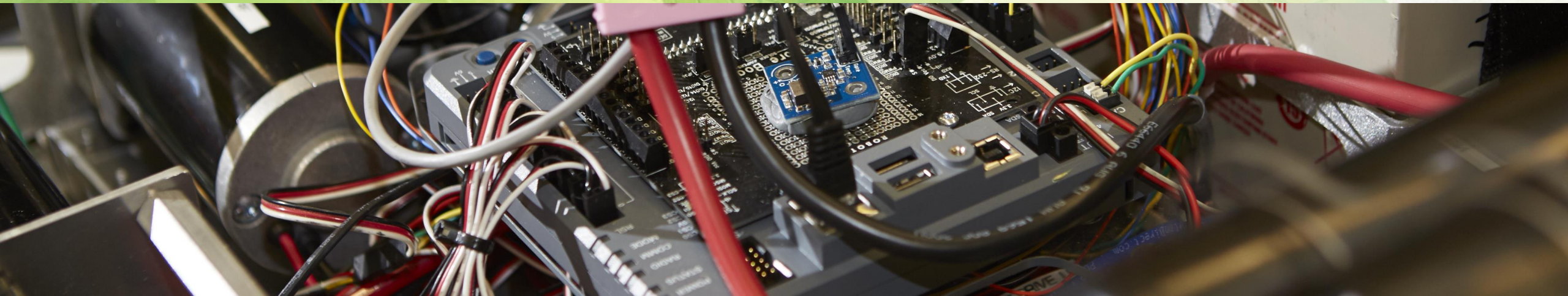


# Electronics & Control System



# About Me

- Electrical Student Lead for 2 years
- Electronics Mentor for 2056
- Co-Lead mentor for 1285 and 1241 in Electronics
- Volunteer For FIRST and VEX
- Volunteered as a CSA, Robot Inspector and Referee

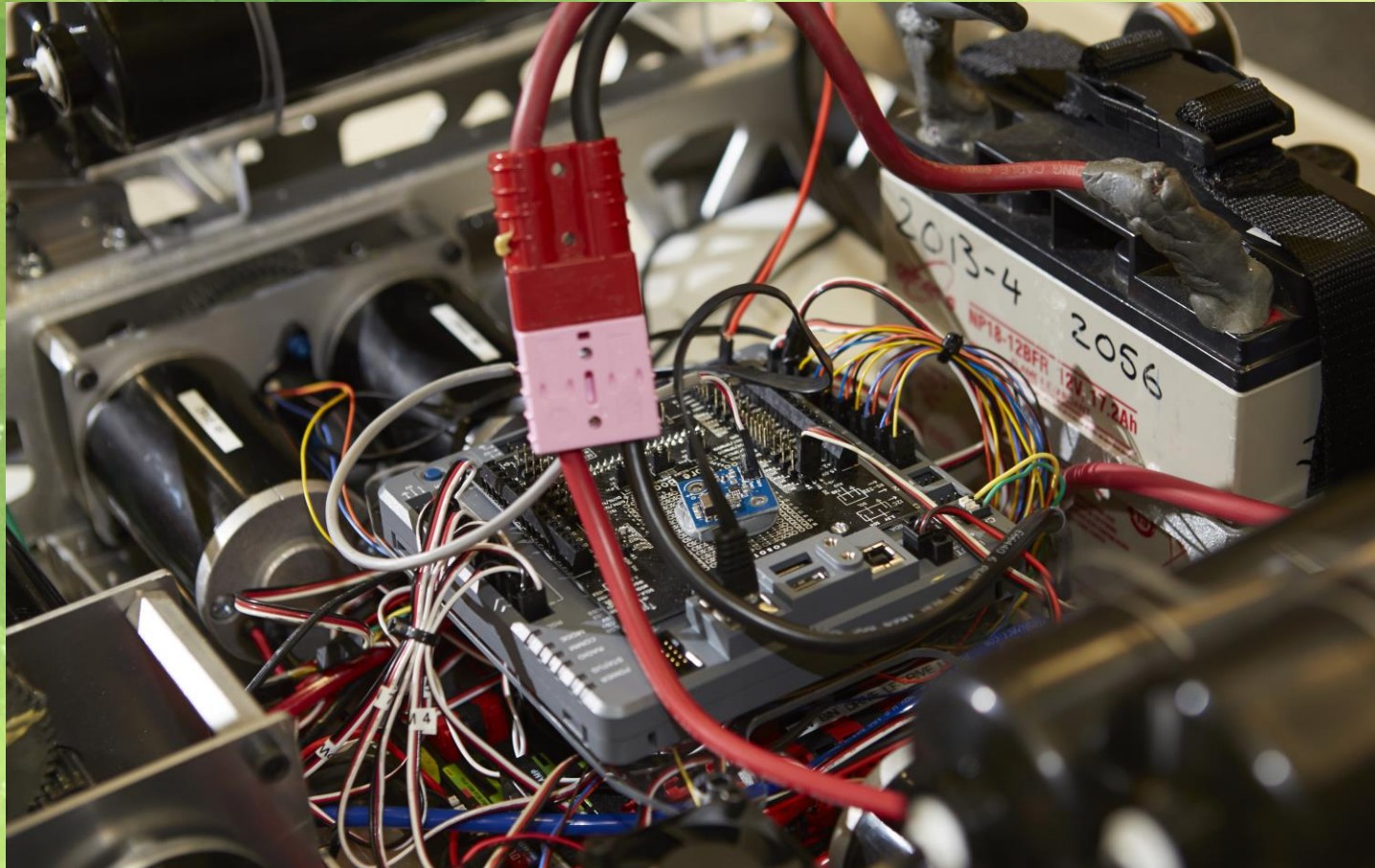
# FRC Robots



A cohesive robot system is required for mobility.

