Training L1

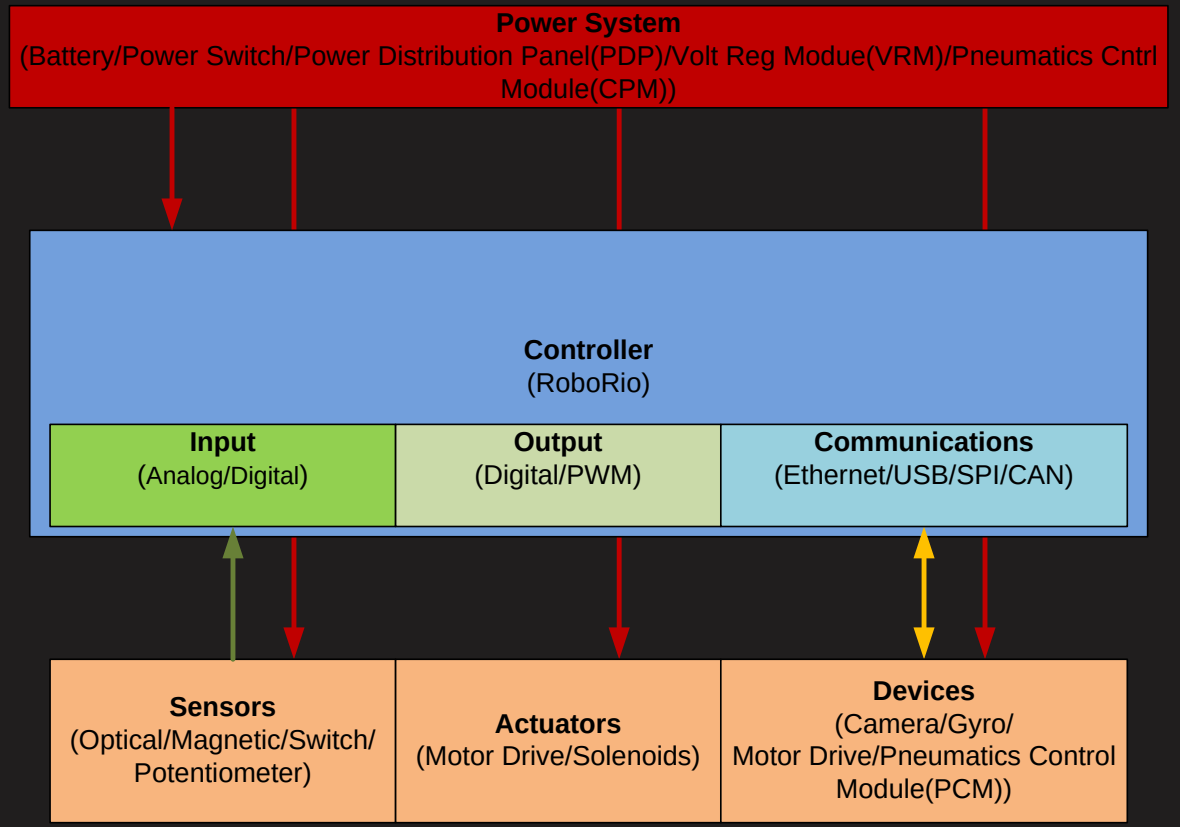
Robot Control System Components

Objectives

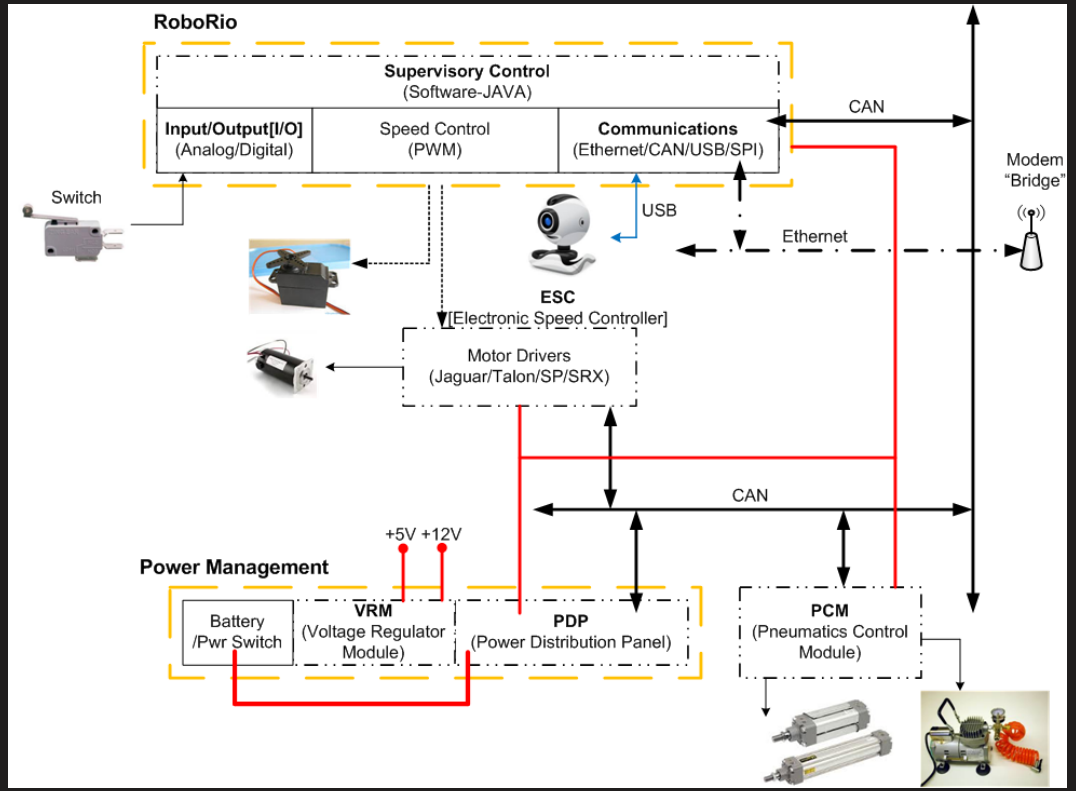
Understand:

- ❑ Understand Robot Control System Language
- ❑ Understand Robot Control System Architecture
- ❑ Understand Robot Control System Components
- ❑ Control System Wiring - Covered in “Electrical Design / Wiring”

