



Citrus Circuits
Fall Workshop Series

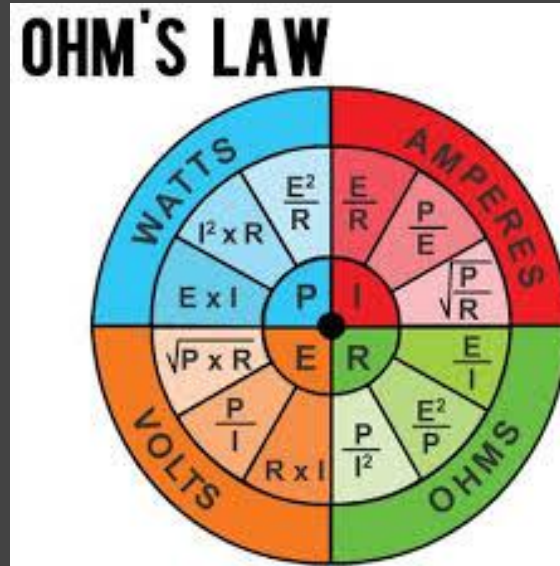
Robot Wiring

By Paul Ngo & Ellie Hass

Know the Trade

Even if you never use ohm's law for wiring an FRC robot, a good understanding of electricity makes for easy wiring. Basics to know:

- i. resistance
- ii. voltage
- iii. current
- iv. capacitance
- v. inductance
- vi. power