All mechanical designs rely on the electrical control system as support.

# Electrical Design



▶ Components

▶ Layout

▶ Sensors

▶ Tips and Tools

# Power Distribution Panel (PDP)



- Connects main components with power
- Fuses to help power distribution
- Power to motors and battery and RoboRio

# Voltage Regulator Module



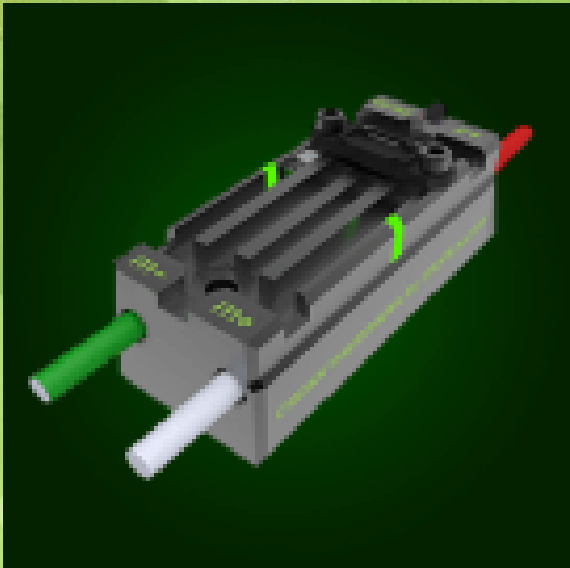
- Converts voltage depending on where it needs to go
- Some components needs different voltages

# RoboRIO



- Digital IO
- PWM connections
- Analog connections
- Brain

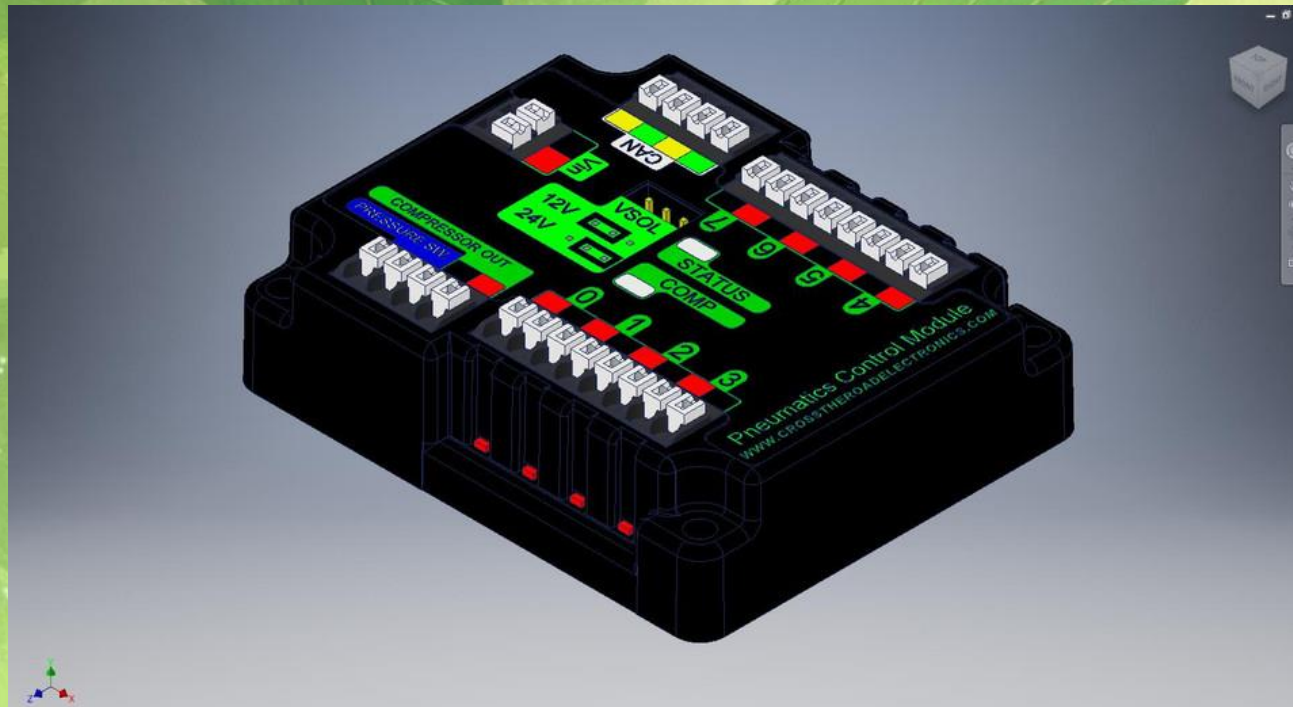
# Motor Controllers



- Types of controllers
- Control of motor speeds
- Helps control robot



# Pneumatic Control Module



- Air compressor
- Solenoids
- Pressure switch
- Controls Pneumatics (Brain)

