

HOWDY BOTS

Robust Wiring for FRC Robots

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Introductions

Presenters

- Clay Tomaszewski - 4 year Veteran FRC student
- Evan Marchman - 5 years of FRC mentoring experience, EE by day
- Special assistance by Austin Page - 13 years of FRC as student and mentor

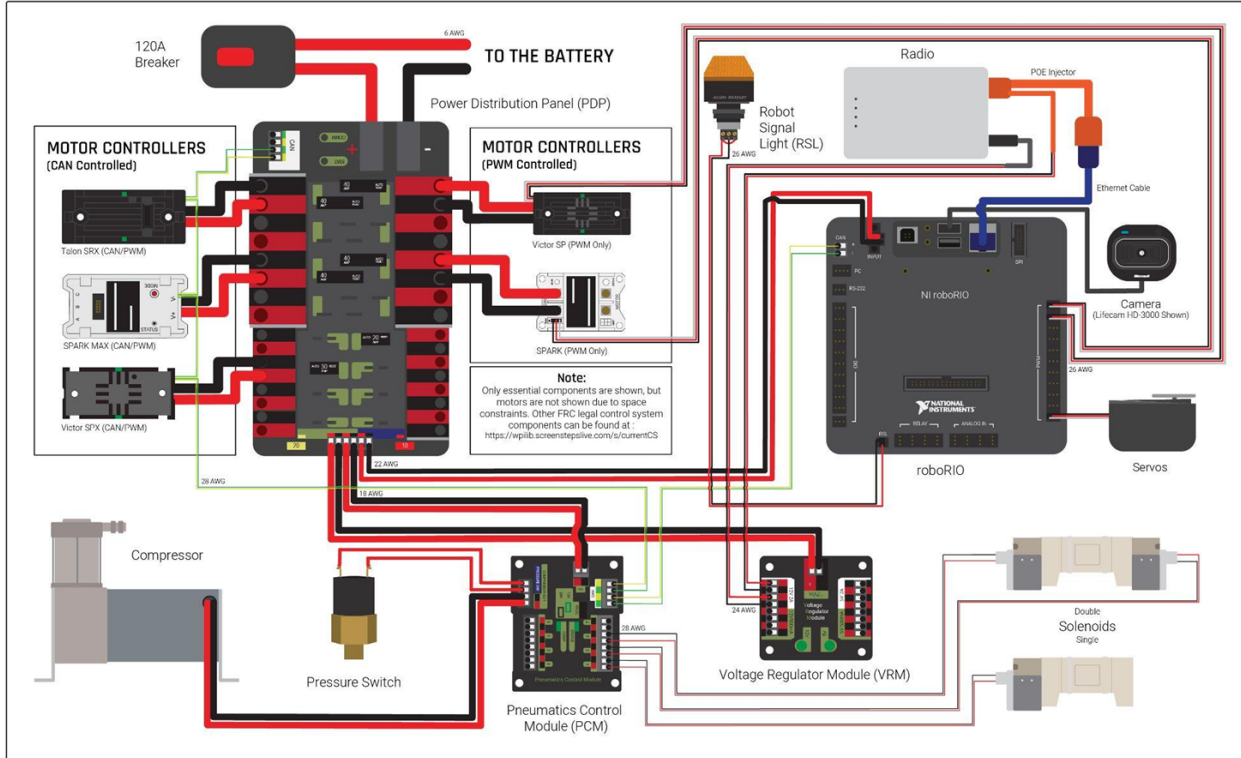
Today's Presentation

- IS - common issues and how to prevent them, don't fail on the field
- IS NOT - cosmetics, pretty wiring, how to pass inspection



TEAM 3161

FRC ROBOT CONTROL SYSTEM COMPONENTS NOT TO SCALE



Common Fails on the field - wires

NOT SECURE = FAILURE POINT

- Loose connections
- Flying batteries
- Connectors not fully seated
- Wires in gears/chain
- Wire abrasion
- Wire entanglement



Batteries

...the leading cause of dead, stuttering and misbehaving robots.

- Maintain them! -> Keep them charged ALL THE TIME.
- Terminal connections must be TIGHT! REALLY REALLY TIGHT!
- Terminal connections must be fully protected (taped).
- SB50 fully seated? Zip tie if needed.
- Pre-adjust the terminal exit direction for your robot.
- TEST it before use (Battery Beak). Charged? R_{INT} good?
- NEVER pick up or carry a battery by the wires.
- Inspect for pulled/strained crimps
- CRIMP the connectors. DO NOT use “screw clamps” for the wire.
- Use fresh #10 hardware (trash the screws that come with the battery)



Battery Terminals

- #10 bolt
- 2x #10 Nord Lock washer
- #10 Nylock nut
- Burndy lug (pre-bent to desired angle)
- Scotch/3M electrical tape

Super inspect Positive to Red and Negative to Black.

Battery terminal to SB50 position!

Wiggle test!!!



Breaker and PDP

- Don't forget to check “under the cover” of the PDP
- Wiggle test often!
- Put a screw/nut driver to it often!
- Nord lock on breaker and PDP



Power fan out

- Tug test *everything*. Tug test *everything*. Tug test *everything*.
- Check strip length in Wago connectors
- Ensure *all* strands are in the connector and not frayed out
 - Pre-twist it!
- Ensure Anderson connectors are fully seated
 - Zip tie them together! Especially if there is *any* strain on the connector.
- Protect pinch/cut points
- Secure all slack wire
- Tug test *everything*. Tug test *everything*. Tug test *everything*.