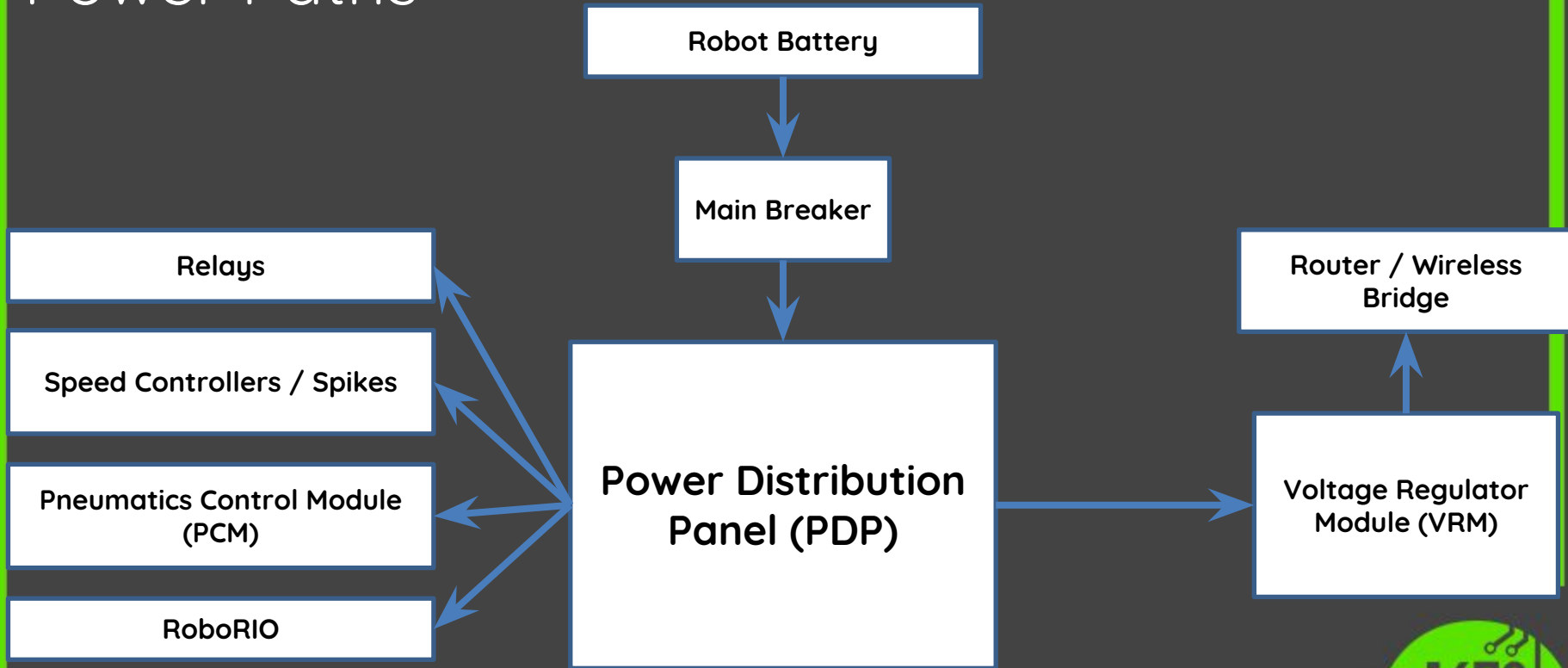


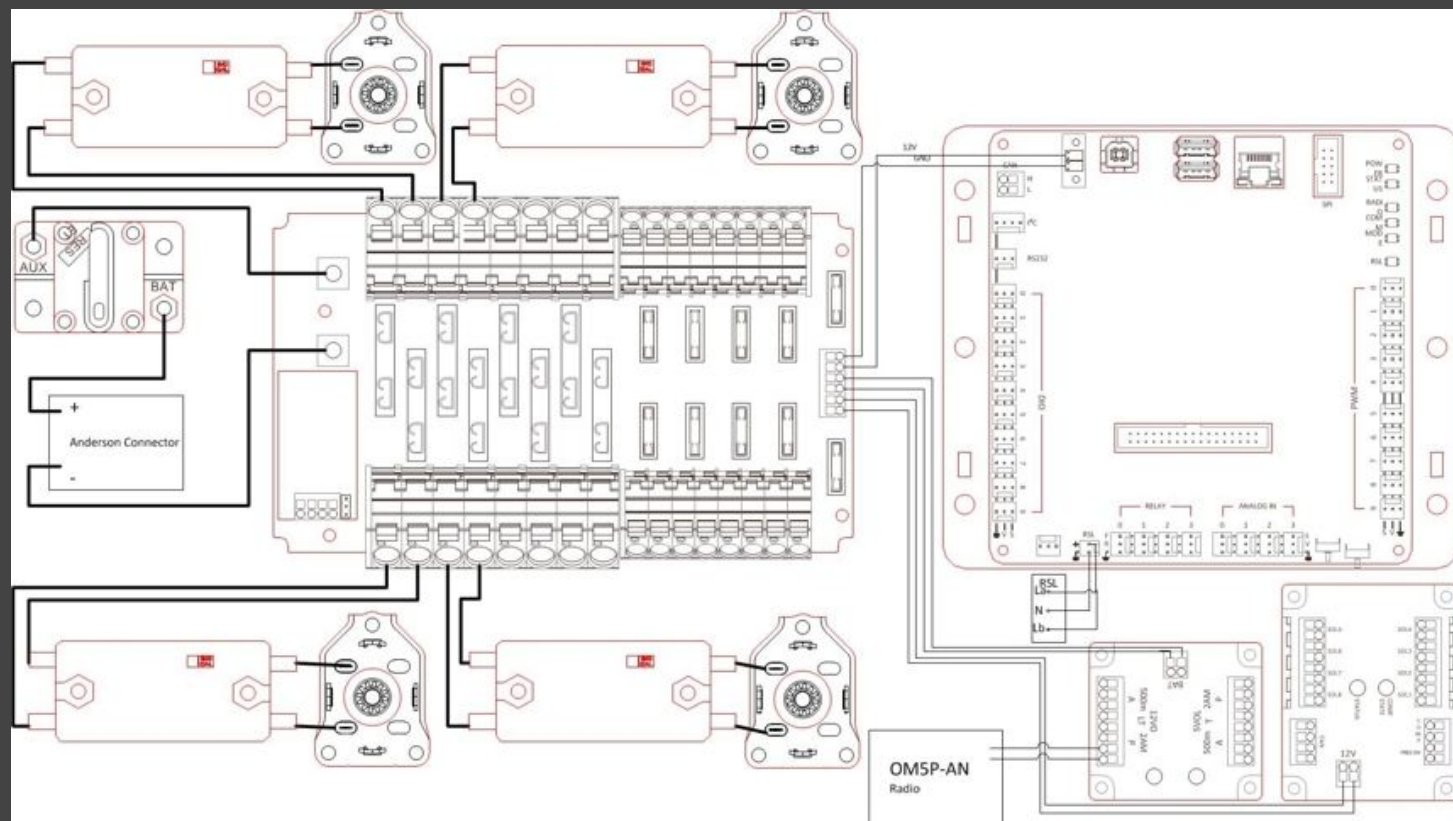
Know the Block Diagram

1. Start with a basic block diagram, then flesh it out with specifics