# Solenoids

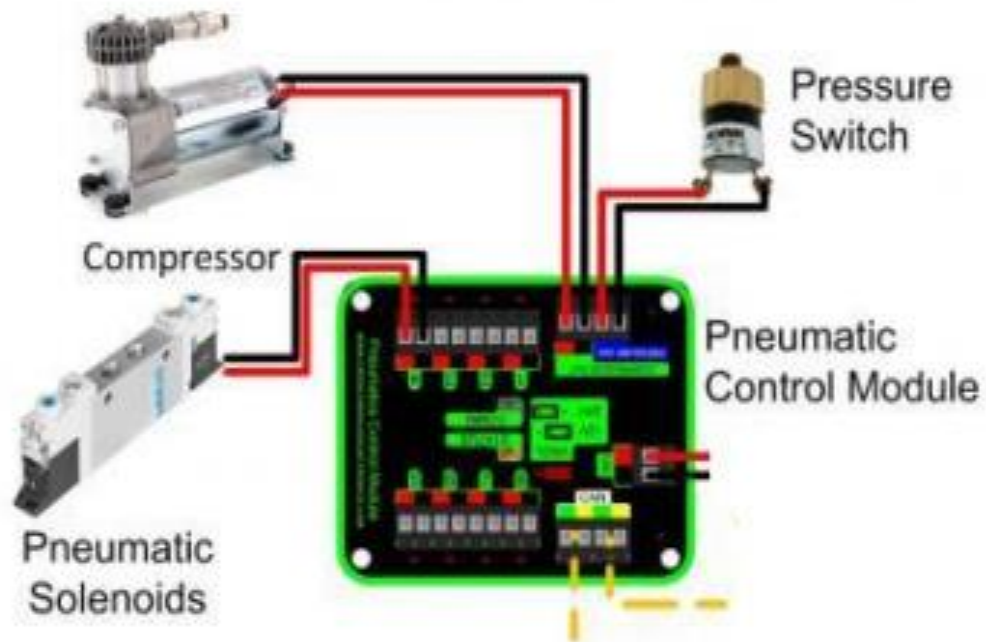
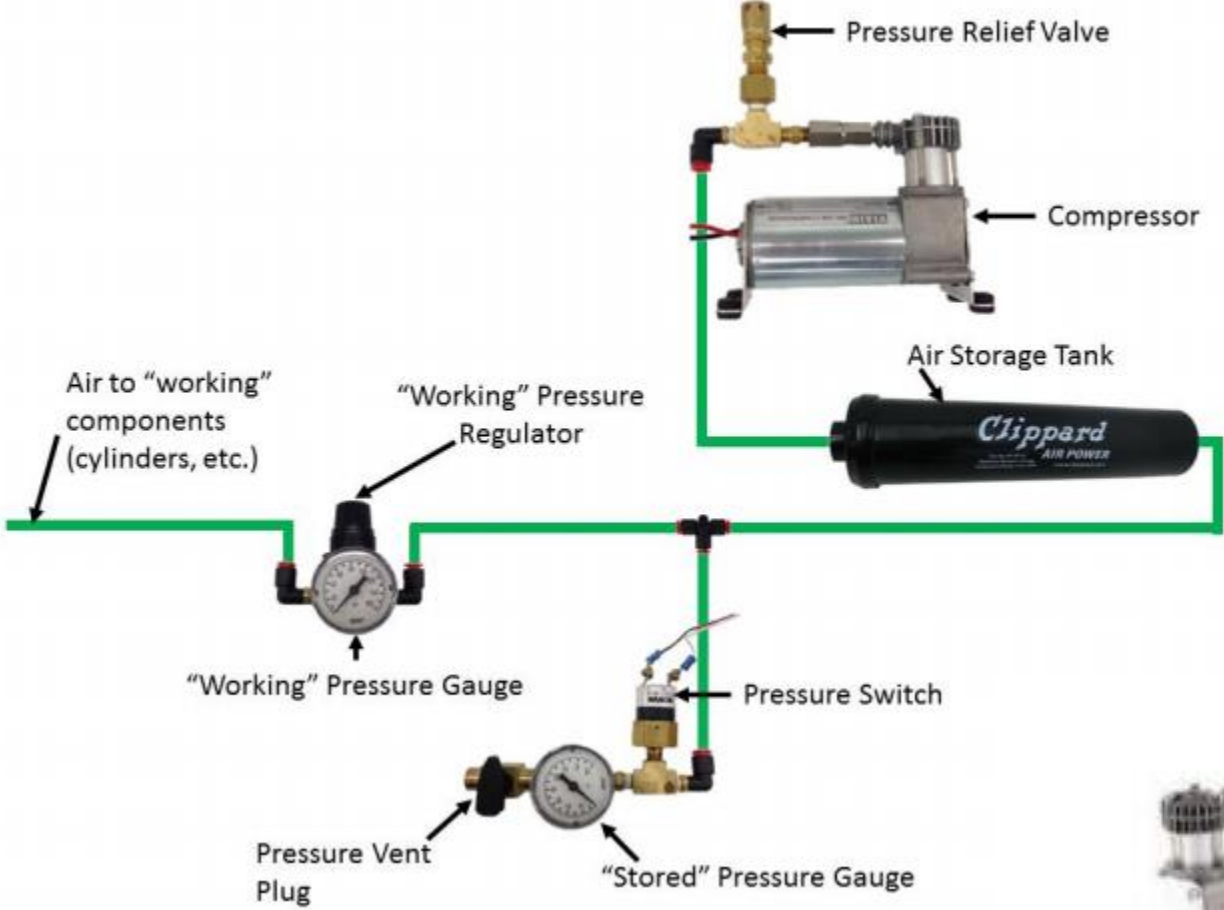
- Controls air flow