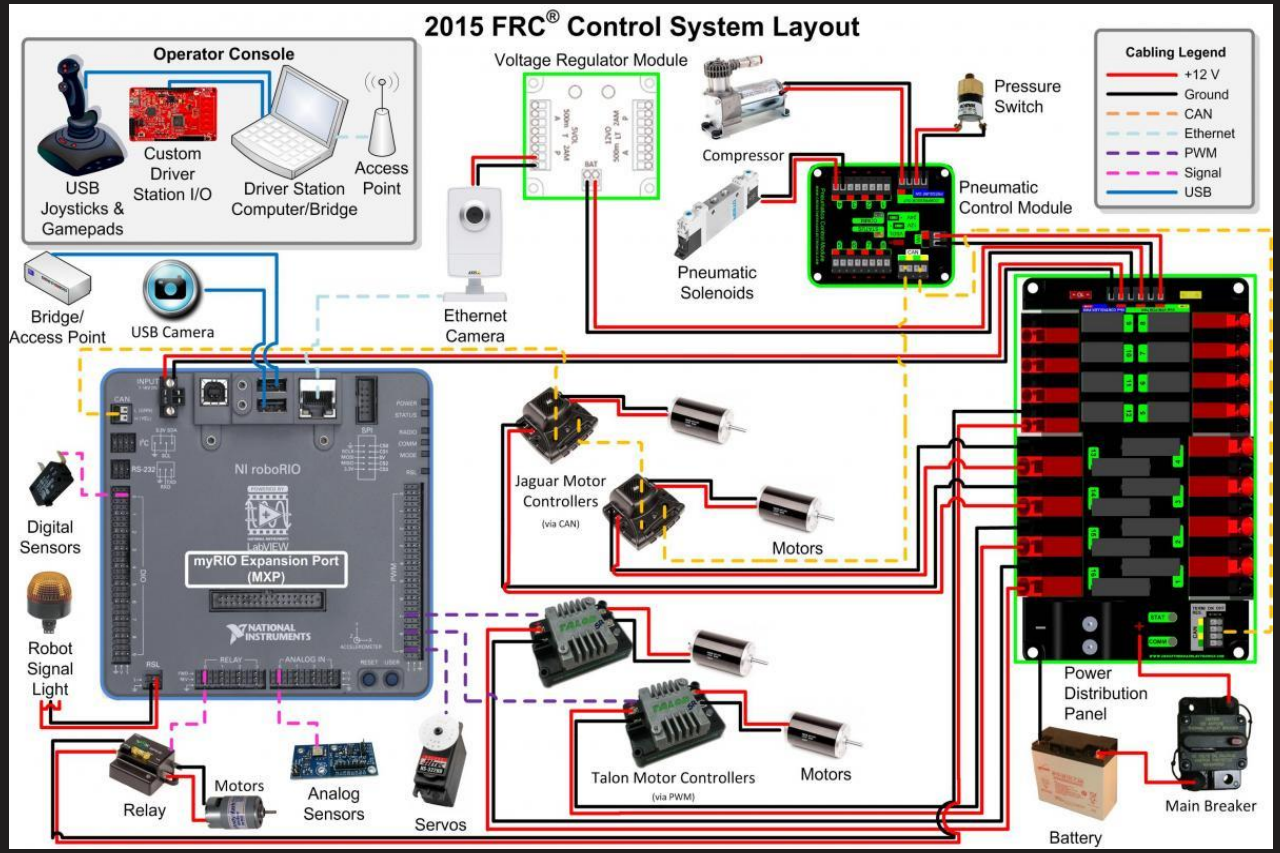
Robot Control System Block Diagram



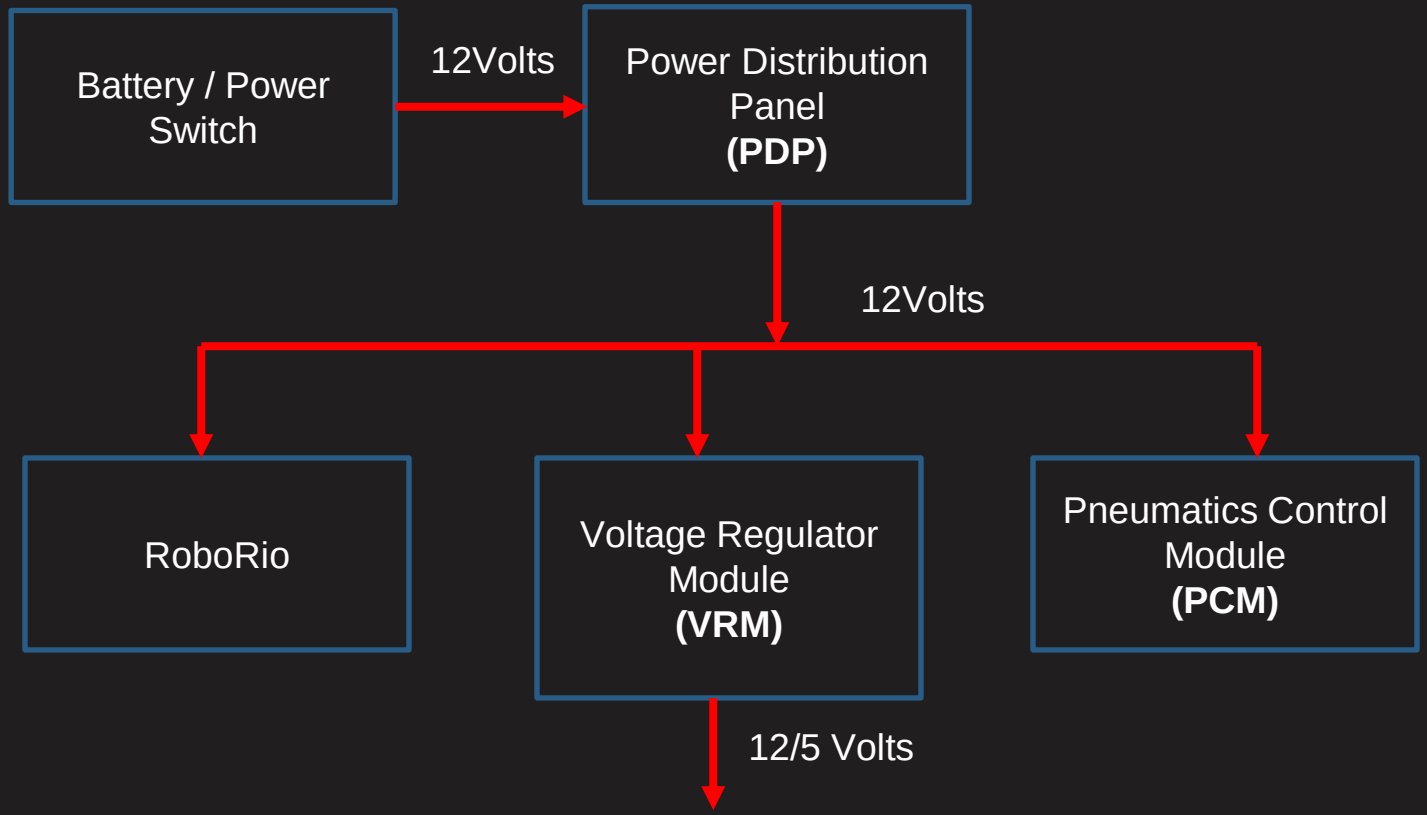
Robot Component Block Diagram



FIRST Pictorial Control System Wiring Diagram



FIRST Robot Power System



Robot Battery

Features

- Sole source of power for robot
- 12V /18 Ah capacity
- 150A max rated output
- Rechargeable up to 250 times
- Sealed lead acid chemistry
- Can be used in any position
- 3-5 year life expectancy

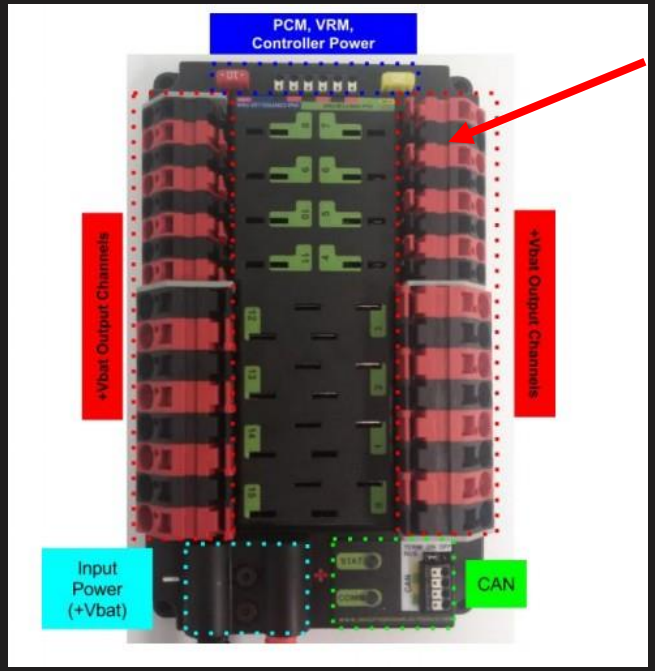
Main Circuit Breaker

Features

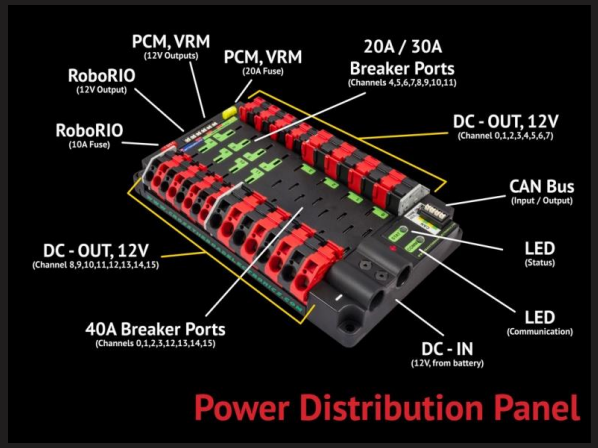
