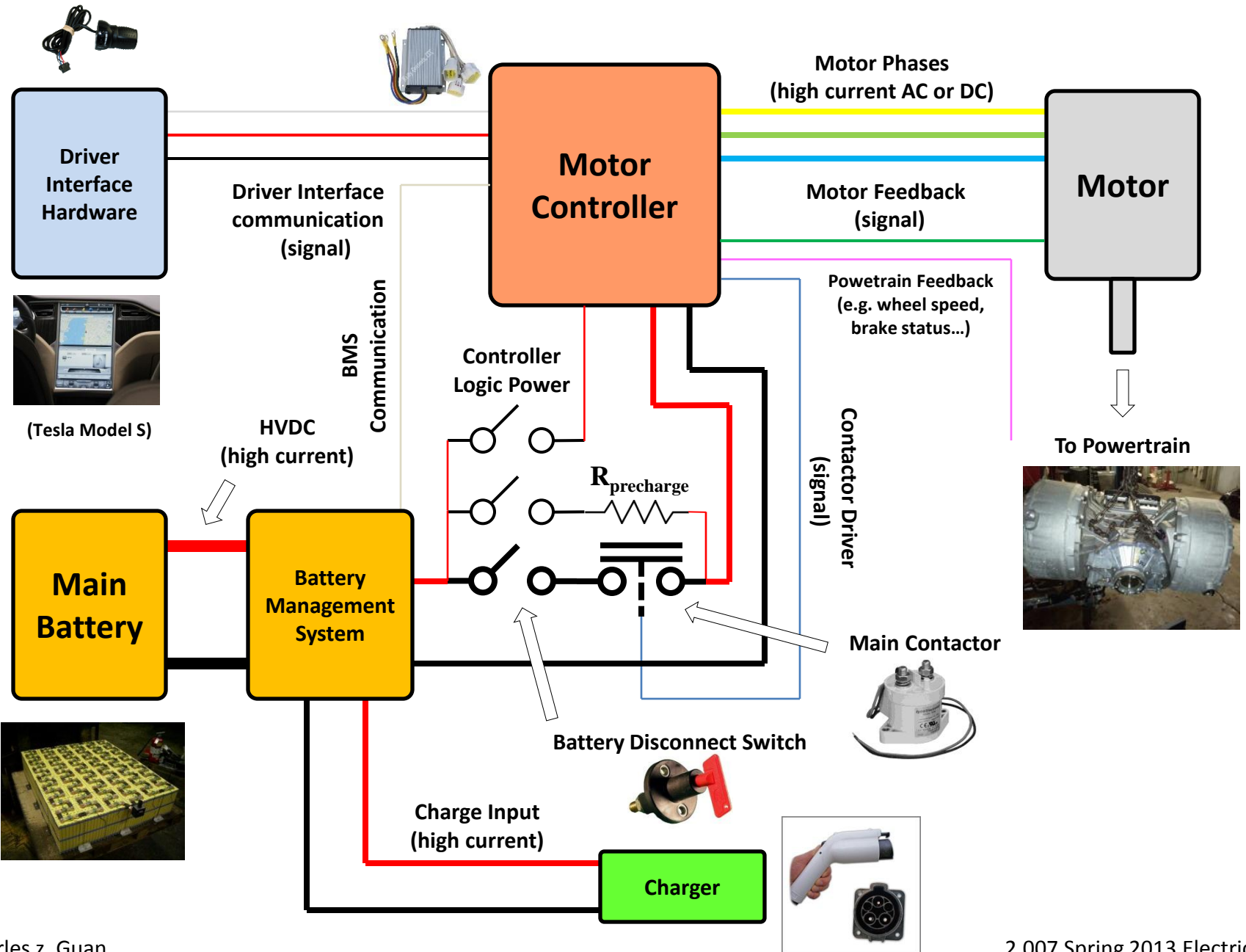