- Output maximum pressure of 60psi

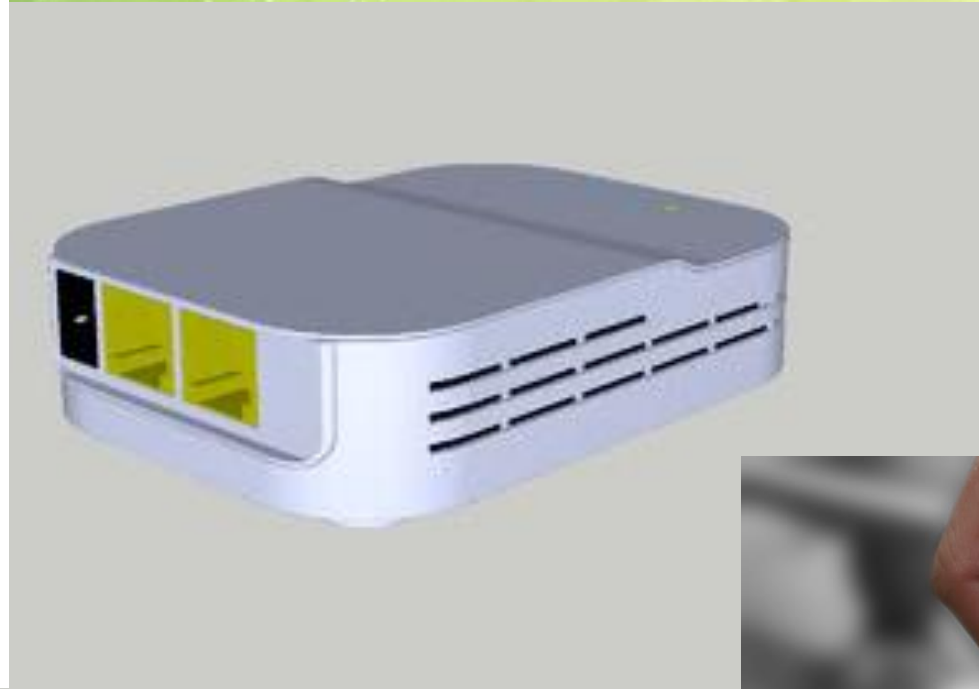
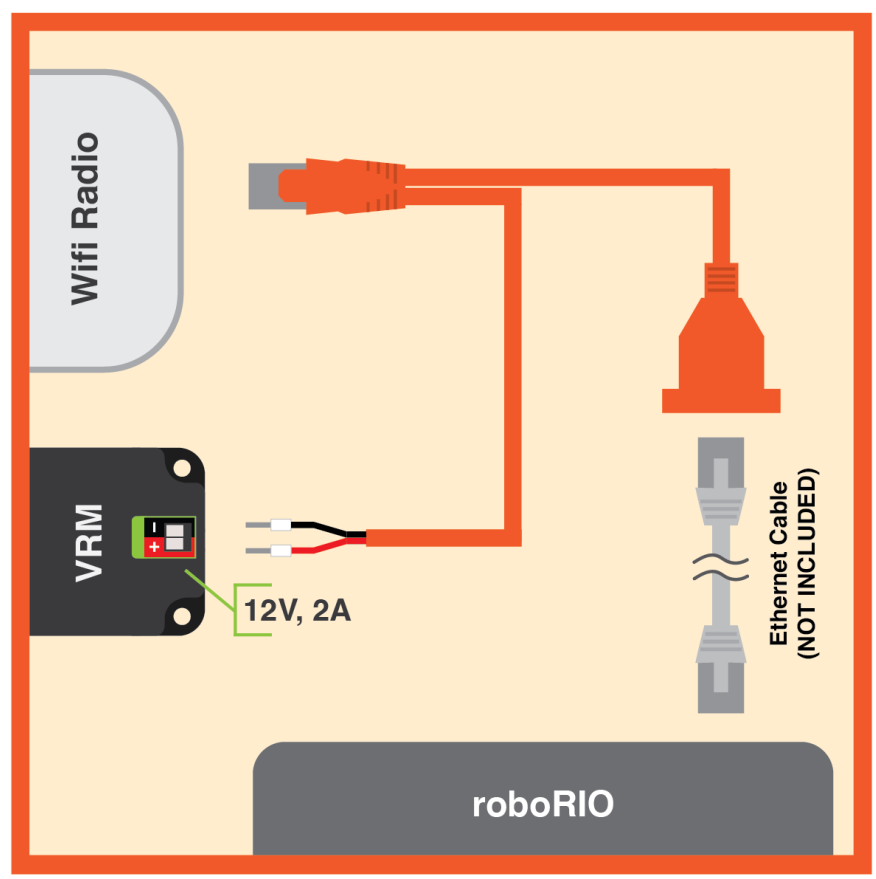
- Connects to the PCM



