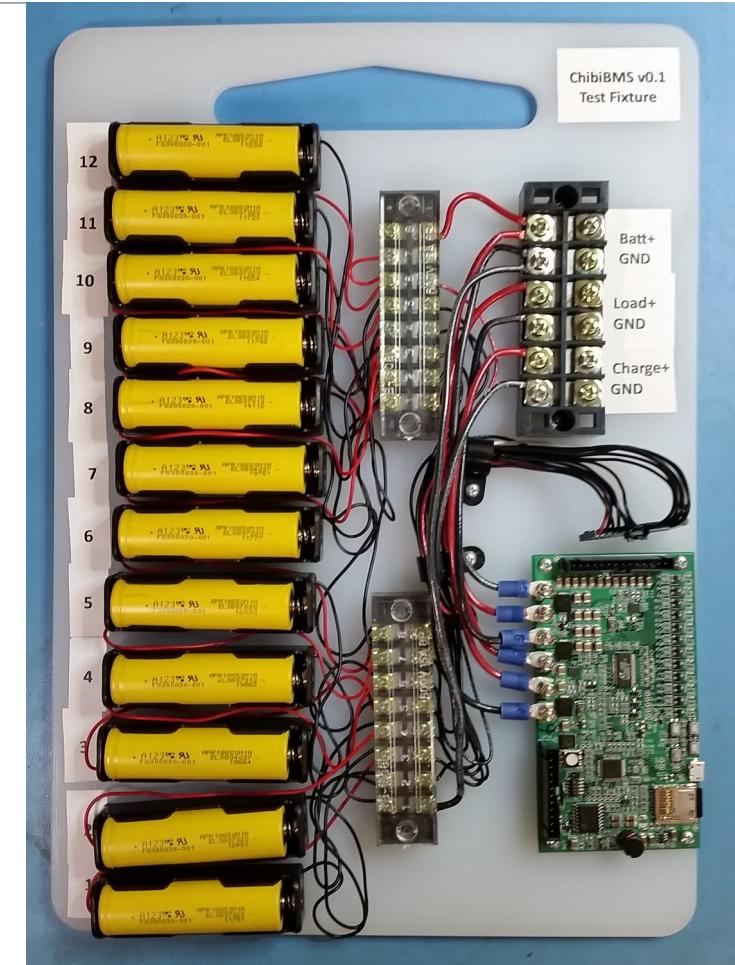
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BMS PCB Layout

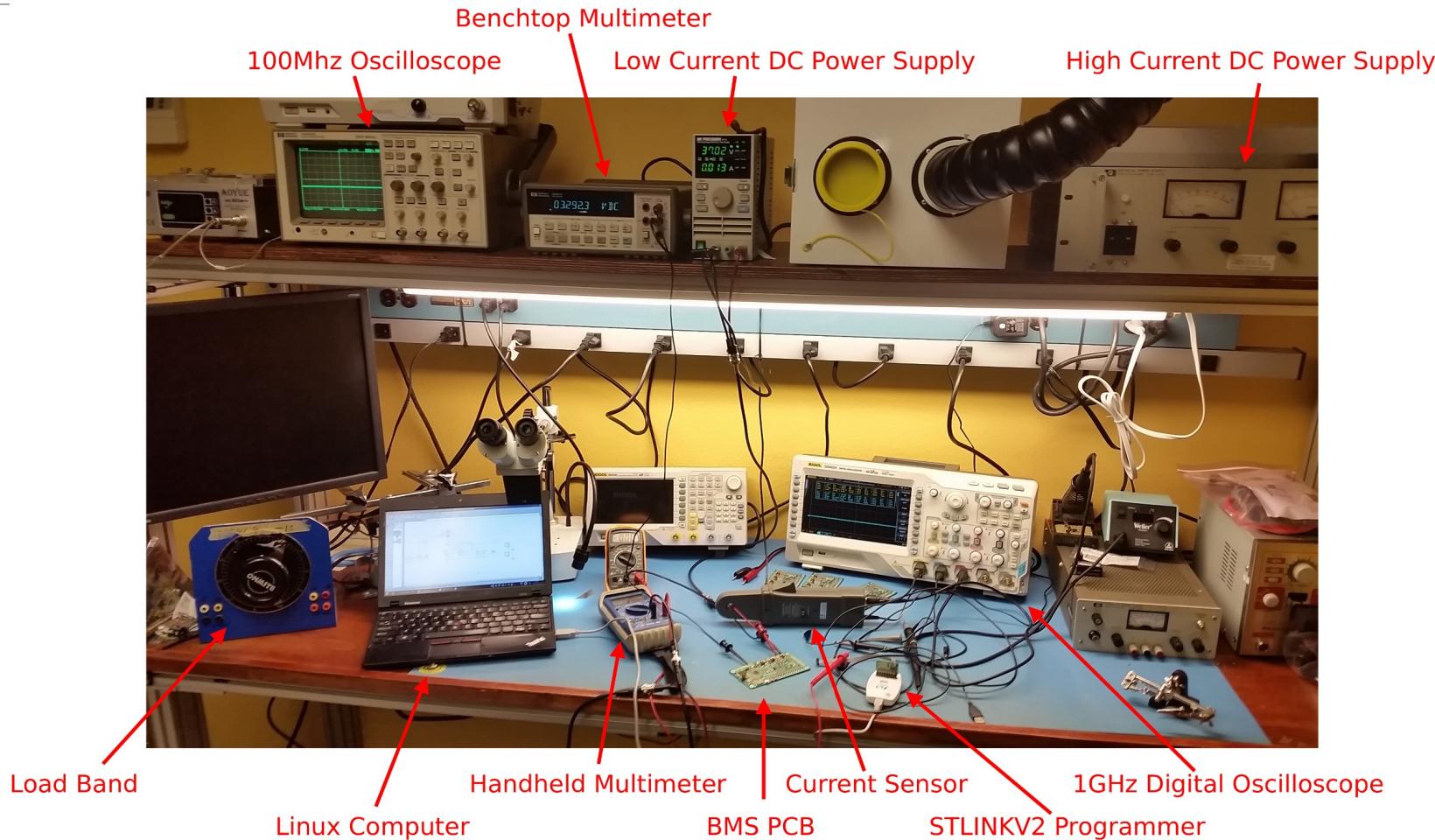


Development and Testing BMS PCB Test Fixture

- ❑ 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