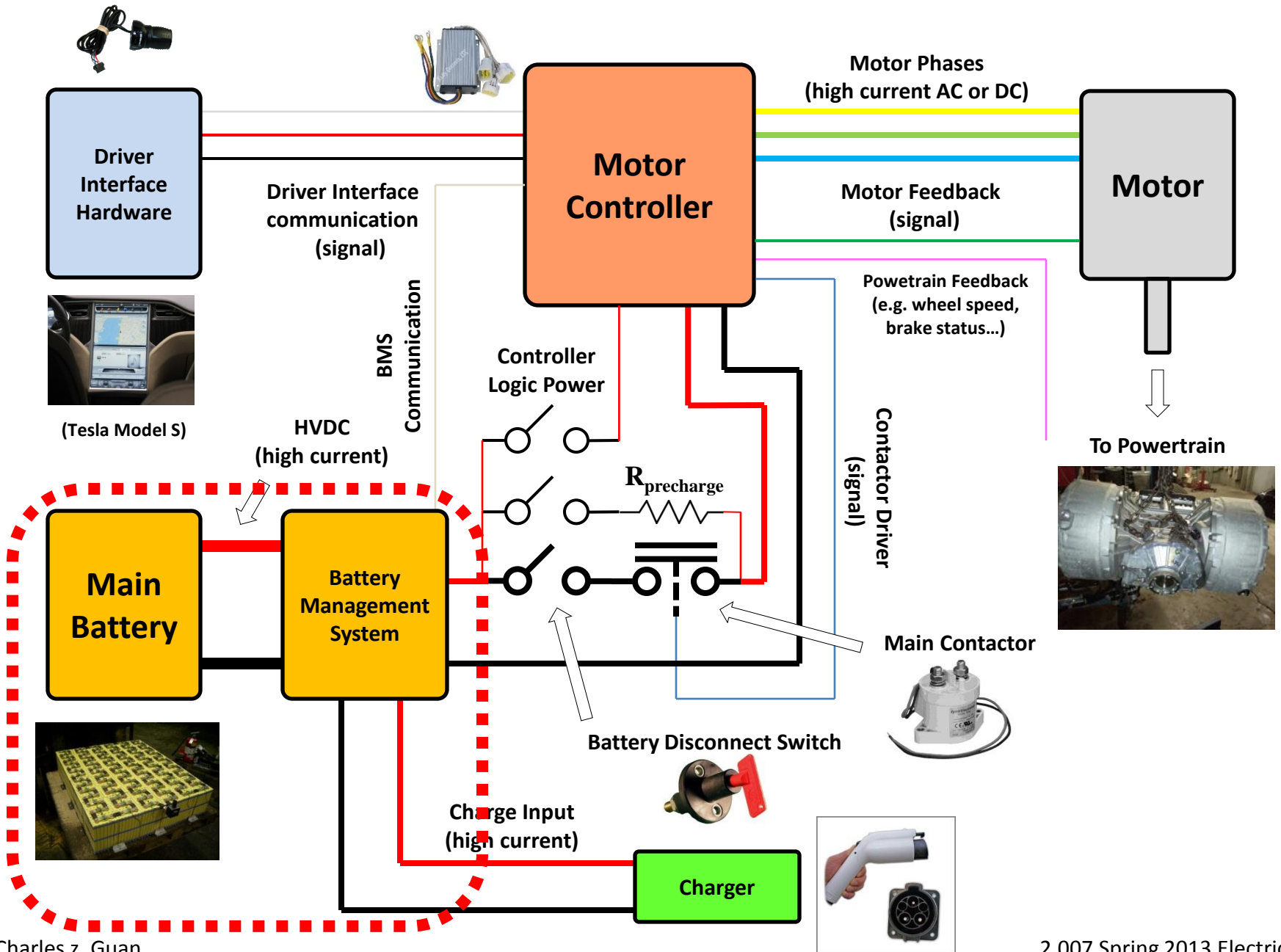