2. For FRC, consider breaking block diagrams into “power” and “brains” – one diagram for power flow, one for signals.
3. FRC electrical is virtually the same each year

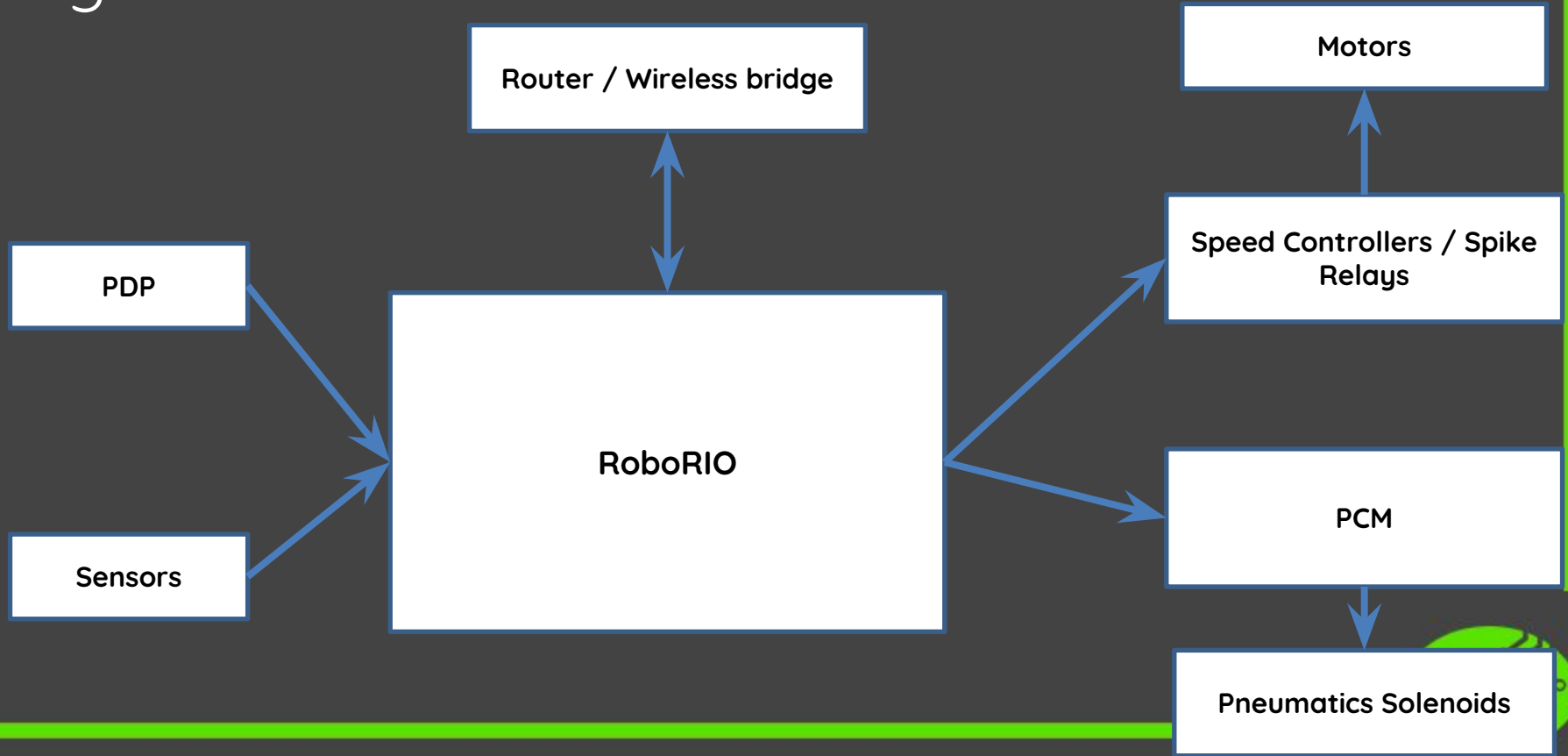


Power Paths





Signal Paths



Necessary Components

What comes in the kit of parts?