# Pneumatics Setup

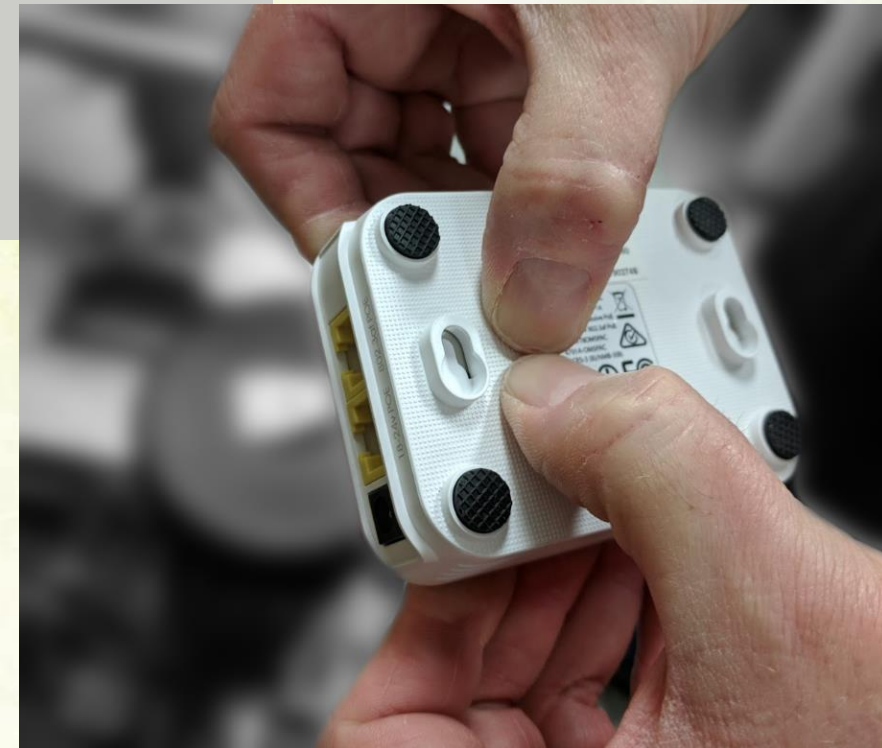


Cabling Legend	
	+12 V
	Ground
	CAN
	Ethernet
	PWM
	Signal
	USB



# Radio

- Communication between the driver station and the robot
- USE POE PLEASE



# Sensors

Allow comprehensive control of the robot

SRX Magnetic Encoder

VersaPlanetary Integrated Encoder



# Potentiometer



Converts angular position into analog measurement

Measures the variable resistance, which can be read as an analog value

Can determine position and direction of rotation

# Encoders

Converts angular position or motion of a shaft/axle to digital signal

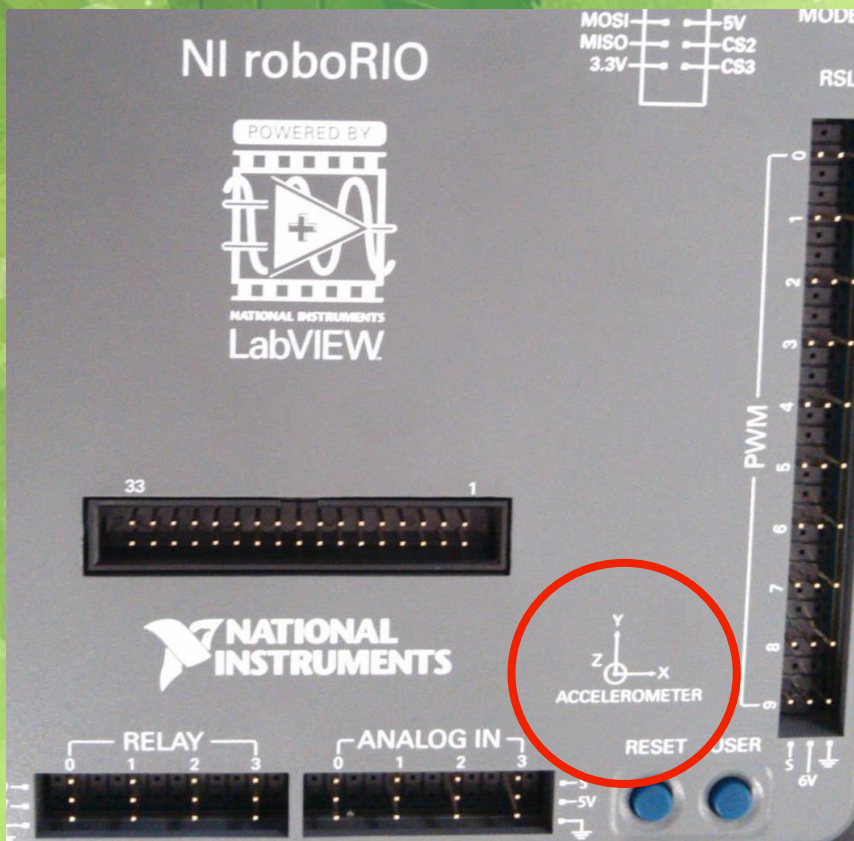
Determine translation distance, rotational velocity or angle of robot component