Basic Electric Vehicle System Diagram

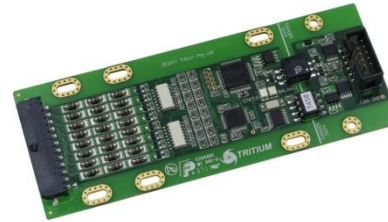


Basic Electric Vehicle System Diagram



Battery Management System

- Monitors battery status
- Cell balancing
 - Out of balance cells can over or undercharge
- “Fuel Gauge”
- Charge management
 - Termination at end of charge
- Under/Over Voltage Protection
- Under/Over Temperature Protection

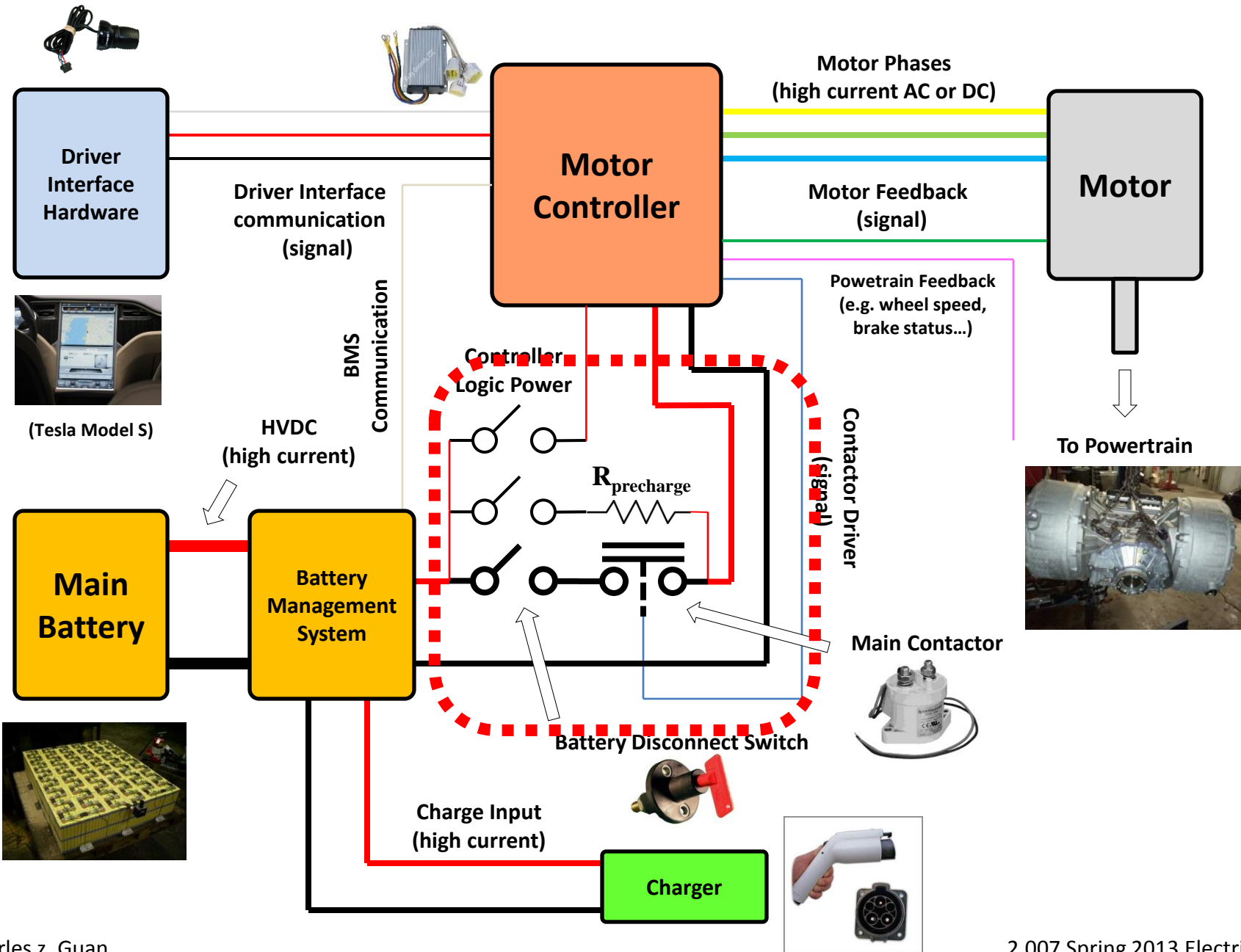


Integrated Solutions

- **Ain't nobody got time for that**
- “Lead Acid Replacement” module
- 40A built-in fuse, internal BMS, 2 terminals
- Need to build own charger connection