- 120A protection rating
- Integrated switch
- Insulated terminal caps

The Main Circuit Breaker protects the entire electrical system and acts as the master power switch

Power Distribution Panel(PDP)



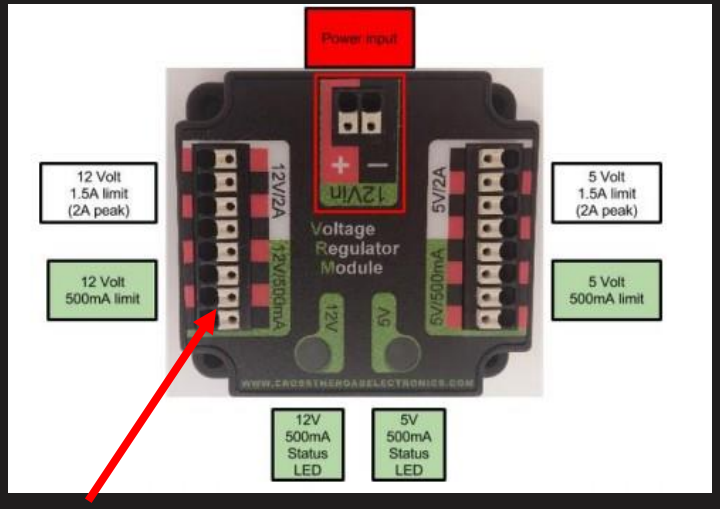
Weidmueller Connectors

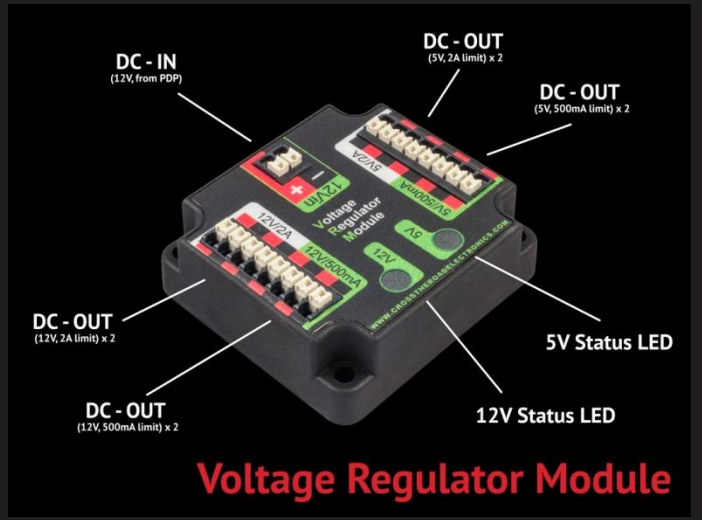


Features:

- 8 40-Amp Connections (numbered 0 to 3 and 12 to 15)
- 8 30 or 20 Amp Connections (numbered 4 to 11)
- 1 connection for VRM power
- 1 connection for PCM power
- 1 connection for RoboRIO)
- 2 CAN connections A termination jumper in case
- Status lights