Main components:

1. Rotating disc
2. Light source
3. Photosensor

# Accelerometer

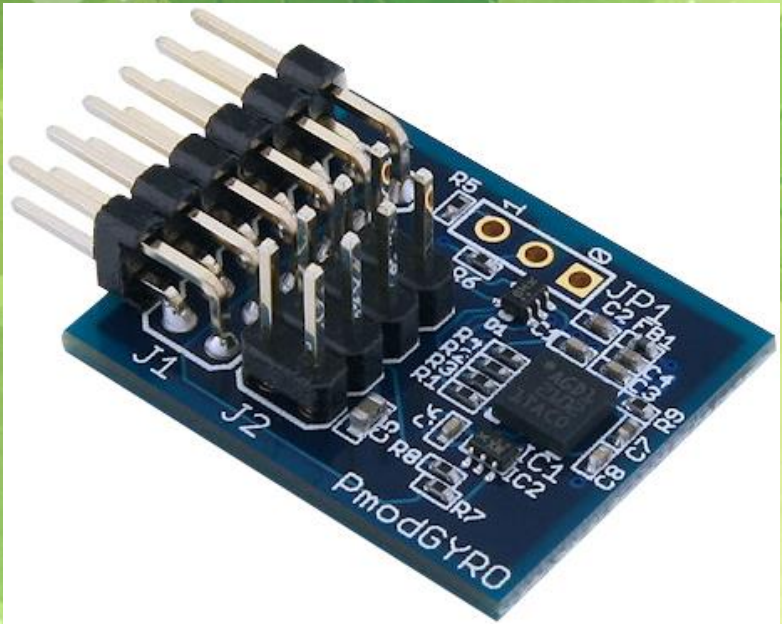


3-Axis accelerometer, conveniently located on the roboRIO

Used to determine acceleration of the robot, for example the degree to which the robot is tilted