Basic Electric Vehicle System Diagram



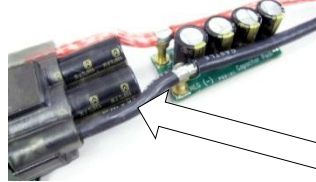
Power Switching

- Remote power switch
 - You activate a signal circuit, controller sends power to large contactor to close main power
 - May have discrete battery disconnect switch anyway
- Direct power switch
 - You operate battery disconnect directly
- Small vehicles generally use direct switches for simplicity
- Direct switch must be able to carry all of battery current

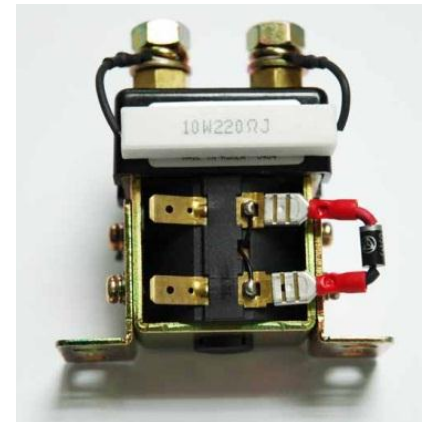


Precharge Circuit

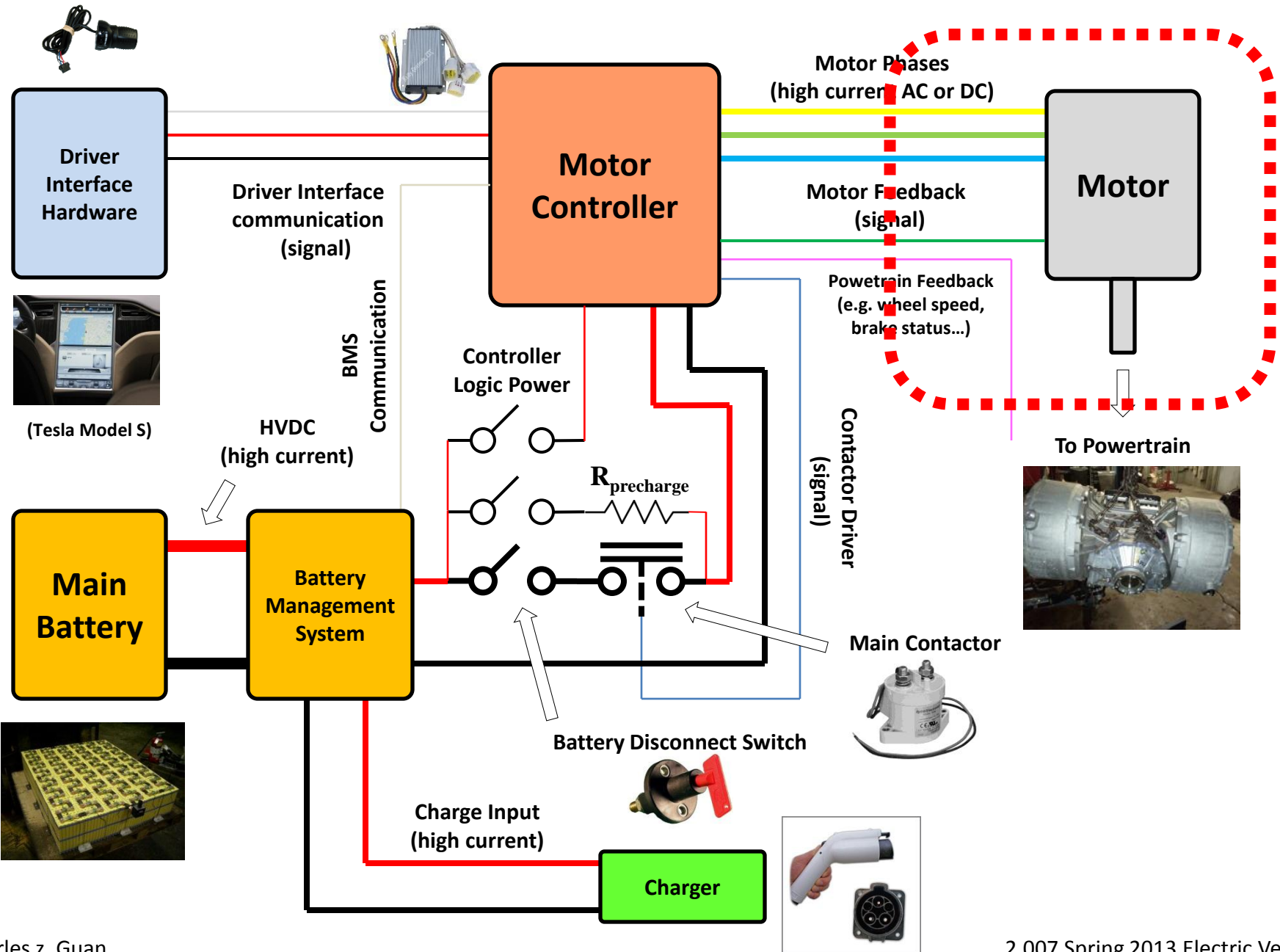
- Input capacitance acts as dead short to instantaneous application of voltage