Voltage Regulator Module(VRM)



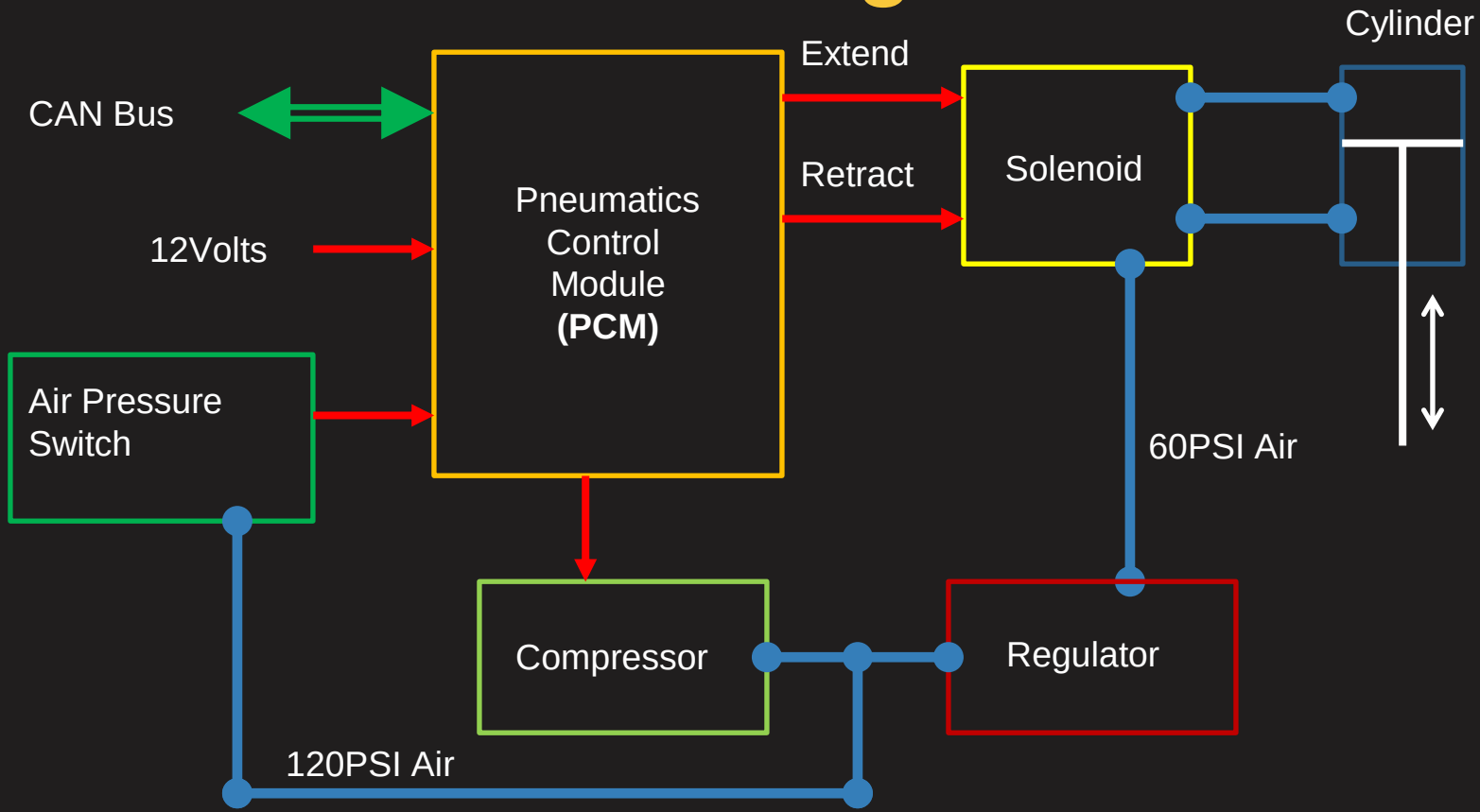


Weidmueller Connectors

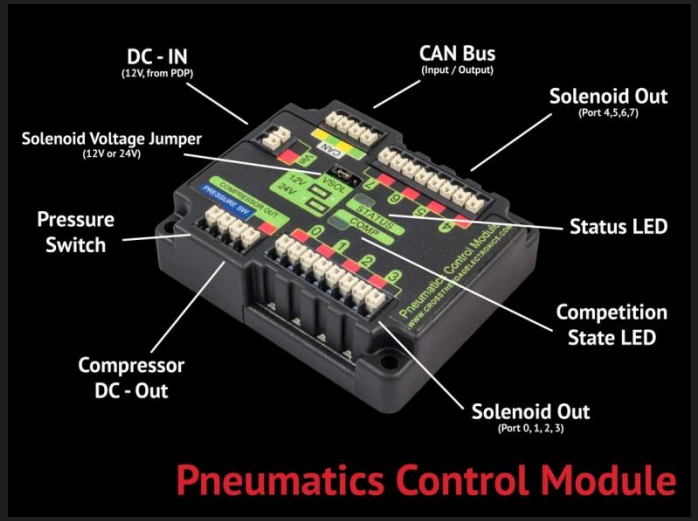
Features:

- 2- 12 volt outputs. 2 amp total.
- 2-12 volt outputs. 0.5 amps total.
- 2- 5 volt outputs. 2 amps total.
- 2- 5 volt outputs. 0.5 amps total.