Signal wires

- Tug test *everything*. Tug test *everything*. Tug test *everything*.
- Check strip length in Wago connectors
- Ensure *all* strands are in the connector and not frayed out
 - Pre-twist it!
- Ensure Anderson connectors are fully seated
 - Zip tie them together! Especially if there is *any* strain on the connector.
- Ensure PWM/CAN connectors are fully seated
 - Zip tie them together! Remove all strain on the connectors.
- Protect pinch/cut points
- Secure all slack wire
- Tug test *everything*. Tug test *everything*. Tug test *everything*.

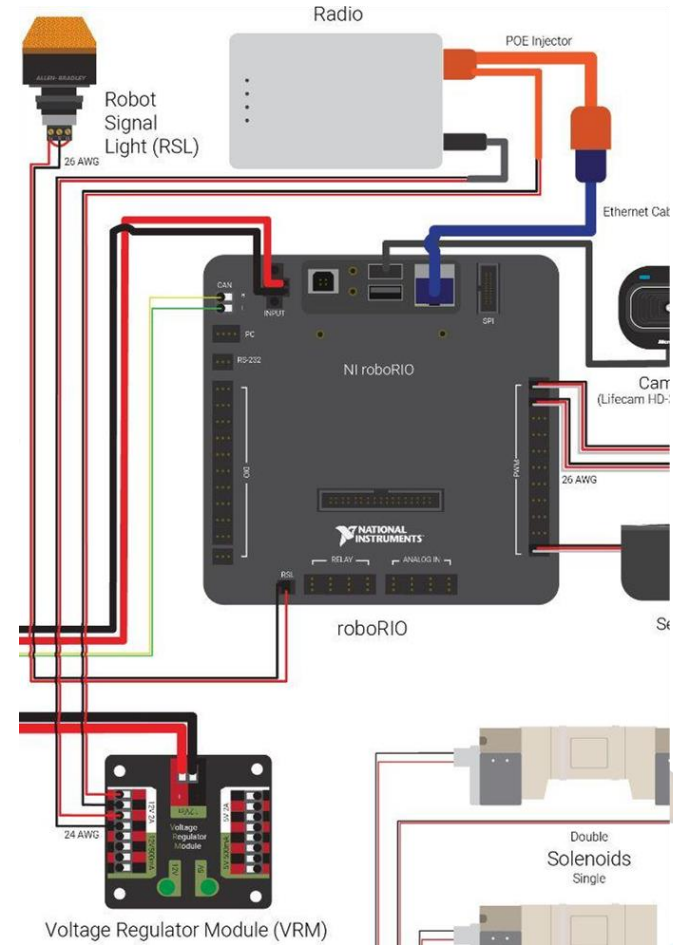


Radio Power

...is the second most common failure mode.
(maybe the first?!?)

- Belt and suspenders!
- 12V via barrel connector
 - Wire strain relieved and secured on both ends
- 12V via passive POE injector
 - Wire strain relieved and secured on both ends
- Ensure NO pull out

LONG reboot time = motionless robot = very sad team = crying fans



First Turn-on Check

1. Two independent sets of eyes
2. Black to Black / Red to Red
 - a. Battery *terminal* to PDP
 - b. PDP to loads
3. CAN - Green/Green / Yellow/Yellow
4. PWM - Red/Red, Black/Black, White/White
5. Breakers are correct values
6. Tug test everything
7. Wiggle test all bolted connections



Between the matches

- FRESH battery! Don't risk it.
- Wiggle test battery to PDP
- Tug test all wires that see movement/bounce
- Inspect radio connections
- Inspect all wires that can be contacted from outside the robot
 - i.e. Limelight power



System “Sweep”

Refer to diagram, two checks: “Power” and “signal”

Check every connection in “direction of power flow” or “direction of command”. Start with the Rio, work your way out from there.

Battery -> breaker -> PDP -> VRM -> device

-> PCM -> device

-> motor / device

RoboRio -> CAN / PWM -> device

-> PCM/Canifier/etc -> device



Match Checklist

- Battery Charged
- Battery $R_{INT} < 0.02$ Ohms
- Battery terminals tight and protected
- Battery secured in robot
- Radio secured
- Radio power secured
- Verify all the “problem spots”
- No loose cables that will get snagged by mechanisms, other robots or field elements
- Laptop charged!



Battery Cable Parts Lists

- SB50
 - Housing - [Powerwerx](#) or [Mouser](#)
 - Terminals - [Powerwerx](#) or [Mouser](#)
- 6 AWG wire - [Powerwerx](#)
- 4 AWG noodle wire - [Black](#) and [Red](#) (source shorter lengths on Amazon)
- Lugs - [Amazon](#) (Thomas & Betts version)
- #10-32 Flange Locknuts - [McMaster](#)
- #10-32 x $\frac{5}{8}$ " SHCS - [McMaster](#)
- Nord locks - [McMaster](#)
- Glue lined heatshrink - [Amazon](#)



Thank you!

Slides will be posted to:
howdybots.org/resources/

Additional Questions?
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