- Causes switch erosion, high voltage transients
- *Precharge* resistor applies battery voltage through current-limiting resistor. Typ. 100 – 1000 ohms
- Wired in parallel with main switch or contactor, through separate switch
 - In rare cases, controller has precharge circuitry built-in

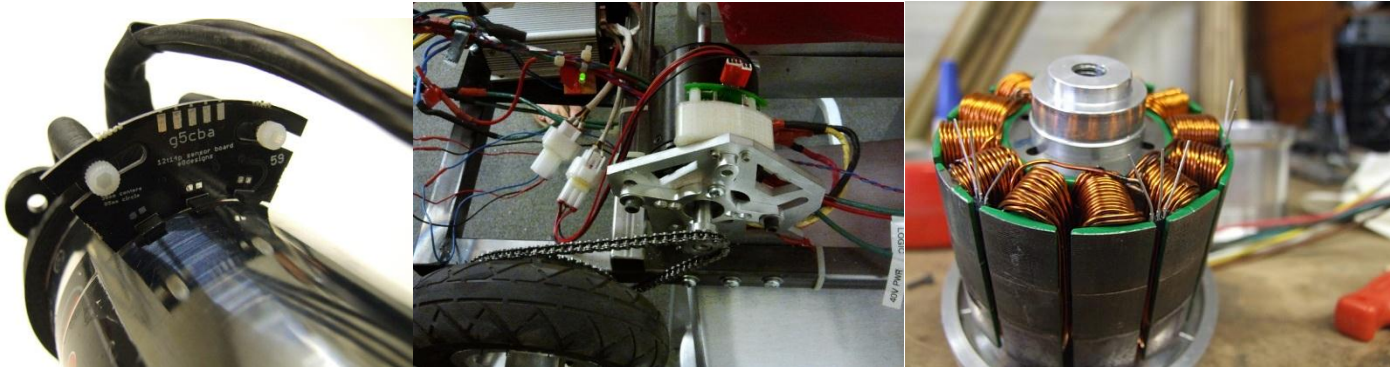


Basic Electric Vehicle System Diagram



Motor Feedback

- DC brush motor: Apply directly to battery
 - Typically a tachometer or wheelspeed sensor in large EVs
- AC Induction motor: Tachometer
- AC permanent magnet (“brushless”) motor: Position feedback
 - Absolute optical or magnetic encoder
- Sensorless AC drives may more sophisticated techniques
 - Winding inductance sensing (ultra high speed current reading)
- Small/Hobby Evs: Hall Effect magnetic sensors
 - <http://educypedia.karadimov.info/library/2pole-bldc-motor031102.swf>



Electrical System Takeaways

- 2 to 3 switches, or methods of switching
 - Main power switch (or relay / contactor)
 - Precharge system
 - Controller logic / auxiliary power, if applicable
- All electrical switches and elements must be solidly mounted.
No loose wiring.
- Brushless? Hall sensor board will be provided.
- Free to use: 12 gauge wire, 14 gauge wire, 3 types of power connectors, Battery terminal connectors, replacement fuses



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