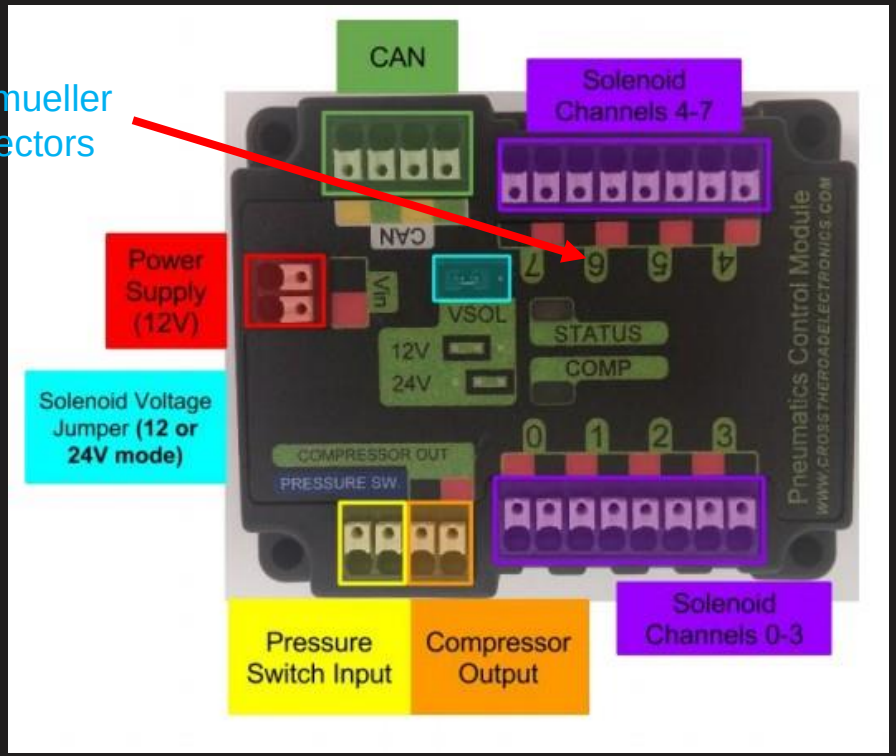
Pneumatics Block Diagram



Pneumatics Control Module



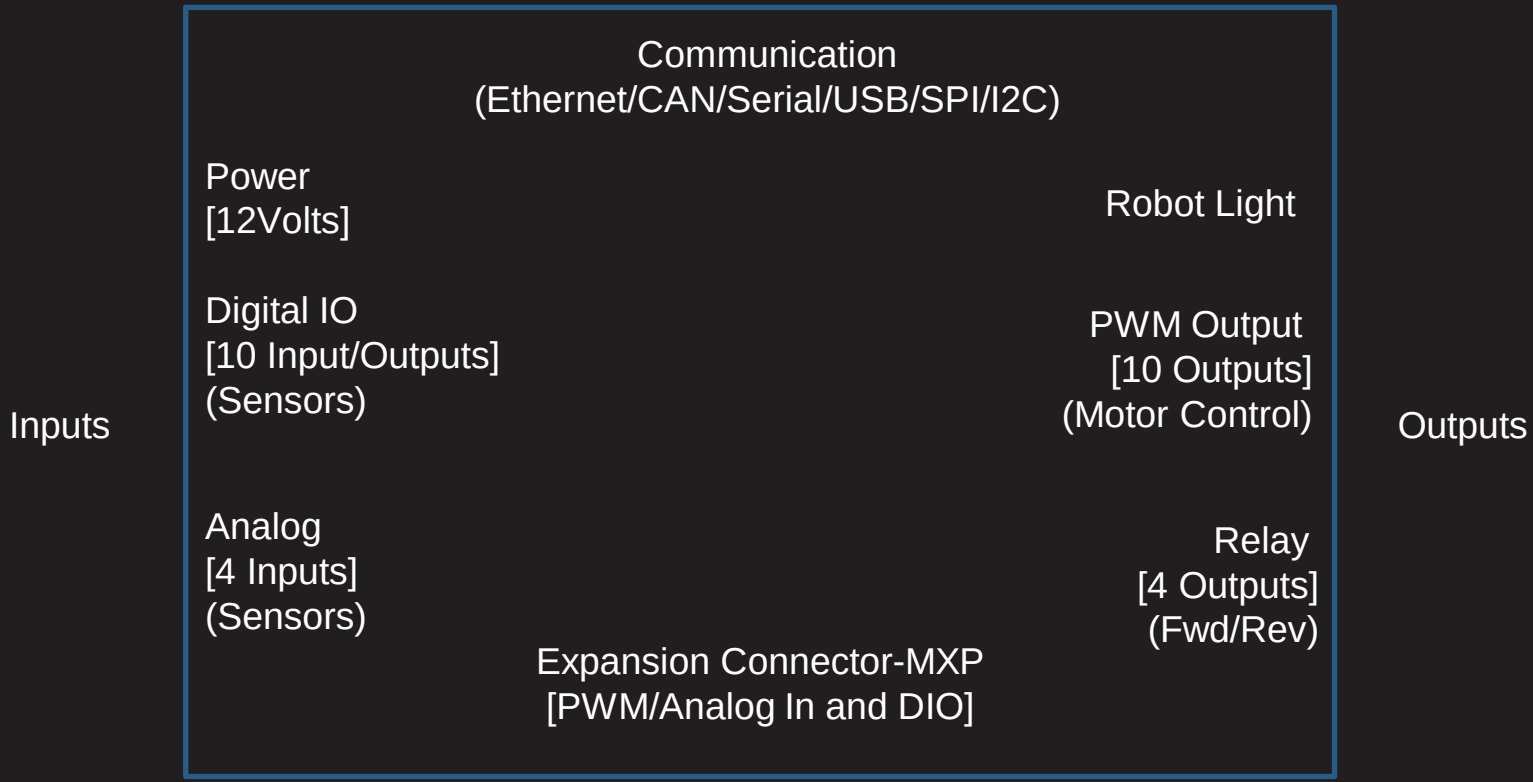
Weidmueller Connectors



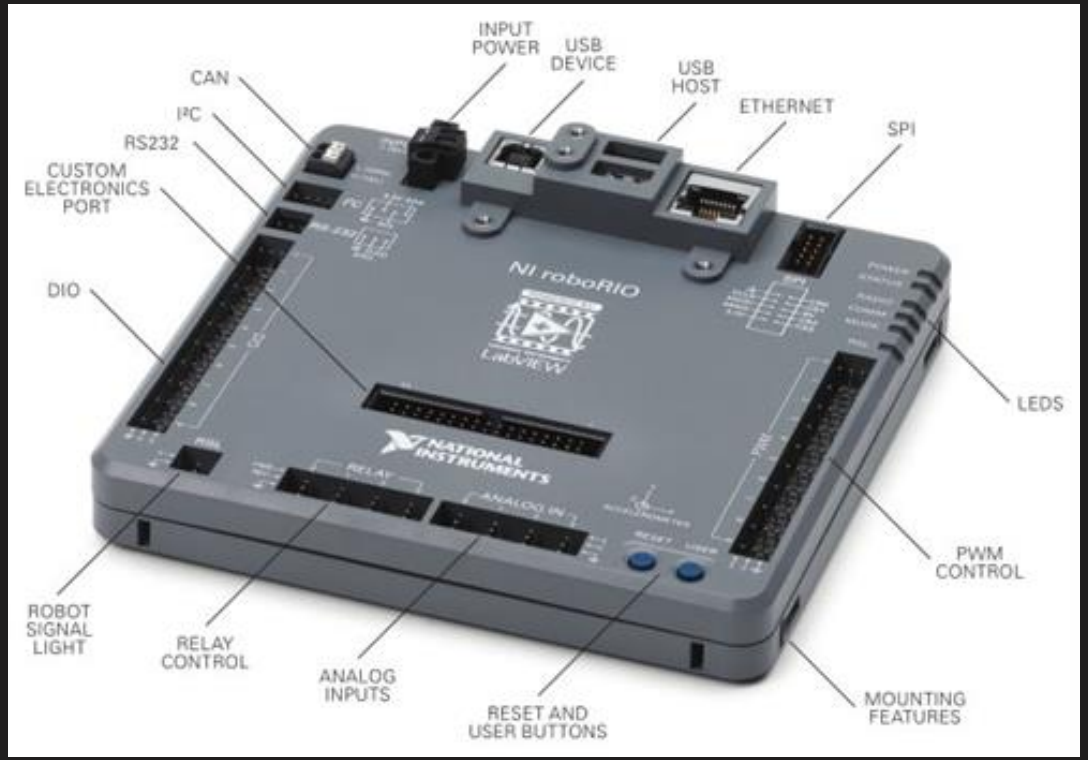
Features:

- 1- pressure switch input
- 8- solenoid outputs
- 1- compressor output
- 2- CAN Connections - pass through

Robot Controller – RoboRio Block Diagram



RoboRio Layout



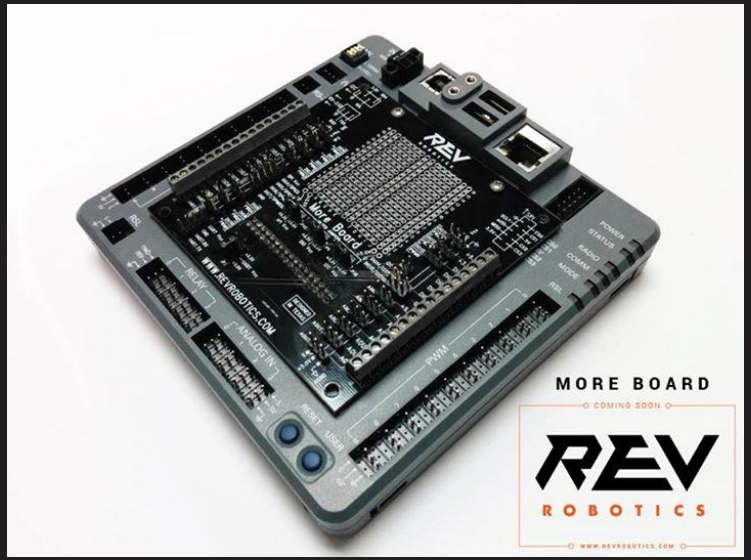
Expansion Connector(MXP) Definition

DIO 15 / I2C SDA	34	33	+3.3V
DIO 14 / I2C SCL	32	31	DIO 10 / PWM6
DGND	30	29	DIO 9 / PWM5
DGND	28	27	DIO 8 / PWM4
DIO 13 / PWM9	26	25	DIO 7 / SPI MOSI
DGND	24	23	DIO 6 / SPI MISO
DIO 12 / PWM8	22	21	DIO 5 / SPI CLK
DGND	20	19	DIO 4 / SPI CS
DIO 11 / PWM7	18	17	DIO 3 / PWM3
DGND	16	15	DIO 2 / PWM2
UART.TX	14	13	DIO 1 / PWM1
DGND	12	11	DIO 0 / PWM0
UART.RX	10	9	AI3
DGND	8	7	AI2
AGND	6	5	AI1
AO1	4	3	AI0
AO0	2	1	+5V

Features:

- Up to 10 PWM
- Up to 16 Digital IO
- SPI
- I2C
- Serial
- 4 Analog Inputs
- 2 Analog Outputs
- 5/3.3 Volts Outputs