First, break up the materials into categories

1. Types of wires and connectors
2. Robot components
3. Electrical tools



Wires and Connectors

- small signal wire: PWM (3 conductor), CAN
- ethernet cable
- 6 gauge or greater wire (4 AWG also common)
- 12 to 18 gauge 2-conductor for distributed power
- special jacks and cable, as for bridge power
- electrical tape / heat shrink for insulation
- solenoid cabling
- crimps: ring / spade connectors, quick disconnect, anderson, narrow gauge for pin headers
- terminal blocks



Connectors

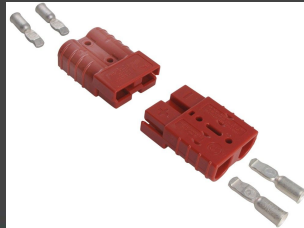
Crimp connectors
ring/spade conn



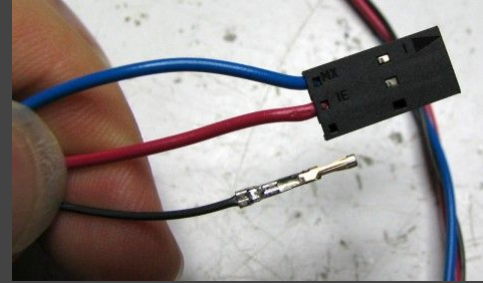
Anderson quick
disconnect



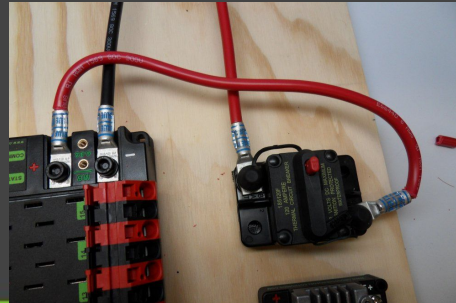
Anderson



Narrow gauge (18-24) for
pin headers

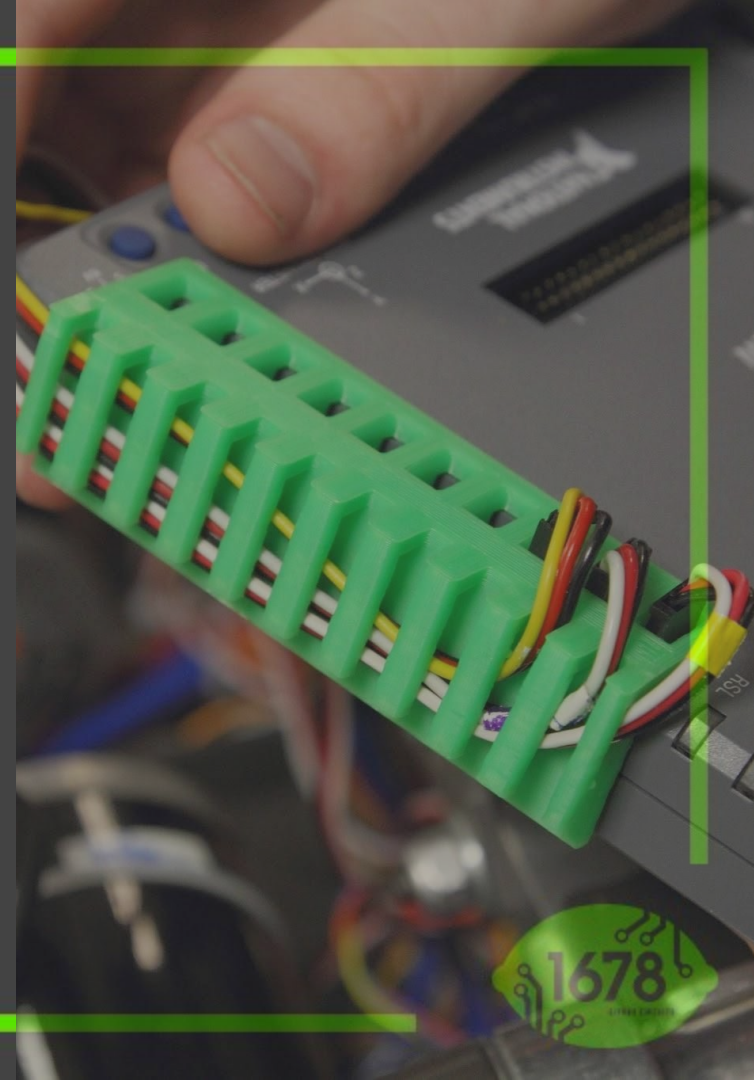


6 AWG lugs



Components (continued)

- a. RoboRIO
- b. speed controllers / relays
- c. batteries
- d. bridge
- e. PCM
- f. VRM
- g. main breaker
- h. other breakers and fuses
- i. sensors



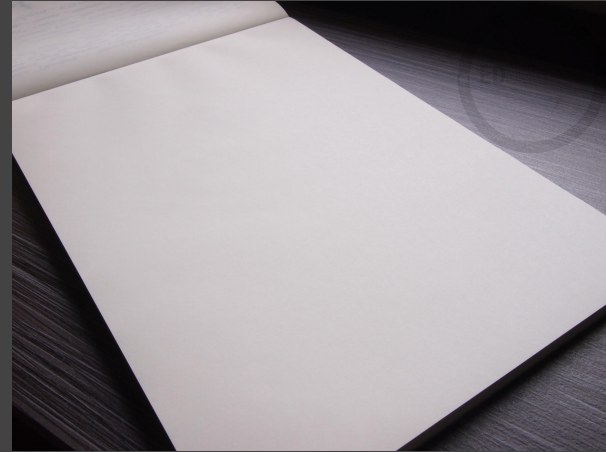
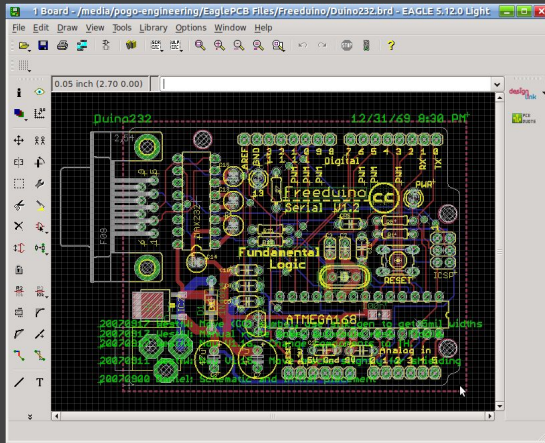
Electrical Tools

1. crimpers (multiple gauge sizes)
2. wire cutters
3. wire strippers
4. soldering equipment
5. heat gun (if using heat shrink or proper PCBs)