# Gyro



Sense rotational movement and changes in orientation

Changes in vibration are read as analog values

Functions best at the center of robot axis of rotation

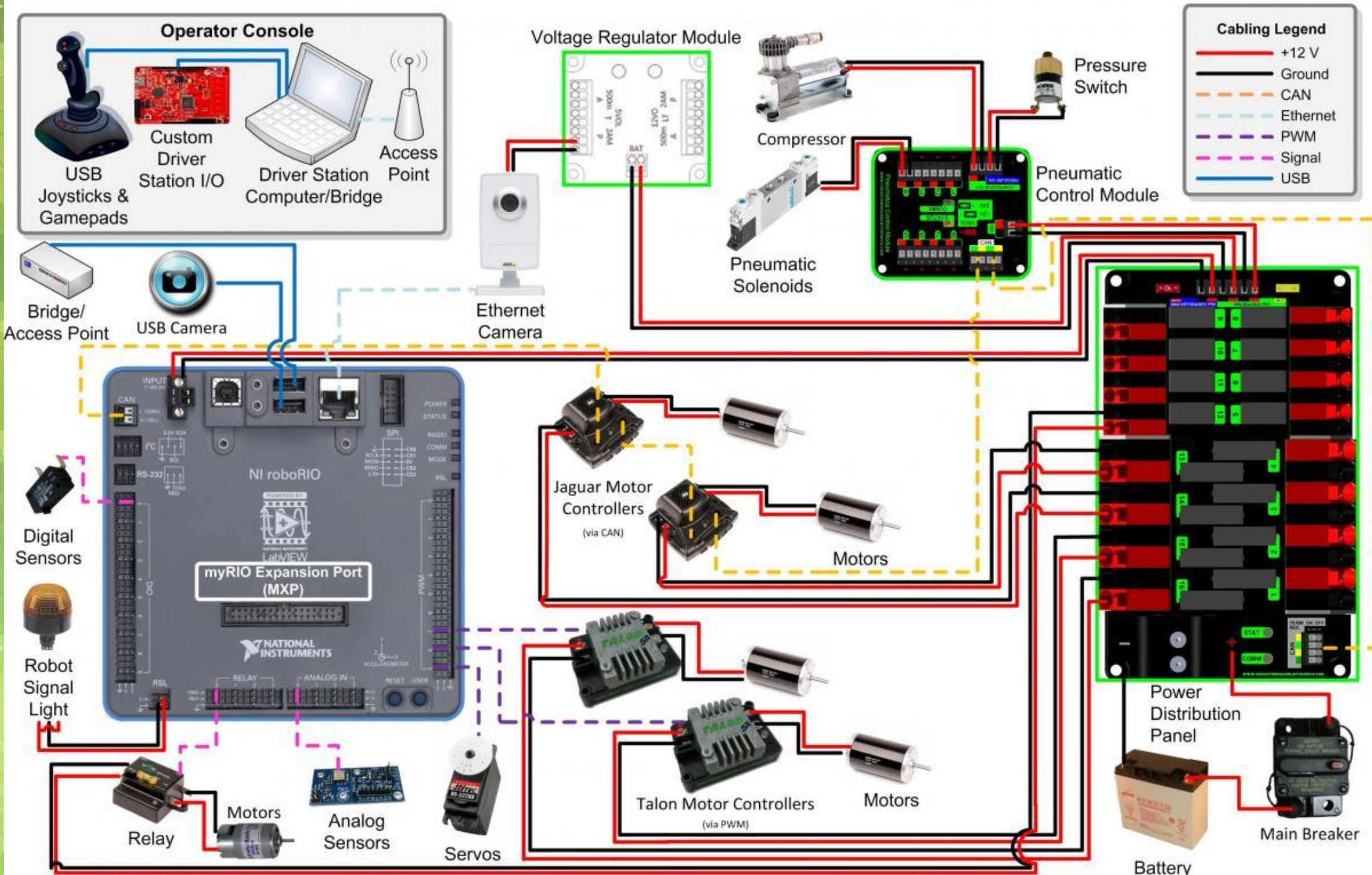
# Switches

Simple to implement and use...  
but only provide feedback on single  
position of a moving part

Detect a fixed position, ensure mechanical  
limits are not exceeded

Identify presence of game piece or object





Plan

fasten it  
wherever  
it fits



# Component Considerations

## **Main Circuit Breaker**

Visible  
Easily accessible  
Protected from exterior elements

---

## **Battery**

Keep low, at the base of the robot  
Easily accessible  
Keep well secured

---

## **Speed Controllers**

Close to PDP, directly in line to corresponding motor  
Accessible for calibration and assessing electrical issues

---

## **Radio**

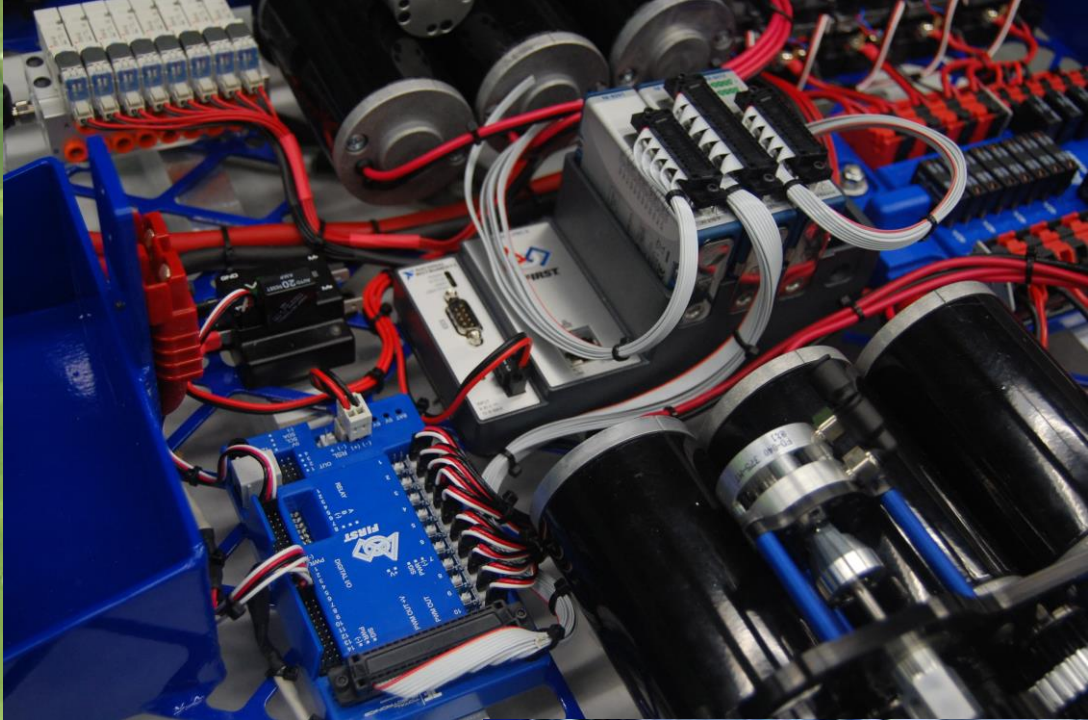
Status indicators visible  
Protected from exterior elements