Commercial MXP Boards

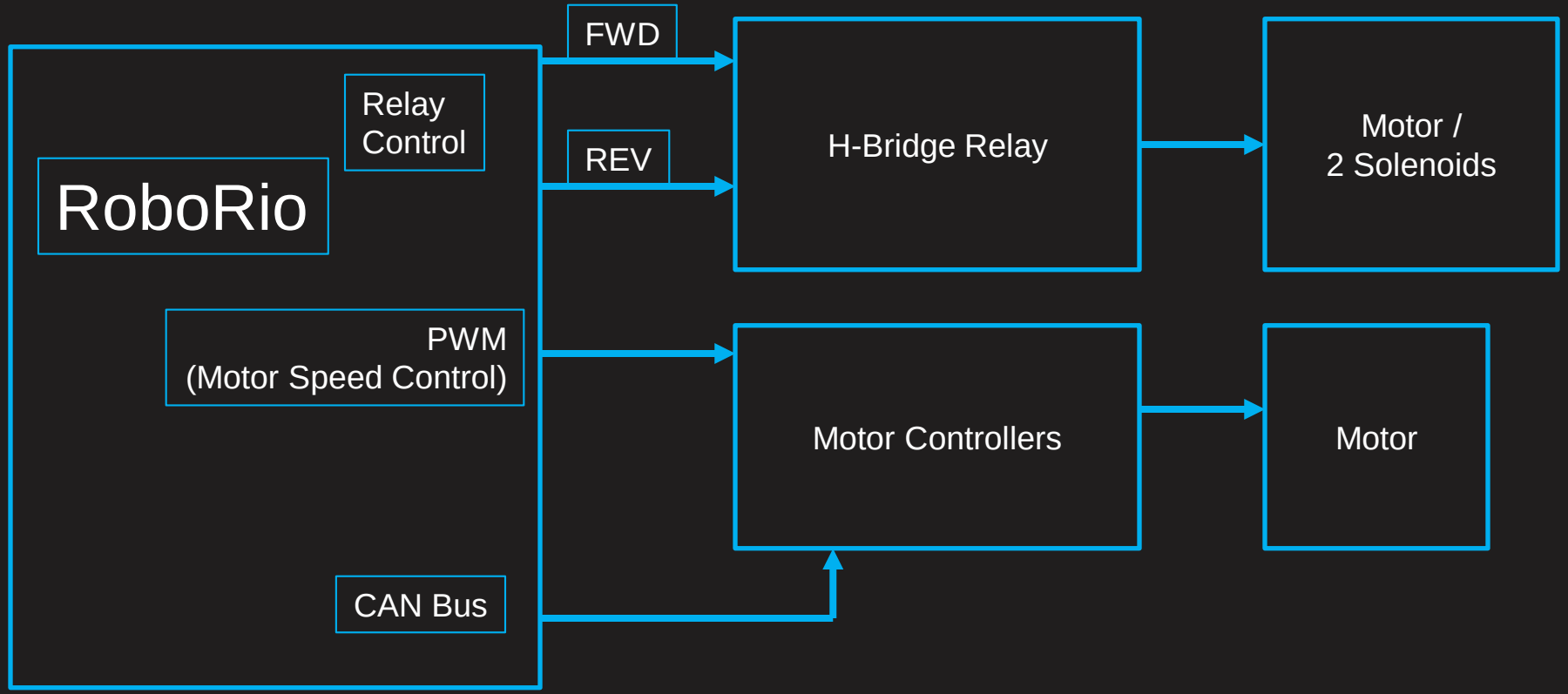


Robot Signal Light

Features
- Bright, wide angle
- Panel mount

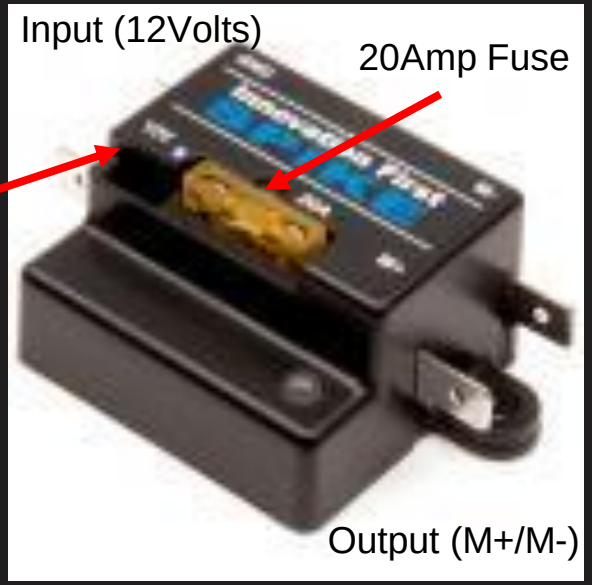
The Robot Signal Light is used to indicate the status of the robot and is a required safety feature

RoboRio Motor/Solenoid Control Block Diagram



H-Bridge Relay (Spike)

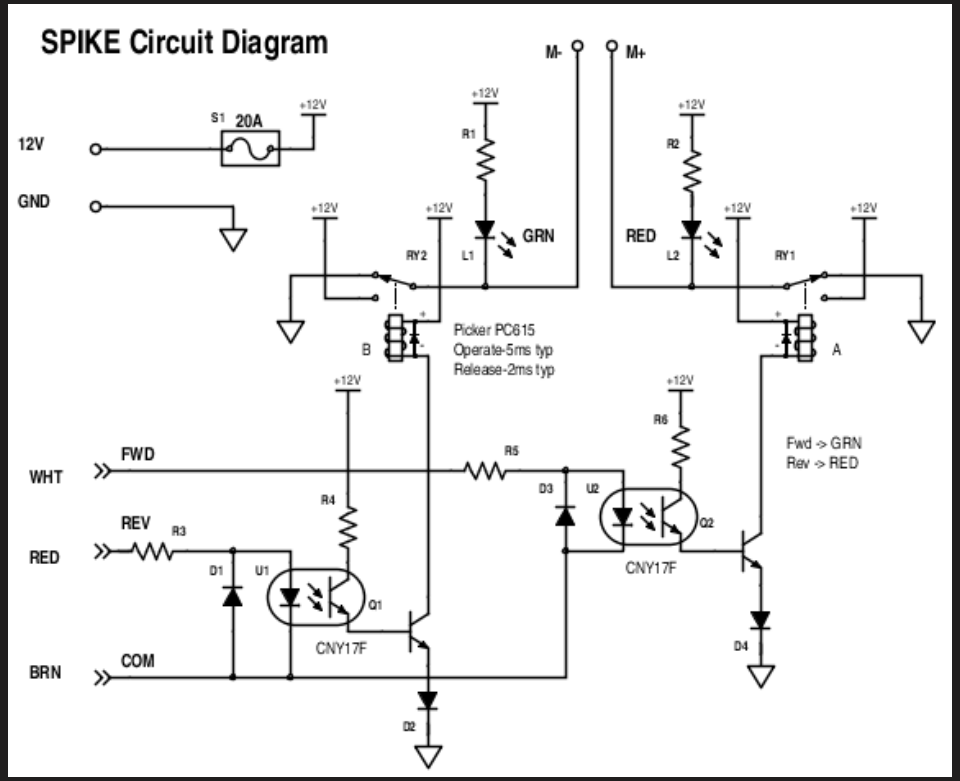
RoboRio Control Cable
Wht-Fwd(Relay)
Red-Rev(Relay)
Brn-Gnd (Relay)



Features:

- Bidirectional control of small motors(i.e. gear motors)
- Drives Solenoids (i.e. air valves solenoid, electric solenoid)
- On/off switch for power to a device
- 20AMP Fuse or Circuit Breaker

Spike Schematic

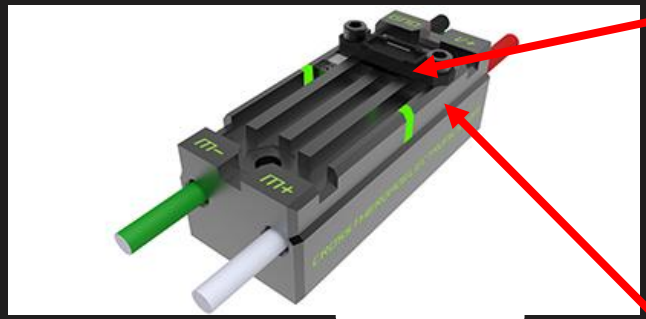


Motor Controllers

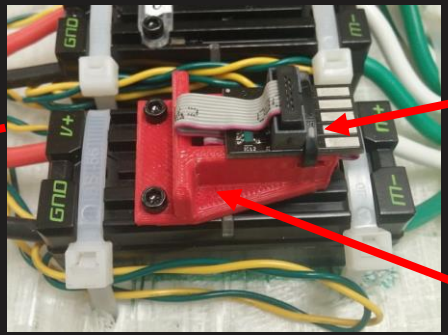
Older Motor Controllers
(Jaguar/Talon/Victor)