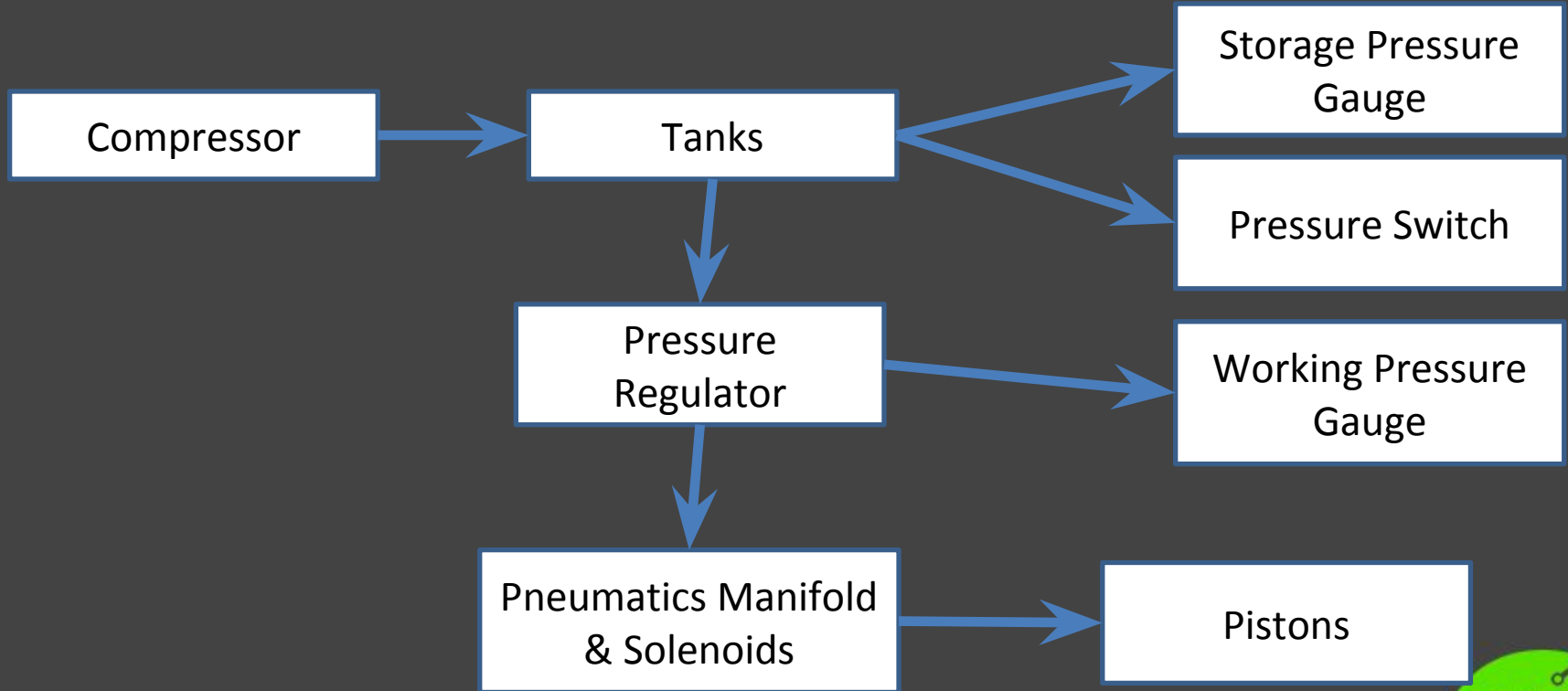


Layout

- Use paper models, draw on a whiteboard, use CAD, whatever – but plan your layout using a scale model, include all the components you can.
- Plan for access – will you be able to change a component if it breaks or needs diagnosing?
- Keep wires short, especially power lines



