Electrical Workshop

Georgia Institute of Technology

ROBOJACKETS

COMPETITIVE ROBOTICS AT GEORGIA TECH

www.robojackets.org



What's Happening?

This season, NI and Rev have released the next generation of technology that will be powering FRC robots for the coming years. This involves:

- RoboRio 2.0
- REV Power Distribution Hub
- REV Pneumatic Hub
- REV Radio Power Module



Power System



Batteries

- 12v or higher means it's operating correctly
- Keep an order of usage for the batteries, it helps with battery health (naming batteries can help with this)



Power Distribution Hub (PDH)

ION

- Receives power from battery and main breaker
- Provides fused battery power to
 - Motor Controllers
 - RoboRIO (Main Robot Controller)
 - Voltage Regulator
 - Pneumatics Controller
- Terminates CAN ring
- Note: CTR PDP still a valid

A Note on Fuses

- Limit the amount of current flowing through a circuit at any point in time
 - The load determines how much current is "drawn"
 - Motors draw more current when they apply more torque
- You have 20 slots (0-19) for a max of 40A loads and 3 slots (20-22) for 15-20A loads
 - If you need more slots for 15A loads, consider purchasing the REV Mini Power Module
- Fuses are thermally triggered time to blow depends on the amount of current flowing

Power Distribution Hub (PDH) Part 2

- Channels 20-22 generally should be used for the RoboRio, the Radio Power Module and the Pneumatic Hub
- Channel 23 is Switchable, which means that teams can utilize software (code) to turn custom circuits on or off.



Motors

- Brushed CIM, Venom, 775/Redline, BAG Motor
 - Simple to wire and control, inexpensive
- Brushless Neo, Neo 550, Falcon
 - Better power/weight ratio than Brushed
 - Requires a different
 motor controller







Motor Controllers

- Brushed
 - Talon SRX Integrated sensor features
 - Victor SPX Low price with less features
 - Spark Barebones, simple
- Brushless
 - SparkMAX only legal choice in 2023 season



Motor Controller Features

- CAN Motor Controllers (Talon SRX, Victor SPX, SparkMax)
 - Have configurable settings over CAN
 - Closed loop control (Talon SRX and SparkMax)
 - Uses sensors plugged into motor controller to accurately control motor properties (current and speed)
 - Follower mode (Victor SPX)
 - Useful if you have two motors attached to the same mechanism, send a command to one motor and both follow the same speed (even under closed loop)

Special Exceptions

- Some motors have built in controllers and sensors
- Falcon 500
 - Brushless motor with integrated motor controller and encoder.
- Venom Smart Motor
 - Brushed CIM motor







Control System



RoboRio

- This is what you (or your software team) will be writing code for
- Processor with a variety of communication options including USB, PWM, CAN, and Digital IO
- Controls Robot Signal Light (RSL)





RoboRio 2.0 New Features

- SD Card Slot
- Selective Brownout Voltage Setpoint (RoboRio 1.0 had 7V)
- Faster processor and memory speeds



Communications

- Digital IO Can output a 0 or 3.3V signal, or read a LOW or HIGH (up to 5V) digital signal
 - Useful for reading switches or encoders
- PWM Pulse Width Modulation
 - A series of pulses whose width corresponds to a control value, used for motor speed or servo angle
- CAN Controller Area Network
 - 2-wire signaling protocol to communicate a variety of information between RoboRio, Motor Controllers, Pneumatics Controller, etc.

CAN Network

- All devices that use CAN must be connected together and will thus form a "network"
 - In FRC, this network takes the shape of a "daisy chain"
 - This chain starts at the RoboRio and ends at the PDH (make sure to set the termination switch to on)
 - In between, you can add any number of motor controllers



CAN Network





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.



Router

- Used for communication with the control PC
- Connect male-to-male ethernet to POE injector cable
- Then connect the other end of the POE cable to the router with the crimped wires in the 12v on the VRM







If you happen to have the REV Radio Power Module...





USB

Two ports on the RoboRio, can be used to power devices like cameras and Raspberry Pi's



What about the PH and the VRM?



VRM

Known as the Voltage Regulator Module

- Takes a 12V output from the PDH and regulates it to provide applications for smaller devices such as:
 - Router (Radio), though the Radio Power Module can also be used (and is much simpler).
 - Signal Light
 - Raspberry Pi
 - Camera(s)

Pneumatics Hub

- Provides power to all Pneumatic devices such as solenoids, the compressor, the pressure switch
- Part of the CAN loop.





Wiring



Wires

- Stranded vs Solid Core
- Use color codes that are consistent
- Gauge Thickness of wire
 - Based on amount of allowed current in wire
 - Wire gauge rules are in game manual



Connectors

- Make it easier to replace failed components
- Allow for wire lengths to be changed easily
- Anderson Powerpole Most common connector type
 - Terminate your motor and power wires in this!



Drag Chain

- Keep wires organized in moving mechanisms (esp linear slides)
 - Loop chain down from stationary point then up to moving point





2023

For the 2023 season, the new REV products will be coming in your kickoff kits.

FIRST states that CTR products will continue to be legal for future years.



2024

For the 2024 season, FIRST has stated that the Radios may be replaced by a new or different model. We don't know if this will happen yet, but FIRST will notify us when it does.



Resources

New RoboRio Features: https://www.firstinspires.org/robotics/frc/blog/2021-ni-guest -blog-roborio2-0

REV Documentation for PDH, PH, and VRH: <u>https://docs.revrobotics.com/docs/rev-ion</u>

Includes documentation for common issues and status indicators.

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LED Status Indicators

General Status LED

These led patterns only apply to firmware version 21.1.7 and later

LED Status	LED Description	When	Hub Status				
	Blue Solid	Anytime	Device on but no communication established	Channel Status LED These led patterns only apply to version 21.1.7 and later			
	Green Solid	Anytime	Main Communication with roboRIO established	LED Status	LED Description	When	Component Status
0000000	Magenta Blinking	Anytime	Keep Alive Timeout		LED off	Anytime	Channel has voltage and is operating as expected
	Solid Cyan	Anytime	Secondary Heartbeat (Connected to REV Hardware Client)		Ped Solid	Anvtime	Channel has NO voltage and there is an active fault.
	Orange/Blue Blinking	Anytime	Low Battery		Ked Solid	Anytime	Check for tripped or
80808080	Orange/Yellow Blinking	Anytime	CAN Fault	******	Red Blink	Anytime	Sticky fault on the channel. Check for tripped circuit breaker.
0000000	Orange/Cyan Blinking	Anytime	Hardware Fault				
	Orange/Red Blinking	Anytime	Fail Safe				
0000000	Orange/Magenta Blinking	Anytime	Device Over Current				



https://docs.google.com/presentation/d/14ZVF ehQr6H9nWjlMWguPvAEPkTaGUv1o/edit?usp=s haring&ouid=114262867738564196769&rtpof=tr ue&sd=true



Thanks for listening!

Questions?