2015 Motor Controllers

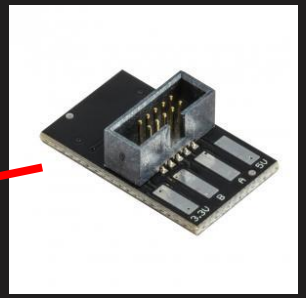
2015-2019 Motor Controllers
Talon SRX(PWM, CAN, PID)
Victor SP(PWM Only)



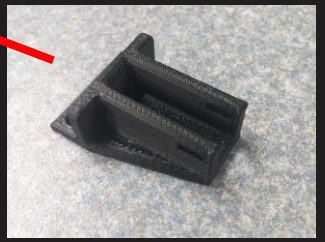
Cable to Connector Adapter



Cable Adapter



3D Printed



Universal Breakout Board

Brushed DC Motors

CIM / Mini CIM
(Typically robot drive motors)

Snow Blower
(Worm Gear)

Window
(Worm Gear)

RC Servo

Banebot
(Planetary Gear)

Sensors: Switch(On/Off)

Bumper Switch

Air Pressure Switch

Limit Switch

Optical Switch

Magnetic Switch

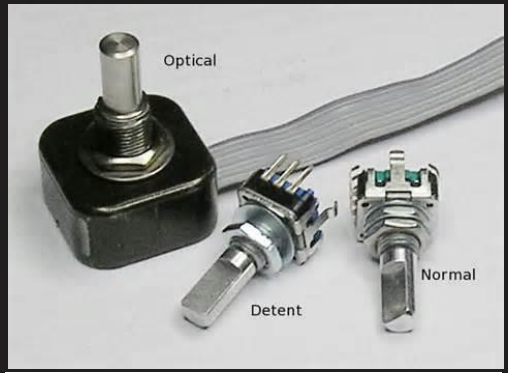
Proximity Switch
(Metal detection)

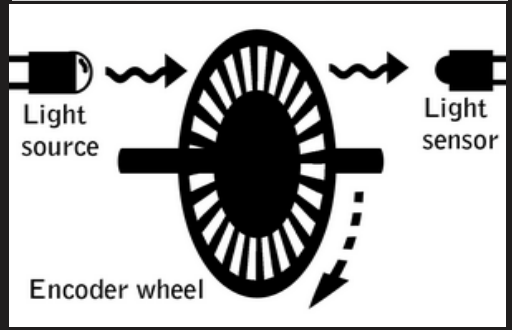
Sensors: Rotational

Gyro
(Compass)

Potentiometer
(volt proportional to rotation)

Encoder
(Incremental movement)





Sensors: Distance

Infarred
(3-15ft)

LiDAR
(Class1 Laser Range Finder-40ft)

Ultrasonic
(10-15ft)

Communications

RoboRio Serial Communications types:

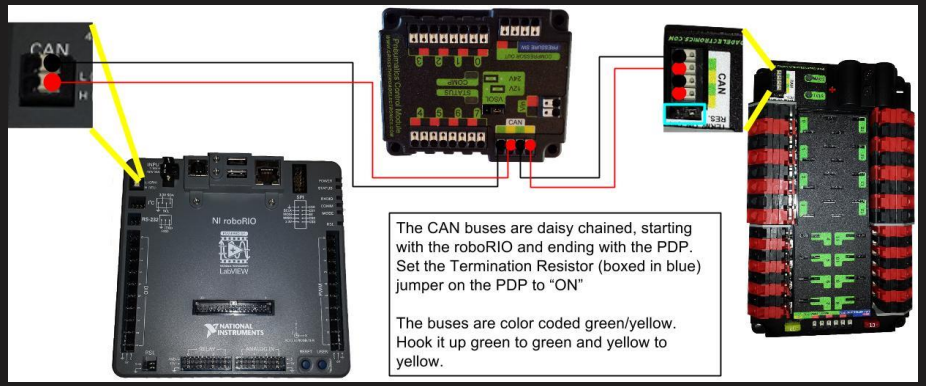
- RS232 (up to 115,200 Baud, no flow control)
- USB (USB 2.0)
- Ethernet (10/100Mbit/s)
- 2-SPI (up to 1Mhz clock)
- 2-I2C (up to 400KHz)
- CAN (1Mbit/sec)

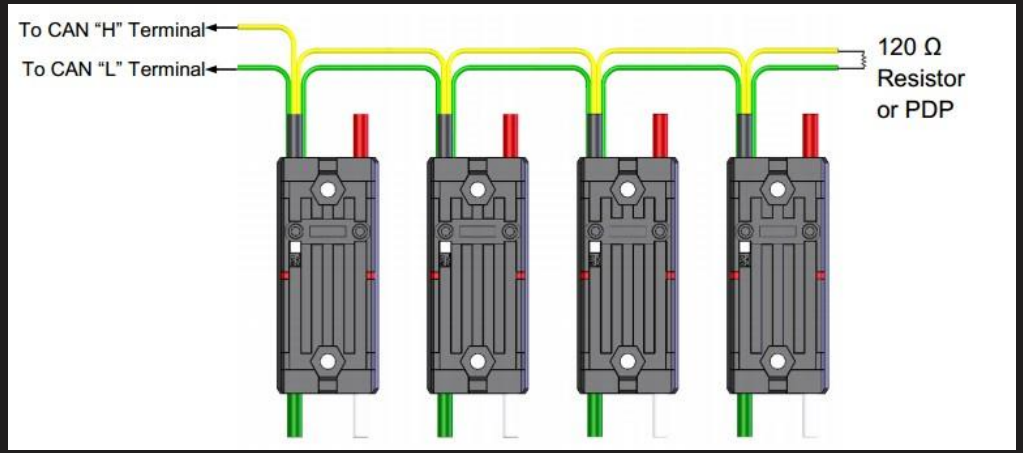
Ethernet

Wireless Bridge

The Wireless Bridge provides a communication link between the driver station and the robot

CAN Bus


CAN
NI roboRIO
The CAN buses are daisy chained, starting with the roboRIO and ending with the PDP. Set the Termination Resistor (boxed in blue) jumper on the PDP to "ON"
The buses are color coded green/yellow. Hook it up green to green and yellow to yellow.


To CAN "H" Terminal
To CAN "L" Terminal
120 Ω Resistor or PDP

Revisions

V161023 – RJV, added spike schematic
V160608 - RJV, Converted to new Team 2228 slide format
V150729 – RJV, Original