Pneumatics Paths



Important things to remember

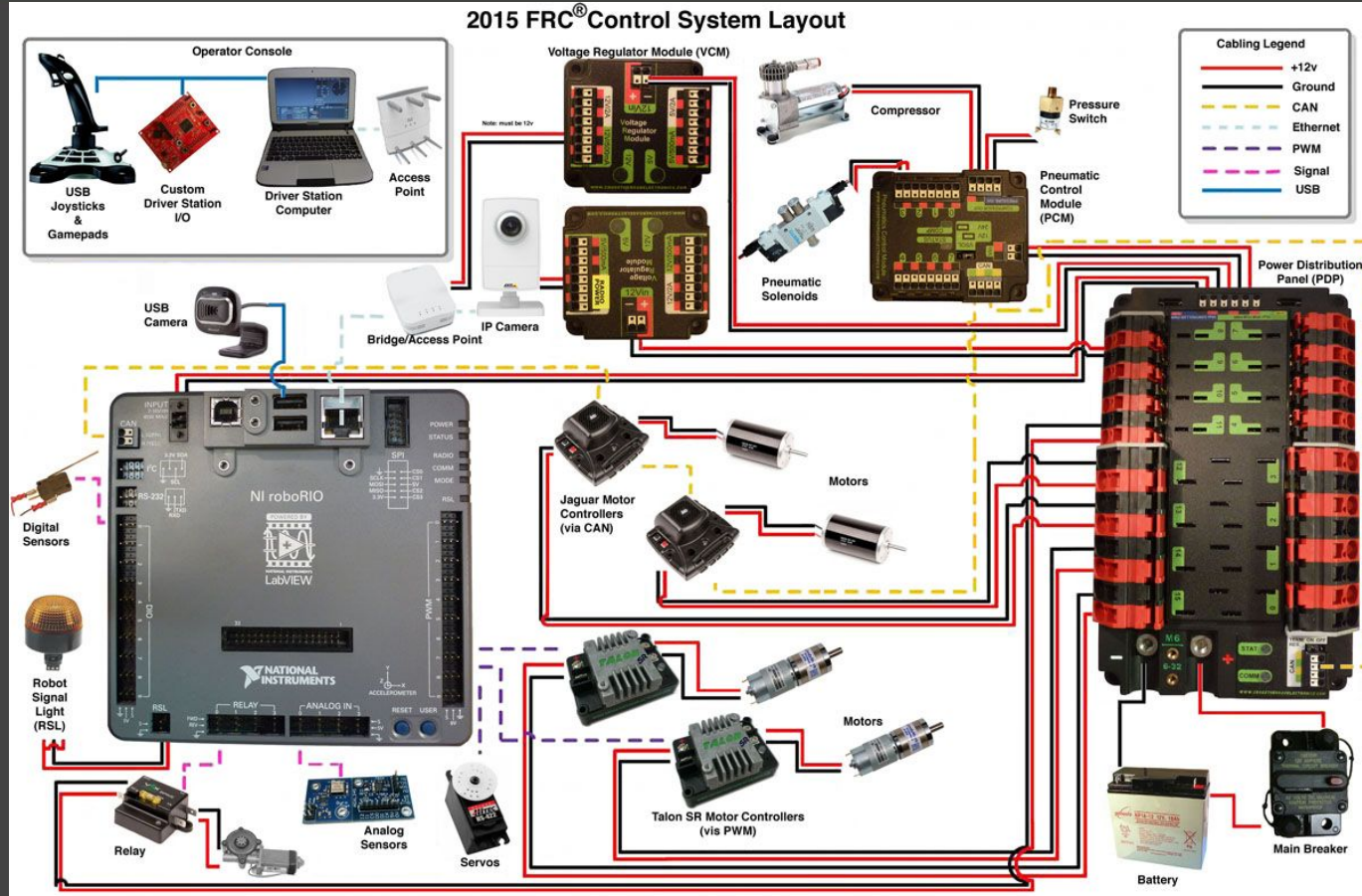
- a. Important connector types:
 - i. terminal blocks
 - ii. quick disconnect
 - iii. pin header / molex
 - iv. anderson
 - v. Weidemuller LSF-SMT connectors on RoboRIO, PDP, PCM, VRM
 - vi. screw terminals
- b. Attach components to substrate, then wire between components
 - i. avoid loose wires, make sure no wires will interfere with moving parts
 - ii. keep wires organized so they are easy to follow and modify.
 - iii. make sure crimps and other joints are secure - those are the failure points where the electrical system could break.
 - iv. be very careful about avoiding and preventing short circuits, reversing polarity
- c. Keep things adjustable / replaceable – don't solder to long wires to components, use standard length wire with connectors
- d. Label things! At both ends of each wire, add tags that name the wire. Do not label ends different things.
- e. Battery wiring
 - i. FIRST has very strict rules about connecting the battery - follow them. Why? Their method of connecting batteries is good for preventing shorts. Shorting a robot battery has dangerous potential to burn things and start fires.



Wiring Practices

- Pull-test: check crimps and other connectors
- Keep wires secure and away from moving parts
- Label things
- Keep wire paths organized
- Bend radius for pneumatics tubing
- Bend radius for wires that will move

A finished robot!





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Thank You!