# General Guidelines

## Wire Gauge Reference

Minimum recommended wire sizing

PDP 40 amp circuit	12 AWG
PDP 30 amp circuit	14 AWG
PDP 20 amp circuit	18 AWG
roboRio/bridge/5A circuits	20 AWG
Main breaker/battery (50 amp)	6 AWG



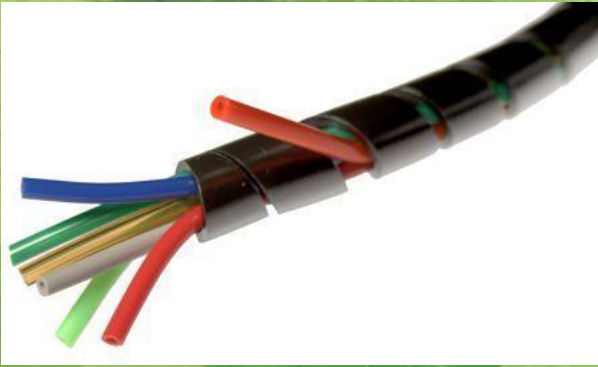
# Wiring Tips

## 1 Keep it neat

- Helps to avoid connection issues
- Keep Wires Short but long enough
- Allows for easier troubleshooting & diagnosis



# Wiring Tips



## 2 Zip ties, bundles & mounts

- Bundle and route like wires along definitive paths from one component to the next
- Hardware helps keep wire stationary and attached to surfaces





# Wiring Tips



3

## Disconnects & terminal

- Anderson Powerpole connectors allow for quick disconnect of wires and easy component replacement
- Use quick disconnect terminals on motors



# Wiring Tips

## 4 Label

- Channels on the PD board
- CAN and PWM connections into roboRIO
- Use meaningful naming conventions

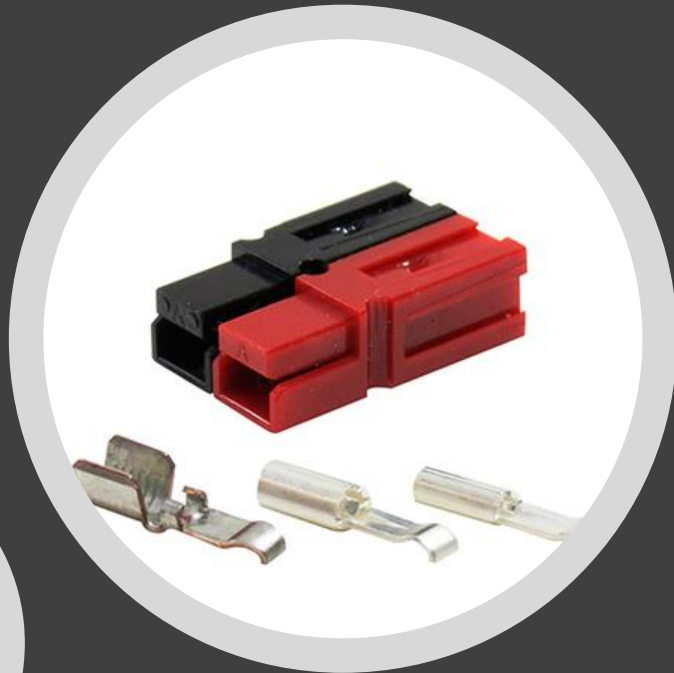


# Electrical Tools

- Crimpers (TR1crimp and PowerWerx Economy)
- Wire cutters + Wire strippers
- Soldering gun + Solder
- Heat gun + Heat Shrink
- Ferrule Crimpers + Ferrules
- Multimeter
- Retention clips
- Anderson Powerpole connectors
- PDP WAGO TOOL



Powerwery



# Electrical Tools

# FRC LINKS

- <https://www.vexrobotics.com/vexpro>
- <http://www.ctr-electronics.com/>
- <https://www.andymark.com/>
- <https://www.studica.com/>
- <https://www.mcmaster.com/>
- [https://wpilib.screenstepslive.com/s/currentCS/m/cs\\_hardware/I/144\\_971-wiring-the-frc-control-system](https://wpilib.screenstepslive.com/s/currentCS/m/cs_hardware/I/144_971-wiring-the-frc-control-system)
- <https://www.firstinspires.org/resource-library/frc/electrical-and-software-resources>

# Other FRC Teams Resources

- <https://www.citruscircuits.org/resources.html>
- <http://frc971.org/content/resources>
- <http://www.simbotics.org/resources>
- <https://www.team254.com/resources/>
- <https://www.strykeforce.org/resources/>
- <http://www.killerbees33.com/resources/>
- <https://www.teamrush27.net/resources>
- <https://www.thecompassalliance.org/resources>
- <https://www.nutrons.com/resources>
- <https://www.robowranglers148.com/resources.html>
- <http://team1323.com/wiki/>

**Thank you!**

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